ANNEXURE-"X"

CC-3/ MCC-4	
Session: 2024-25	
Part A – Introduction	
Subject	Mathematics
Semester	III
Name of the Course	Differential Equations-1
Course Code	B23-MAT-301
Course Type: (CC/MCC/MDC/CC-M/ DSEC/VOC/DSE/PC/AEC/VAC)	CC
Level of the course	200-299
Pre-requisite for the course (if any)	Mathematics as a subject at 4.0 Level (Class XII)
Course Learning Outcomes(CLOs):	**After completing this course, the learner will be able to:** 1. Gain knowledge of the basic concepts of ordinary differential equations and learn various techniques of finding exact solutions of certain solvable first order differential equations. 2. Have procedural knowledge and cognitive and technical skills of solving homogeneous and non-homogeneous second order linear ordinary differential equations with constant coefficients and with variable coefficients. 3. Gain knowledge of theory of total differential equations and basic concepts of partial differential equations. To learn methods and techniques for solving linear PDEs of first order and to acquire technical skills

	for accomplishing assigned tasks relating to formulation and solution of PDEs in broad multidisciplinary contexts. 4. Have knowledge of concepts and theories of second order PDEs and to apply theory of PDEs to determine integral surfaces through a given curve and to find orthogonal surfaces. To understand compatible systems and to learn cognitive and technical skills required for selecting and using relevant Charpit method, Jacobi method methods to assess the appropriateness of approaches for solving PDEs.
CLO 5 is related to the practical component.	5. To attain cognitive and technical skills required for selecting and using relevant methods and techniques to assess the appropriateness of approaches to solving problems associated with the differential equations. To attain technical skill of solving differential equations by using built in functions of MAXIMA software.

	Theory	Practical	Total
Credits	3	1	4
Contact Hours	3	2	5
Internal Assessment Marks	20	10	30
End Term Examination Marks	50	20	70
Examination Time	3 Hours	3 Hours	

Max. Marks:100

Part B- Contents of the Course

Instructions for Paper- Setter

Note: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will contain 5 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question.

Unit	Topics	Contact Hours
I	Basic concepts and genesis of ordinary differential equations, Order and degree of a differential equation, Solutions of differential equations of first order and first degree, Exact differential equations, Integrating factor, First order higher degree equations solvable for x, y and p, Lagrange's equations, Clairaut's form and singular solutions. Orthogonal trajectories of one-parameter families of curves in a plane.	12
II	Solutions of linear ordinary differential equations with constant coefficients, linear non-homogeneous differential equations. Linear differential equation of second order with variable coefficients. Method of reduction of order, method of undetermined coefficients, method of variation of parameters. Cauchy-Euler equation.	12
III	Solution of simultaneous differential equations, total differential equations. Genesis of Partial differential equations (PDE), Concept of linear and non-linear PDEs. Complete solution, general solution and singular solution of a PDE. Linear PDE of first order. Lagrange's method for PDEs of the form: $P(x,y,z)\,p + Q(x,y,z)\,q = R(x,y,z)$, where $p=\partial z/\partial x$ and $q=\partial z/\partial y$.	12
IV	Integral surfaces passing through a given curve. Surfaces orthogonal to a given system of surfaces. Compatible systems of first order equations. Charpit's method, Special types of first order PDEs, Jacobi's method. Second Order Partial Differential Equations with Constant Coefficients.	12

	Practical	
	The practical component of the course has two parts, Problem Solving and Practical's using MAXIMA software. The examiner will set 4 questions at the time of practical examination asking two questions from the part (A) and two questions from the part (B) by taking course learning outcomes (COs) into consideration. The examinee will be required to solve one problem from the part (A) and to execute one problem successfully from the part (B). Equal weightage will be given to both the parts. The evaluation will be done on the basis of practical record, viva-voce, write up and execution of the program. (A) **Problem Solving**- Questions related to the following problems will be solved and record of those will be maintained in the Practical Notebook: 1. Problems solving for differential equations which are reducible to homogeneous. 2. Problems solving for differential equations which are Exact differential equations. 3. Problems solving for linear differential equations with constant coefficient. 4. Problems solving for linear differential equations with variable coefficient. 5. Problems solving for differential equations by method of variation of parameters. 6. Problems solving for differential equations by method of undetermined coefficients. 7. Problems solving for simultaneous differential equations. 8. Problems solving for different PDEs using Lagrange's method. 9. Problems solving for PDEs with Charpit's method and Jacobi's method.	30

Meeting

A. Singh

(B)The following practicals will be done using MAXIMA software and record of those will be maintained in the practical note book:

1. Solutions of first and second order differential equations.
2. Plotting of family of solutions of differential equations of first, second and third order.
3. Solution of differential equations using method of variation of parameters.
4. Growth and decay model (exponential case only).
5. Lake pollution model (with constant/seasonal flow and pollution concentration).
6. Density-dependent growth model.
7. Predatory-prey model (basic Volterra model, with density dependence, effect of DDT, two prey one predator).
8. To find the solutions Linear differential equations of second order using built in functions of MAXIMA software.
9. To find numerical solution of a first order ODE using plotdf built in function of MAXIMA.
10. To find exact solutions of first and second order ODEs using ode2 and ic1/ic2 built in functions of MAXIMA.
11. To find exact solutions of first and second order ODEs using desolve and atvalue built in functions of MAXIMA.

➢ **Suggested Evaluation Methods**

Internal Assessment:

➢ **Theory 20**

- Class Participation: 5
- Seminar/presentation/assignment/quiz/class test etc.: 5
- Mid-Term Exam: 10

➢ **Practicum 10**

- Class Participation:
- Seminar/Demonstration/Viva-voce/Lab records etc.: 10
- Mid-Term Exam:

End Term Examination:

Theory 50
Written Examination

➢ **Practicum 20**
Lab record, viva-voce, write up and execution of the program

Part C-Learning Resources

Recommended Books:

1. Erwin Kreyszig (2011). *Advanced Engineering Mathematics* (10th edition). J. Wiley & Sons.
2. B. Rai & D. P. Choudhury (2006). *Ordinary Differential Equations - An Introduction*. Narosa Publishing House Pvt. Ltd. New Delhi.
3. Shepley L. Ross (2014). *Differential Equations* (3rd edition). Wiley India Pvt. Ltd.
4. George F. Simmons (2017). *Differential Equations with Applications and Historical Notes* (3rd edition). CRC Press. Taylor & Francis.
5. Ian N. Sneddon (2006). *Elements of Partial Differential Equations*. Dover Publications.

MCC-5

Session: 2024-25	
Part A – Introduction	
Subject	Mathematics
Semester	III
Name of the Course	Groups and rings
Course Code	B23-MAT-302
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	MCC
Level of the course	200-299
Pre-requisite for the course (if any)	Basic Algebra of 100-199 Level
Course Learning Outcomes(CLOs):	**After completing this course, the learner will be able to:** 1. Gain theoretical knowledge of the concept of a group, subgroup, abelian group, cyclic group, normal group, quotient group and have understanding of the results based on these concepts. 2. Have knowledge and understanding of the theory of group homomorphisms, group isomorphisms and group automorphisms. Learn about the permutation groups, permutations, centre of a group and theorems based on these concepts. 3. Gain the deeper knowledge of the concepts of a ring, subring, ideal, integral domain, field of quotient and understanding of the results based on these concepts. 4. Know about Euclidean rings, Polynomial rings and

CLO 5 is related to the practical component.	Unique factorization domain. 5. Attain the deeper knowledge and understanding of groups and rings, their underlying principles and theories, by solving some problems based on them.

	Theory	Practical	Total
Credits	3	1	4
Contact Hours	3	2	5
Internal Assessment Marks	20	10	30
End Term Examination Marks	50	20	70
Examination Time	3 Hours	3 Hours	

Max. Marks:100

Part B- Contents of the Course

Instructions for Paper- Setter

Note: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will contain 5 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question.

Unit	Topics	Contact Hours
I	Definition of a group, Elementary properties of groups, Subgroups and subgroup criteria, Cosets, Index of a sub-group, Coset decomposition, Lagrange's theorem and its consequences, Cyclic groups, Normal subgroups, Quotient groups.	12
II	Homomorphisms, Isomophisms, Automorphisms and inner Automorphisms of groups, Automorphisms of cyclic groups, Permutation groups, Even and odd permutations, Alternating groups, Cayley's theorem, Centre of a group.	12

III	Introduction to rings, Subrings, Integral domains and fields, Characteristic of a ring, Ring homomorphism, Ideals: principal, prime and maximal ideals, Quotient ring, Field of quotients of an integral domain.	12
IV	Euclidean rings, Polynomial rings, Polynomials over the rational field, The Eisenstein's criterion, Polynomial rings over commutative rings, Unique factorization domain.	12
	Practical	
	The examiner will set 4 questions at the time of practical examination by taking course learning outcomes (CLOs) into consideration. The examinee will be required to solve 2 questions. The evaluation will be done on the basis of practical record, viva-voce and written examination. **Problem Solving**-Questions related to the practical applications based on following problems will be worked out and record of those will be maintained in the Practical Note Book: 1. Problems to find the order and inverse of the elements of a group. 2. Problems to find the generators of a cyclic group. 3. Problem to find all possible subgroups of a finite group. 4. Problems to verify Lagrange's theorem. 5.Problems to verify Cayley's theorem and theorem of isomorphism. 6. Problems to find index of a group. 7. Problems related to automorphisms of finite or infinite cyclic groups. 8. Problems related to the multiplication of permutations and to write a permutation as the product of transpositions. 9. Problems to find the inverse of a permutation. 10. Problems to determine whether a subset of a ring is an ideal or not. 11. Problems related to maximal and prime ideals. 12. Problems to find the units of a commutative ring with unity. 13. Problems to determine whether a polynomial is irreducible over the field of rational numbers or not. 14. Problem to determine whether an integral domain is Euclidean domain or not. 15. Problem to determine whether an integral domain is unique factorization domain or not.	30
	➢ **Suggested Evaluation Methods**	

Internal Assessment:	End Term Examination:
➢ **Theory 20** • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➢ **Practicum 10** • Class Participation: • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam:	**Theory : 50** Written Examination **Practicum: 20** Lab record, viva-voce, write up and execution of the program

Part C-Learning Resources

Recommended Books:

1. M. Artin (2011). *Abstract Algebra* (2nd Edition). Pearson.
2. V. Sahai and V. Bist (2010). *Algebra* (3rd Edition). Narosa Publishing House.
3. N. Herstein (2008). *Topics in Algebra* (2nd Edition). Wiley India Pvt. Ltd.
4. S. Singh and Q. Zameeruddin (2006). *Modern Algebra* (8th Edition). Vikas Publishing House Pvt. Ltd.
5. John B. Fraleigh (2002). *A First Course in Abstract Algebra* (7th Edition). Pearson.
6. D.A.R. Wallace (1998). *Groups, Rings and Fields*. Springer
7. J. J. Rotman (1995). *An Introduction to the Theory of Groups* (4th Edition). Springer Verlag.

MDC-3

Session: 2024-25	
Part A – Introduction	
Subject	Mathematics
Semester	III
Name of the Course	Mathematics for All
Course Code	B23-MAT-303
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	MDC
Level of the course	100-199
Pre-requisite for the course (if any)	NA
Course Learning Outcomes (CLOs): CLO 5 is related to practical components of the course.	**After completing this course, the learner will be able to:** 1. Gain knowledge of the concepts of sets, Venn diagrams, De-Morgan's laws, basic set operations and apply this factual knowledge to solve daily life mathematical problems which can be formulated in terms of sets. 2. Understand the concept of differentiation as the rate of change of dependent variable with respect to the change in independent variable. Gain knowledge of differentiation of various functions and apply it to the problems of its own discipline and other disciplines for computing the rate of change. 3. Acquire cognitive and technical knowledge about a variety of methods of representation of statistical data and methods of measure of central tendency. Analyze the problem and apply the best measure of central tendency to draw inferences from the available data. 4. Understand the concept of correlation, correlation methods and conclude about the type of correlation for the available data. Comprehend the skills of curve fitting. 5. Attain a range of cognitive and technical skills to differentiate and integrate various functions. Use

	procedural knowledge to solve simple first order differential equations. Have technical and practical skills required for selecting and using suitable methods for data representation and measure of central tendency.		
	Theory	Practical	Total
Credits	2	1	3
Contact Hours	2	2	4
Internal Assessment Marks	15	5	20
End Term Examination Marks	35	20	55
Examination Time	3Hrs	3Hrs	

Max. Marks:75

Part B-Contents of the Course

Instructions for Paper- Setter

Note: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will contain 7 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question.

Unit	Topics	Contact Hours
I	The concept of a set, Types of sets, Operations on sets, Venn diagram, De-Morgan's laws. The concept of a function, Elementary functions and their graphical representation. Solution of simple quadratic and cubic equations.	8
II	The concept of differentiation, differentiation of simple functions, second order differentiation, Maxima and minima of a function, Use of differentiation for solving problems related to real-life situations.	8

III	Presentation of data: Frequency distribution and cumulative frequency distribution, Diagrammatic and graphical presentation of data, Construction of bar, Pie diagrams, Histograms, Frequency polygon, Frequency curve and Ogives. Measures of central tendency: Arithmetic mean, Median, Mode, Geometric mean and Harmonic mean for ungrouped and grouped data.	8
IV	Correlation: Concept and types of correlation, Methods of finding correlation: Scatter diagram, Karl Pearson's coefficients of correlation, Rank correlation. Principle of least square, Fitting of straight line, second degree curve.	8
	Practical	
	The examiner will set 4 questions at the time of practical examination by taking course learning outcomes (CLOs) into consideration. The examinee will be required to solve 2 questions. The evaluation will be done on the basis of practical record, viva-voce and written examination. **Problem Solving**- Questions related to the practical applications based on following problems will be worked out and record of those will be maintained in the Practical	30

	Note Book: 1. Problems involving operations on set using Venn diagram. 2. Problem based on De-Morgan's law. 3. Real life problems leading to quadratic equations. 4. Problem involving solution of simple cubic equations. 5. Formulation and solution of realistic problems to solve system of linear equations. 6. Problem to find nth term of A.P. and G.P. Series. 7. Problems to find first and second derivatives of functions. 8. Problems related to application of maxima and minima in real world problems. 9. Representation of data using Bar and pie diagrams. 10. Representation of data using Histogram, Frequency polygon, Frequency curves and Ogives. 11. Problems to compute measures of central tendency. 12. Problem to calculate Karl Pearson's coefficient of correlation. 13. Problem to fit the straight line for the given data. 14. Practical problems involving solution of simple first order differential equations.	

Suggested Evaluation Methods

Internal Assessment: ➢ **Theory 15** • Class Participation: 4 • Seminar/presentation/assignment/quiz/class test etc.: 4 • Mid-Term Exam: 7 ➢ **Practicum 5** • Class Participation: • Seminar/Demonstration/Viva-voce/Lab records etc.: 5 • Mid-Term Exam:	**End Term Examination:** ➢ **Theory 35** Written Examination ➢ **Practicum 20** Lab record, viva-voce, written examination.

Part C-Learning Resources

Recommended Books:

1. S.C. Gupta and V.K. Kapoor (2014). *Fundamentals of Mathematical Statistics*, S. Chand & Sons, Delhi.
2. R.V. Hogg, J. W. McKean and A. T. Craig (2013). *Introduction to Mathematical Statistics* (7th edition), Pearson Education.
3. J. V. Dyke, J. Rogers and H. Adams (2011). *Fundamentals of Mathematics,* Cengage Learning.
4. A.S. Tussy, R. D. Gustafson and D. Koenig (2010). *Basic Mathematics for College Students.* Brooks Cole.
5. G. Klambauer (1986). *Aspects of calculus*. Springer-Verlag.

Session: 2024-25	
Part A – Introduction	
Subject	Mathematics
Semester	IV
Name of the Course	Analytical Geometry & Vector Calculus
Course Code	B23-MAT-401
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC
Level of the course	200-299
Pre-requisite for the course (if any)	Mathematics as a subject at level 4.0 (Class XII)
Course Learning Outcomes(CLOs):	After completing this course, the learner will be able to: 1. Gain knowledge of the concept of different conic sections, their classification and properties. Understand various terms related to conic sections and gain skills to use them in problem solving. 2. Have knowledge of general form of equation of a sphere and attain procedural knowledge required for solving problems related to intersection of spheres, tangent plane and line, orthogonality, length of tangent and co-axial system of spheres. Learn about equations of cones and apply knowledge for problem solving. 3. Have deeper knowledge and understanding of

	cylinder, enveloping cylinder, tangent plane, director sphere, normal, envelope and to make further use thereof. 4. Understand and solve problems related to scalar and vector product of vectors, vector differentiation, directional derivatives, gradient, divergence and curl operators. Have deeper understanding of line, surface and volume integrals, their evaluation, proof of Gauss Divergence, Green's and Stoke's theorems and gain theoretical and technical knowledge in computing different surface flux integrals, volume integrals and line integrals used in other disciplines also. 5. Attain cognitive and technical skills required for formulate and solve real life practical problems on sphere, cone and cylinder; to generate solutions of practical problems involving complex line, surface and volume integral using Gauss Divergence theorem, Stoke's theorem, Green's theorem in a very easy manner.
CLO 5 is related to the practical component of the course.	

Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Internal Assessment Marks	20	10	30
End term Examination Marks	50	20	70

Examination Time	3 Hours	3 Hours
	Max. Marks:100	

Part B- Contents of the Course

Instructions for Paper- Setter

The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will contain 5 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question.

Unit	Topics	Contact Hours
I	General equation of second degree: Classification of conic sections; centre, asymptotes, axes, eccentricity, foci and directrices of conics. Tangent at any point to a conic, chord of contact, pole of line to a conic, director circle of a conic. Polar equation of a conic, tangent and normal to a conic, confocal conics.	12
II	Sphere: General form, Plane section of a sphere. Sphere through a given circle. Intersection of two spheres, tangent plane and line, polar plane and line, orthogonal spheres, radical plane of two spheres and co-axal system of spheres.	12
III	Cone: Equation of a cone, right circular cone, quadric cone, enveloping cone. Tangent plane and condition of tangency. Cylinder: Right circular cylinder and enveloping cylinder. Central Conicoids: Equation of tangent plane. Director sphere.	12

IV	Scalar and Vector product of three vectors, four vectors, reciprocal vectors, vector differentiation and derivative along a curve, directional derivatives; Gradient of a scalar point function, divergence and curl of vector point functions, their geometrical meanings and vector identities. Vector integration: line integral, surface integral and volume integral. Theorem of Gauss, Green, Stoke and problems based on these.	12
	Practical	
	The examiner will set 4 questions at the time of practical examination asking two questions by taking course learning outcomes (CLOs) into consideration. The examinee will be required to solve two problems. The evaluation will be done on the basis of practical record, viva-voce, write up and execution of the program. **Problem Solving: Questions related to the following problems will be worked out and record of those will be maintained in the Practical Notebook:** 1. Practical problems to find nature of the curve, center and the equation of the conic referred to center as the origin. 2. Practical problems to demonstrate the length of axes, eccentricity and the equations of the conic. 3. Practical problems related to reduction of a general equation to the standard form and to discuss nature of conicoid, when all the characteristics roots of discriminant cubic are different from zero.	30

4. Formulation and solution of real life situations which uses mathematical knowledge and characteristics of sphere (at least two).
5. Formulation and solution of real life situations which uses mathematical knowledge and characteristics of cone (at least two).
6. Formulation and solution of real life situations which uses mathematical knowledge and characteristics of cylinder (at least two).
7. Practical problems to understand geometrical meanings of gradient, divergence and curl.
8. Practical problems to demonstrate use of vector identities based on gradient, divergence and curl.
9. Practical problems to study applications of Gauss Divergence theorem.
10. Practical problems to study applications of Stoke's theorem.
11. Practical problems to study applications of Green's theorem.

Suggested Evaluation Methods

Internal Assessment:

- **Theory 20**
  - Class Participation: 5
  - Seminar/presentation/assignment/quiz/class test etc.: 5
  - Mid-Term Exam: 10
- **Practicum 10**
  - Class Participation:
  - Seminar/Demonstration/Viva-voce/Lab records etc.: 10
  - Mid-Term Exam:

End Term Examination:

- **Theory 50**
  Written Examination
- **Practicum 20**
  Lab record, viva-voce, write up and execution of the program

Part C-Learning Resources

Recommended Books:

1. Robert J. T. Bell (2022). *An Elementary Treatise on Coordinate Geometry of Three Dimensions*. Legare Street Press.
2. George B. Thomas Jr., Joel Hass, Christopher Heil & Maurice D. Weir (2018). *Thomas' Calculus* (14th edition). Pearson Education.
3. Howard Anton, I. Bivens & Stephen Davis (2016). *Calculus* (11th edition). Wiley India.
4. James Stewart (2012). *Multivariable Calculus* (7th edition). Brooks/Cole Cengage Learning.
5. D. Chatterjee (2009). *Analytical Geometry: Two and Three Dimensions*. Narosa Publishing House.
6. Murray Spiegel and Seymour Lipschutz (2009). *Vector Analysis* (2nd edition). Schaum Outline Series.
7. Shanti Narayan and P.K. Mittal (2007). *Analytical Solid Geometry*. S. Chand and Company.
8. Shanti Narayan and P.K. Mittal (2003). *A Text Book of Vector Calculus*. S. Chand.
9. Monty J. Strauss, Gerald L. Bradley & Karl J. Smith (2002). *Calculus* (3rd edition). Pearson Education.
10. Gordon Fuller and Dalton Tarwater (1992). *Analytic Geometry* (7th edition). Pearson.
11. J.H. Kindle (1990). *Analytic Geometry*. McGraw-Hill
12. Gabriel Klambauer (1986). *Aspects of Calculus*. Springer-Verlag.

Session: 2024-25	
Part A - Introduction	
Subject	Mathematics
Semester	IV
Name of the Course	Linear Algebra
Course Code	B23-MAT-402
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	MCC
Level of the course	200-299
Pre-requisite for the course (if any)	100-199
Course Learning Outcomes(CLOs):	**After completing this course, the learner will be able to:** 1. Have comprehensive knowledge and understanding of the concepts of vector space, subspace, linear span, linearly independence, basis, dimension and quotient space. 2. Gain the procedural knowledge required to find the null space, range space, rank, nullity of linear transformation. Understand the proof of rank-nullity theorem and change of basis concept. 3. Have deeper knowledge of the concept of algebra of linear transformations, dual spaces and bi-dual spaces. Find the eigen values, eigen vectors and minimal polynomials of linear transformations. 4. Gain the theoretical knowledge and understanding of inner product space, Gram Schmidt orthogonalization process and

CLO 5 is related to the practical component.	Bessel's inequality. Attain the cognitive skills to apply the learnt concepts to solve mathematical problems. 5. Attain cognitive and technical skills required for performing and accomplishing complex tasks related to problems of linear algebra. Have technical and practical skills required to solve problems related to linear algebra using built in functions of MAXIMA and other FOSS software.

	Theory	Practical	Total
Credits	3	1	4
Contact Hours	3	2	5
Internal Assessment Marks	20	10	30
End Term Examination Marks	50	20	70
Examination Time	3 Hours	3 Hours	

Max. Marks:100

Part B- Contents of the Course

Instructions for Paper- Setter

Note: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will contain 5 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question.

Unit	Topics	Contact Hours
I	Vector spaces: Vector spaces, Subspaces, Linear sum and direct sum of subspaces, Linear span, Linearly independent and dependent subsets of a vector space, Finitely generated vector spaces, Existence theorem for basis of a finitely generated vector space, Invariance of	12

	the number of elements in basis of a finitely generated vector space, Dimension, Quotient space and its dimension.	
II	Homomorphisms : Linear transformations and linear functionals on vector spaces, Matrix of a linear transformation, Null space and range space of a linear transformation, Rank and nullity theorem, Singular and non-singular linear transformation, Change of basis.	12
III	Algebra of linear transformations, Dual spaces, Bi-dual spaces, Annihilator of subspaces of finite dimensional vector space. Eigen values, Eigen vectors, Minimal polynomial and diagonalization of a linear transformation.	12
IV	Inner product spaces: Inner product spaces, Cauchy-Schwarz inequality, Orthogonal sets and basis, Bessel's inequality for finite dimensional vector spaces, Gram-Schmidt orthogonalization process. Adjoint of a linear transformation and its properties, Unitary linear transformations.	12
	Practical	
	The practical component of the course has two parts, Problem Solving and Practical's using MAXIMA/Scilab/SageMath software. The examiner will set 4 questions at the time of practical examination asking two questions from the part (A) and two questions from the part (B) by taking course learning outcomes (CLOs) into consideration. The examinee will be required to solve one problem from the part (A) and to execute one problem successfully from the part (B). Equal weightage will be given to both the parts. The evaluation will be done on the basis of practical record, viva-voce, write up and execution of the program. **(A) Problem Solving**- Questions related to the following problems	30

will be solved and record of those will be maintained in the Practical Notebook:

1. Problems based on Extension theorem.
2. Problems based on Existence theorem.
3. Problems to verify rank and nullity theorem.
4. Problems to find coordinates of a vector relative to an ordered basis.
5. Problems to determine basis and dimension of quotient space of a given finite dimensional vector space.
6. Problems related to change of basis.
7. Problems related to bi-dual spaces.
8. Problems related to the diagonalization of a linear transformation.

(B)The following practicals will be done using MAXIMA/Scilab/SageMath software and record of those will be maintained in the practical note book:

1. Practical problems to determine rank of a matrix associated with linear transformation.
2. Practical problems to determine Nullity of a matrix associated with linear transformation.
3. Practical problems to verify rank-nullity theorem.
4. Practical problems to find null space of matrix associated with linear transformation.
5. To determine eigen values of a matrix associated with linear transformation.
6. To determine normalized eigen vector of a matrix associated with linear transformation.
7. Practical problems related to inner product of vectors or functions.
8. Problems related to Gram-Schmidt orthogonalization process.

➢ **Suggested Evaluation Methods**

Internal Assessment:	**End Term Examination:**
➢ **Theory 20** • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➢ **Practicum 10** • Class Participation: • Seminar/Demonstration/Viva-voce/Lab records etc.: 10	**Theory: 50** Written Examination **Practicum: 20** Lab record, viva-voce, write up and execution of the program

- Mid-Term Exam:

Part C-Learning Resources

Recommended Books:

1. K. Hoffman and R. Kunze (2015). *Linear Algebra* (2nd edition). Prentice-Hall.
2. I. S. Luther and I. B. S. Passi (2012). *Algebra Vol. –II*. Narosa Publishing House.P. B.
3. V. Sahai and V. Bist (2013). *Linear Algebra* (2nd Edition). Narosa Publishing House.
4. S. Lang (2005). *Introduction to Linear Algebra* (2nd edition). Springer India.
5. P.B. Bhattacharya, S. K. Jain and S. R. Nagpaul (1997). *Basic Abstract Algebra* (Indian Edition). Cambridge University Press.
6. I. N. Herstein (1975). *Topics in Algebra*. Wiley Eastern Ltd. New Delhi.

MCC-8	
Session: 2024-25	
Part A - Introduction	
Subject	Mathematics
Semester	IV
Name of the Course	Differential Equations-II
Course Code	B23-MAT-403
Course Type: (CC/MCC/MDC /CC-M/DSEC/VOC/ DSE/PC / AEC/VAC)	MCC
Level of the course	200-299
Pre-requisite for the course (if any)	Differential Equations-I (B23-MAT-301)
Course Learning Outcomes(CLOs):	**After completing this course, the learner will be able to:** 1. Have the procedural knowledge and cognitive and technical skills of solving second and higher order linear partial differential equations (homogeneous and non-homogeneous). Develop the skills to find the solution of PDEs with variable coefficients. 2. Have deeper knowledge to classify the second order partial differential equations and reduce them in canonical forms, to find characteristic equations and curves. Learn cognitive skill for solving non-linear partial differential equations and their application to solve problems of science and society. 3. Gain theoretical and practical knowledge to solve the Laplace, heat and wave equations. Have technical and cognitive skills to generate solutions for modelling and

CLO 5 is related to the practical component.	solving real world problems. 4. Gain knowledge and attain skills of solving ordinary and partial differential equations with the help of Laplace transforms and Fourier transforms. 5. Acquire cognitive and technical skills to accomplish complex tasks of solving second order PDEs by analyzing different methods and using available softwares.

	Theory	Practical	Total
Credits	3	1	4
Contact Hours	3	2	5
Internal Assessment Marks	20	10	30
End Term Exam Marks	50	20	70
Examination time	3 Hours	3 Hours	

Maximum Marks = 100

Part B- Contents of the Course

Instructions for Paper- Setter

Note: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will contain 5 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question.

Unit	Topics	Contact Hours
I	Integral surfaces passing through a given curve, surfaces orthogonal to a given system of surfaces. Solutions of second and higher order linear partial differential equations (homogeneous and non-homogeneous) with constant coefficients. Solution of PDEs with variable coefficients.	12
II	Classification of linear partial differential equations of second order,	12

	Hyperbolic, parabolic and elliptic types. Reduction of second order linear partial differential equations to Canonical (Normal) forms and their solutions. Characteristic equations and characteristic curves of second order partial differential equation. Monge's method for solving second order partial differential equations. Solution of linear hyperbolic equation.	
III	Method of separation of variables. Laplace's equation: occurrence, elementary solution, families of equipotential surfaces, boundary value problems, separation of variables. Wave equation: occurrence, elementary solution, separation of variables. Diffusion (Heat) equation: occurrence, elementary solution, separation of variables.	12
IV	Basics of Laplace transform and inverse Laplace transform. Solutions of ordinary and partial differential equations using Laplace transforms. Basics of Fourier transform and inverse Fourier transform. Solutions of partial differential equations using Fourier transform.	12
	Practical	
	The practical component of the course has two parts, Problem Solving and Practical's with free and open source software (FOSS) Scilab/MAXIMA/SageMath The examiner will set 4 questions at the time of practical examination asking two questions from the part (A) and two questions from the part (B) by taking course outcomes (CLOs) into consideration. The examinee will be required to solve one problem from the part (A) and to execute one problem successfully from the part (B). Equal weightage will be given to both the parts. The evaluation will be done on the basis of	30

practical record, viva-voce, write up and execution of the program.

(A) Problem Solving-Questions related to the following problems will be solved and record of those will be maintained in the Practical Notebook:

1. Problems of solving homogenous linear partial differential equations of second and higher order.
2. Problems of solving non homogenous linear partial differential equations with constant coefficients.
3. Problems of solving partial differential equations with variable coefficients reducible to equations with constant coefficients.
4. Problems of reducing the second order partial differential equations to canonical form and solve it.
5. Problems of solving second order partial differential equations by Monge's method.
6. Solving problems of Wave, Heat and Laplace equations.
7. Solving ordinary and partial differential equations with the help of Laplace transform.
8. Solving partial differential equations with the help of Fourier transform.

(B)The following practical's will be done using free and open source software (FOSS) Scilab/MAXIMA/SageMath record of those will be maintained in the practical note book:

1. To find the Solutions of second and higher order homogeneous linear partial differential equations.
2. To find the Solutions of second and higher order non-homogeneous linear partial differential equations.

	3. To find characteristic equations of second order partial differential equation. 4. To find the solution of one dimensional Wave equations. 5. To find the solution of two dimensional Wave equations. 6. To find the solution of one dimensional Heat equations. 7. To find the solution of two dimensional Heat equations. 8. To find the solution of Laplace equations. 9. To find the solutions of ordinary and partial differential equations with the help of Laplace transform. 10. Solving partial differential equations with the help of Fourier transform.	

Suggested Evaluation Methods

Internal Assessment: ➢ **Theory 20** • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➢ **Practicum 10** • Class Participation: • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam:	**End Term Examination:** ➢ **Theory 50** Written Examination ➢ **Practicum 20** Lab record, viva-voce, write up and execution of the program

Part C-Learning Resources

Recommended Books:

1. Erwin Kreyszig (2011). *Advanced Engineering Mathematics* (10th edition). J. Wiley & Sons.
2. TynMyint-U & Lokenath Debnath (2013). *Linear Partial Differential Equation for Scientists and Engineers* (4th edition). Springer India.
3. H. T. H. Piaggio (2004). *An Elementary Treatise on Differential Equations and Their Applications*. CBS Publishers.
4. S. B. Rao & H. R. Anuradha (1996). *Differential Equations with Applications*. University Press.

5. Ian N. Sneddon (2006). *Elements of Partial Differential Equations.* Dover Publications.
6. Murray R. Spiegel (2005). *Laplace transforms.* Schaum's outline series.
7. Ian N. Sneddon (1974). *The use of Integral transforms.* McGraw Hill.
8. Lokenath Debnath, Dambaru Bhatta (2014). *Integral Transforms and Their Applications* (Third Edition). CRC Press, Boca Raton.

DSE-1	
Session: 2024-25	
Part A – Introduction	
Subject	Mathematics
Semester	IV
Name of the Course	Probability Theory & Statistics
Course Code	B23-MAT-404
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE
Level of the course	200-299
Pre-requisite for the course (if any)	Mathematics as a subject at level 4.0 (Class XII)
Course Learning Outcomes(CLOs):	**After completing this course, the learner will be able to:** 1. Gain the deeper knowledge and understanding of theory of probability, distribution function, probability density functions and joint probability distribution function and learn to use those for problem solving. Attain the cognitive skills to use Baye's theorem to solve realistic models. 2. Have the knowledge of the concepts of mathematical expectation, moments, moment generating function uniform, binomial, geometric and Poisson distributions and attain the skills required for choosing statistical tool to solve real life problem. 3. Gain the knowledge of the concepts of uniform, normal, beta,

CLO 5 is related to the practical component.	gamma, Cauchy, lognormal, Laplace distributions and their applications in real life statistical models. 4. Gain the procedural knowledge to find correlation coefficient, covariance, linear regression and to solve problems by method of least squares. Acquire the skills required to apply studied statistical methods in investigation and solution of real based statistical models. 5. Attain cognitive and technical skills required for performing and accomplishing complex tasks relating to realistic statistical models. To attain technical skills to demonstrate measures of central tendency and dispersion, rank correlation, fitting of different distributions using built in functions of SPSS/ Excel software.

	Theory	Practical	Total
Credits	3	1	4
Contact Hours	3	2	5
Internal Assessment Marks	20	10	30
End Term Examination Marks	50	20	70
Examination Time	3Hours	3Hours	

Max. Marks: 100

Part B- Contents of the Course

Instructions for Paper- Setter

Note: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will contain 5 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question.

Unit	Topics	Contact Hours

I	Basic notions of probability, Conditional probability and independence, Baye's theorem. Random variables: Discrete and continuous, Cumulative distribution function (c.d.f.), Probability mass function (p.m.f.), Probability density functions (p.d.f.), Illustrations and properties of random variables, univariate transformations with illustrations. Two dimensional random variables: Discrete and continuous, Joint, Marginal and conditional c.d.f., p.d.f., p.m.f, independence of variables, bivariate transformations with illustrations	12
II	Mathematical expectation, Moments, Moment generating function, Joint moment generating function, Characteristic function. Discrete probability distributions: Uniform, Binomial, Negative binomial, Geometric and Poisson.	12
III	Continuous probability distributions: Uniform, Normal, Beta, Gamma, Cauchy, Exponential, lognormal and Laplace distribution, properties and limiting/approximation cases.	12
IV	The Correlation coefficient, Covariance, Calculation of covariance from joint moment generating function, Linear regression, The method of least squares, Fitting of curves, Exponential curves.	12
	Practical	
	The practical component of the course has two parts, Problem Solving and Practical's using SPSS/Excel software. The examiner will set 4 questions at the time of practical examination asking two questions from the part (A) and two questions from the part (B) by taking course learning outcomes	30

(CLOs) into consideration. The examinee will be required to solve one problem from the part (A) and to execute one problem successfully from the part (B). Equal weightage will be given to both the parts. The evaluation will be done on the basis of practical record, viva-voce, write up and execution of the program.

Problem Solving-Questions related to the practical applications based on following problems will be worked out and record of those will be maintained in the Practical Note Book:

1. Problems based on conditional probability.
2. Problems based on Bayes' Theorem.
3. Problems based on probability density function.
4. Problems based on joint probability distribution function of random variables.
5. Problems to find marginal probability distribution and conditional probability distribution function of random variables.
6. Problems to compute Karl Pearson's coefficient of correlation for given bivariate frequency distribution.
7. Problems to find Spearman's rank correlation coefficient for given data.
8. Problems related to realistic models involving binomial distribution.
9. Application based problems involving Poisson distribution.
10. Problems involving normal distribution to solve real life models.
11. Problem solving related to expectation and moment of random variables.

	(B) The following practicals will be done using SPSS/ Excel software and record of those will be maintained in the practical note book: 1. Problems related to measures of central tendency. 2. Problems related to measures of dispersion. 3. Fitting of binomial distribution. 4. Fitting of Poisson distribution. 5. Fitting of normal distribution. 6. Fitting of lines of regression. 7. Fitting of curves by least square method. 8. Regression analysis. 9. Practical problems related to correlation coefficients and rank correlation.	

Suggested Evaluation Methods

Internal Assessment: ➢ **Theory 20** • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➢ **Practicum 10** • Class Participation: • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam:	**End Term Examination:** ➢ **Theory 50** Written Examination ➢ **Practicum 20** Lab record, viva-voce, written examination.

Part C-Learning Resources

Recommended Books:

1. S.C. Gupta and V.K. Kapoor (2020). *Fundamentals of Mathematical Statistics*. Sultan Chand & Sons.
2. S.P. Gupta (2019). *Statistical Methods*. Sultan Chand & Sons.
3. N.G. Das (2017). *Statistical Methods*. McGraw Hill Education.
4. I. Miller and M. Miller (2014). *John E. Freund's Mathematical Statistics with Applications* (8th edition). Pearson. Dorling Kindersley Pvt. Ltd. India.
5. S. M. Ross (2014). *Introduction to Probability Models* (11th edition). Elsevier.
6. R. V. Hogg, J. W. McKean and A. T. Craig (2013). *Introduction to Mathematical Statistics* (7th

Edition). Pearson Education.
7. S. David (2003). *Elementary Probability* (2nd Edition). Cambridge University Press.
8. Jim Pitman (1993). *Probability*, Springer-Verlag.

DSE-1	
Session: 2024-25	
Part A – Introduction	
Subject	Mathematics
Semester	IV
Name of the Course	Special Functions
Course Code	B23-MAT-405
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE
Level of the course	200-299
Pre-requisite for the course (if any)	Calculus and Differential Equations of level 100-199
Course Learning Outcomes (CLOs):	**After completing this course, the learner will be able to:** 1. Gain the knowledge and understanding of singular points of differential equations and learn to solve the equations, having singular points, by Power series method. Have deeper knowledge about Hypergeometric differential equation, Hypergeometric function and its properties and the procedure of solving Hypergeometric differential equation. 2. Have the knowledge about the concepts of Bessel's differential equation and learn procedure to find its solutions of different kind. Acquire deeper knowledge of recurrence relations, generating function, orthogonality and integral of Bessel's functions. Attain skills to make use of

	Bessel functions in scientific problem solving. 3. Gain the deeper knowledge of Legendre's differential equation and learn procedure to find its solution in the form of Legendre functions. Understand the concepts of recurrence relations, generating function, orthogonality of Legendre's function and Rodrigues' formula. Acquire the skills to solve mathematical and scientific problems involving Legendre's equation. 4. Have the knowledge of theoretical concepts of Hermite's differential equation and procedural knowledge to find its solution in the form of Hermite functions. Understand facts and theory about recurrence relations, generating function and othogonality of Hermite function, Rodrigues' formula. Acquire the skills to use Hermite function for solving mathematical and scientific problems. 5. Attain the cognitive and technical skills required for performing and accomplishing complex tasks related to series solution of differential equations, Hypergeometric, Bessel's, Legendre's and Hermite's differential equations. Acquire analytical and numerical skills to solve mathematical and scientific problems involving these differential equations and the special functions.
CLO 5 is related to the practical component.	

	Theory	Practical	Total
Credits	3	1	4
Contact Hours	3	2	5
Internal Assessment Marks	20	10	30

End Term Exam Marks	50	20	70
Examination Time	3Hrs	3Hrs	

Max. Marks: 100

Part B-Contents of the Course

Instructions for Paper- Setter

Note: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will contain 5 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question.

Unit	Topics	Contact Hours
I	Series solution of differential equations: Power series method, Hypergeometric Series, Hypergeometric function and its integral representation, Hypergeometric differential equation and solutions, Contiguous function relations, Simple transformations.	12
II	Bessel equation and its solution, Bessel functions and their properties, Convergence, Recurrence relations and generating functions, Bessel's integral, Orthogonality of Bessel functions.	12
III	Legendre differential equation and its solution, Legendre functions and their properties, Recurrence relations and generating functions, Orthogonality of Legendre polynomials, Rodrigues' formula for Legendre polynomials, Laplace integral representation of Legendre polynomial.	12
IV	Hermite differential equation and its solutions, Hermite function and its properties, Recurrence relations and generating functions, Orthogonality of Hermite polynomials, Rodrigues' formula for Hermite Polynomial.	12

Practical

The practical component of the course has two parts, Problem Solving and Practicals using MAXIMA/Scilab/MATLAB software. The examiner will set 4 questions at the time of practical examination asking two questions from the part (A) and two questions from the part (B) by taking course learning outcomes (CLOs) into consideration. The examinee will be required to solve one problem from the part (A) and to execute one problem successfully from the part (B). Equal weightage will be given to both the parts. The evaluation will be done on the basis of practical record, viva-voce, write up and execution of the program.

(A) Problem Solving- Questions related to the following problems will be solved and record of those will be maintained in the Practical Notebook:

1. Problems solving for ordinary differential equations using Frobenius method.
2. Problems based on Hypergeometric differential equation.
3. Problems involving Bessel's differential equation.
4. Problems related to Legendre differential equation.
5. Problems to find solution of Hermite differential equation.
6. Problems based on recurrence relations and generating functions of Bessel's function.
7. Problems based on recurrence relations and generating functions of Legendre's polynomial.
8. Problems based on recurrence relations and generating functions of Legendre's polynomial.

(B)The following practicals will be done using MATLAB/ SCILAB/MAXIMA software and record of those will be maintained in the practical note book:

1. Practical problems for plotting of the Bessel's functions of first kind of order 0 to 3

	2. Practical problems to find zeros of Bessel's function of first and second kind. 3. Practical problems to find zeros of first derivative of Bessel function of first kind and Legendre's polynomial. 4. Practical problems for plotting of Legendre polynomial for n=1 to 5 in the interval [0,1] and verifying graphically that all roots of Legendre polynomial lies in the interval [0,1]. 5. Practical problems related to coefficients of Legendre polynomial. 6. Practical problems based on plotting of Hermite polynomial. 7. Practical problems related to realistic models involving Bessel differential equation and their solutions. 8. Practical problems related to realistic models involving Legendre's differential equations and their solutions.	

Suggested Evaluation Methods

Internal Assessment: ➢ **Theory 20** • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➢ **Practicum 10** • Class Participation: • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam:	**End Term Examination:** ➢ **Theory 50** Written Examination ➢ **Practicum 20** Lab record, viva-voce, write up and execution of the program

Part C-Learning Resources

Recommended Books:

1. E. Kreyszig (2011). *Advanced Engineering Mathematics* (10th Edition). Wiley.
2. S. L. Ross (2007). *Differential Equations* (3rd Edition). Wiley India.
3. W.W. Bell (2004). *Special Functions for Scientists and Engineers.* Dover Books on Mathematics.
4. L.C. Andrews (1992). *Special Functions of Mathematics for Engineers.* Oxford University Press and SPIE Press.

5. E. D. Ranville (1960). *Special Functions*. Macmillan.
6. George E. Andrews, Richard Askey, Ranjan Roy (1999). *Special Functions*. Cambridge University Press.

VAC-3

Session: 2024-25	
Part A- Introduction	
Subject	Mathematics
Semester	III
Name of the Course	Mathematics in India: From Vedic Period to Modern Times
Course Code	B23-VAC-308
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	VAC
Level of the course	100-199
Pre-requisite for the course (if any)	NA
Course Learning Outcomes (CLOs):	**After completing this course, the learner will be able to:** 1. Have knowledge about the development of mathematical ideas and techniques in Indian mathematics during Vedic and Ancient period. Attain sufficient level of the historical background and contributions of notable Indian mathematicians to explore Indian knowledge system further. 2. Have deeper knowledge about development of mathematics during the Medieval period. Theoretical knowledge used in various branches of mathematics like techniques of calculus and spherical trigonometry found in the Kerala school of astronomy and mathematics will be gained. Learn about the biography and contributions of eminent Indian mathematicians during this period and Indian knowledge system as such. 3. Gain knowledge about development of mathematics in modern period. Have knowledge of notable work of Srinivasa Ramanujan and other mathematicians with other aspects of the old and strong traditions of mathematics in India. Familiarize with biographies of Mathematicians in modern period.

	4. Have Knowledge about the prestigious Fields Medal, Abel Prize in the subject of mathematics and their significance. Gain theoretical knowledge about illustrious contributions of contemporary Indian mathematicians.		
	Theory	Practical	Total
Credits	02	-	02
Contact Hours	02	-	02
Internal Assessment Marks	15	-	15
End Term Examination Marks	35	-	35
Examination Time	3 Hours	-	
	Max. Marks: 50		

Part B- Contents of the Course

Instructions for Paper- Setter

Note: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will contain 7 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question.

Unit	Topics	Contact Hours
I	**Ancient Period**: Development of Indian mathematics during Vedic and Ancient period. Overview of the Vedic period, Mathematical ideas in the Vedas and manuscripts in Indian mathematics. Life, background, notable works, mathematical contribution of Baudhayana, Pingala, Aryabhata, Brahmagupta, Bhaskaracharya, Mahaviracharya and Lilavati.	8
II	**Medieval Period**: Kerala School of Mathematics, Madhava of Sangamagrama, Nilakantha Somayaji, Jyesthadeva: Overview of historical backgrounds and their contribution.	8
III	**Modern Period:** Srinivasa Ramanujan, Satyendra Nath Bose, Radhanath Sikdar, P.C. Mahalanobis, D.R. Kaprekar: Early life, Education, Challenges, Achievements and their contribution.	8

IV	**Medals and Prizes in Mathematics and Contemporary Mathematicians:** Introduction to the prestigious Fields Medal, Abel Prize and their significance. Biography and contributions of illustrious mathematicians from India: Subrahmanyan Chandrasekhar, C.R. Rao, S.R. Srinivasa Varadhan, Manjul Bhargava, Akshay Venkatesh, Harish-Chandra and Shakuntala Devi.	8

Suggested Evaluation Methods

Internal Assessment:	**End Term Examination:**
➢ **Theory 15** Class Participation: 4 Seminar/presentation/assignment/quiz/class test etc.: 4 Mid-Term Exam: 7	➢ **Theory 35** Written examination

Part C-Learning Resources

Recommended Books:

1. C. N. Srinivasiengar (1967). *History of Mathematics in India.* The World Press Pvt. Ltd., Calcutta.
2. A.K. Bag (1979). *A Cultural History of Mathematics in Ancient India.* Chaukhamba Orientalia, Varanasi.
3. George Gheverghese Joseph (2016). *Indian Mathematics: Engaging with the World from Ancient to Modern Times*. World Scientific.
4. T.A. Sarasvati Amma (2007). *Geometry in Ancient and Medieval India*. Motilal Banarsidass Publishers Limited
5. S. Balachandra Rao (1998). *Indian Mathematics and Astronomy: Some Landmarks*. Jnana Deep Publications
6. John Stillwell (2010). *Mathematics and its History*. Springer (Includes a section on Indian mathematics)
7. Ramakalyani V. Sita Sunder Ram (2021). *History and development of Mathematics in India*. National mission for Mathematics and DK Printworld (P) Ltd, New Delhi.
8. Gerard G. Emch (2005). *Contribution to the history of Indian Mathematics.* Hindustan Book Agency.
9. R. B. Singh (2008). *Origin and development of Mathematics*. Vista International Publishing House, New Delhi.

VAC-4

Session: 2024-25

Part A – Introduction

Subject	MATHEMATICS
Semester	IV
Name of the Course	MATHEMATICS IN EVERYDAY LIFE
Course Code	B23-VAC-418
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	VAC
Level of the course	100-199
Pre-requisite for the course (if any)	NA
Course Learning Outcomes(CLOs):	**After completing this course, the learner will be able to:** 1. Gain knowledge of facts, concepts and rules to calculate simple and compound interests. Understand the technical terms related to income tax and Equated monthly installment (EMI) and then to apply their enhanced technical and analytical skills to calculate income tax for different level of income tax payee and aware about how much they have to pay each month on a loan. They will be able to compare the results and discuss the impact of compounding on long term savings. 2. Have deeper knowledge of profit, loss, work, time and distance, coding and decoding inculcate technical and cognitive skill in solving problems related to these. Attain procedural skill to solve real life problems related to ratios

	and proportions. Gain procedural and technical knowledge to solve the practical problems of height and distances using concepts of trigonometry. 3. Attain technical and cognitive skills to analyze and solve numerical based on the concept of sequence and series, Arithmetic Progression, Geometric Progression, permutation and combination. 4. Develop cognitive skill to analyze the results of a sample using measures of central tendency and graphical representation (pie charts, frequency polygons, ogive). To design and conduct a survey on a relevant topic of their choice (e.g., favorite leisure activities, dietary habits, etc.). Have procedural knowledge to solve linear programming problems used in everyday life.

Credits	Theory	Practical	Total
	2	-	2
Contact Hours	2	-	2
Internal Assessment Marks	15	-	15
End Term Exam Marks	35	-	35
Examination time	3 Hours		3 Hours

Part B- Contents of the Course

Instructions for Paper- Setter

Note: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will contain 7 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unitand the compulsory question.

Unit	Topics	Contact Hours
I	Simple interest, Compound interest, Equated monthly installment (EMI), Direct tax calculation.	8
II	Profit and loss, Work, time and distance, Coding and Decoding, Ratio and proportion, Trigonometry and its applications, Mensuration for practical purposes.	8
III	Sequence and series, Arithmetic progression, Geometric progression, Permutation and combinations (simple problems).	8
IV	Mean, Mode, Median, Standard deviation, Variance. Bar graphs, Pie charts, Frequency polygons, Ogive. Linear equation in two variables. Linear programming problems (LPP): Graphical solution.	8

Suggested Evaluation Methods

Internal Assessment: ➢ **Theory 15** • Class Participation: 4 • Seminar/presentation/assignment/quiz/class test etc.: 4 • Mid-Term Exam: 7	**End Term Examination:** **Theory 35** Written examination

Part C-Learning Resources

Recommended Books:

1. R. S. Aggarwal (2022). *Quantitative Aptitude.* S Chand & Company Limited, New Delhi.
2. Jaikishan & Premkishan (2022). *How to Crack Test of Reasoning in All Competitive Exams.* Arihant Publications.
3. A. Guha (2020). *Quantitative Aptitude* (7th Edition). Mc Graw Hill Publications.
4. R. V. Praveen (2016). *Quantitative Aptitude and Reasoning* (3rd Edition). PHI publications.
5. R.S. Aggarwal (2018). *A Modern Approach to Logical Reasoning* . S. Chand.
6. Richa Agarwal (2019). *How to Crack Test of Arithmetic.* Arihant Publications.

SEC-3			
Session: 2024-25			
Part A–Introduction			
Subject	Mathematics		
Semester	III		
Name of the Course	Calculation Skills with Vedic Mathematics-II		
Course Code	B23-SEC-303		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	SEC		
Level of the course	100-199		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes(CLOs): CLO 5 is related to the practical components of the course.	**After completing this course, the learner will be able to:** 1. Gain the knowledge to perform multiplication, division, HCF, LCM and factorization of polynomials using Vedic Sutras. 2. Have the procedural knowledge to apply Vedic sutras to solve linear equations, quadratic equations and simultaneous equations. 3. Have the knowledge and understanding of the concepts of Vedic Geometry and Trigonometry. 4. Attains the cognitive and technical skills to use Vedic sutras and upsutras for solving Algebra, Calculus and Geometry problems with speed and accuracy.		
	Theory	Practical	Total
Credits	2	1	3

Contact Hours	2	2	4
Internal Assessment Marks	15	5	20
End Term Examination Marks	35	15	55
Examination Time	3Hrs	3Hrs	

Max. Marks:75

Part B-Contents of the Course

Instructions for Paper- Setter

Note: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will contain 7 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question.

Unit	Topics	Contact Hours
I	Multiplication (Quadratic expressions of single variable), Urdhwatirygbhyaam Method, Combined Operations. Division and Factorization: Division (Divisor: Linear expression of single variable), Factorization (Quadratic and cubic polynomials of two variables) , Factorization of quadratic polynomial containing more than two variables.	8
II	Solution of Simple Equation, solution of linear equation in one variable, solution of linear equations in two variables, solution of quadratic equations, Solution of simultaneous equations.	8
III	LCM and HCF of polynomials. Concept of Baudhayana Number (BN), BN of an angle, Multiplication of a constant in a BN, BN of complementary angles, BN of sum and difference ($\alpha \pm \beta$) of an angle, BN of halfangle.	8

IV	Pythagorean triple, Trigonometric relation for half, twice and thrice of angle, sum, difference of angles using triples Vedic Geometry: Angle between two lines, perpendicular distance of line from a point.	8

	Practical	
	The examiner will set 4 questions at the time of practical examination by taking course learning outcomes (CLOs) into consideration. The examinee will be required to solve 2 questions. The evaluation will be done on the basis of practical record, viva-voce and written examination. **Problem Solving**-Questions related to the following problems will be solved and record of those will be maintained in the Practical Note Book: 1. Multiplication of algebraic polynomials. 2. Division of two polynomials. 3. Factorization of quadratic and cubic polynomials intwo or more than two variables. 4. LCM and HCF of algebraic expressions. 5. Solution of linear equations of one and twovariables. 6. Solution of quadratic equations. 7. Solution of simultaneous equations. 8. Trigonometric relation for twice of angle. 9. Trigonometric relation for thrice of angle. 10. Sum and difference of angles using triples 11. Angle between two straight lines. 12. Perpendicular Distance of line from a point.	30
	Suggested Evaluation Methods	

Internal Assessment:	End Term Examination:
➢ **Theory 15** • Class Participation: 4 • Seminar/presentation/assignment/quiz/class test etc.: 4 • Mid-Term Exam: 7 ➢ **Practicum 5** • Class Participation: • Seminar/Demonstration/Viva-voce/Lab records etc.: 5 • Mid-Term Exam:	➢ **Theory** **35** Written Examination ➢ **Practicum** **15** Lab record, viva-voce, written examination.

Part C-Learning Resources

Recommended Books:

1. U. S. Patankar and S. M. Patankar (2018). *Elements of Vedic Mathematics.* TTU Press.
2. V.Singhal (2014).*Vedic Mathematics for all ages.* Motilal Banarsidas Publishers.
3. R.K.Thakur (2013).*The Essentials of Vedic Mathematics.* Rupa Publications. New Delhi.
4. P. Tiwari and V.K. Pandey (2012). *Vedic Mathematics - Modern Research Methods.* Campus Books International.
5. S. K. Kapoor (2006).*Vedic Geometry Course.* Lotus Press.
6. A. Gupta (2004). *Power of Vedic Mathematics with Trigonometry.* Jaico Publishing House.
7. S.B.K. Krishna Trithaji(1990). *Vedic Mathematics.* Motilal Banarsidas, New Delhi.

Session: 2024-25	
Part A – Introduction	
Subject	Mathematics
Semester	III
Name of the Course	Learning MATLAB Skills
Course Code	B23-SEC-324
CourseType: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	SEC
Level of the course	200-299
Pre-requisite for the course (if any)	NA
Course Learning Outcomes(CLOs):	After completing this course, the learner will be able to: 1. Gain theoretical knowledge about memory and file management, basic flow controls, MATLAB program development environment that will help to develop programming skills and techniques to solve problems. 2. Have procedural and technical knowledge required for matrix generation, MATLAB, graphic features and its applications. 3. Gain procedural knowledge of MATLAB in

CLO 5 is related to the practical component of the course.	providing skill for solving polynomial, algebraic and transcendental equations, system of linear equations, ordinary differential equations used in interdisciplinary fields. 4. Have knowledge of tools in MATLAB used for numerical differentiation, numerical integration and to learn cognitive and technical skills required for application of these in analysis of various economical, commercial, and statistical problems. 5. Develop cognitive and technical skills to use MATLAB tools in solving various data handling problems related with multidisciplinary subjects and bridge the skill gap. Learn tools and built in functions of MATLAB/Scilab in solving stated problems. Learn technical skills and understand how to analyze all the results graphically in a very easy manner.

Credits	Theory	Practical	Total
	2	1	3
Contact Hours	2	2	4
Internal Assessment Marks	15	5	20
End term Examination Marks	35	20	55
Examination Time	3 Hours	3 Hours	

Max. Marks:75

Part B - Contents of the Course

Instructions for Paper-Setter

Note: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will contain 7 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question.

Unit	Topics	Contact Hours
I	Introduction, starting and quitting a MATLAB session, Desktop tools and development environment: command window, command history window, work space current directory, edit window, figure window, help feature. Types of files, Platform dependence, Search path. Control flow and operators, Hierarchy of operations, built in functions, Round off functions, controlling command window input and output.	8
II	Matrix generation, Array operations: Matrix arithmetic operations, Array arithmetic operations, transposing a matrix, reshaping matrices, concatenating a matrix, special matrices viz. eye, zeros, ones, rand, randn, diag, diag etc., vector generation using linspace, logspace.	8
III	Basic plotting: creating simple plots, adding title, axis label, and annotations, multiple data in one plot, specifying line style and colors, figure tools, plot editing mode, using function to edit graphs, modify the graph to enhance the presentation, multiple plots in one figure, visualizing functions of two variables: mesh and surface plots.	8

IV	Polynomials, entering a polynomial, polynomial evaluation, roots of polynomial, polynomial arithmetic, polynomial integration (using MATLAB command), polynomial differentiation (using MATLAB command), Evaluation of polynomials.	8

	Practical	
	The examiner will set 4 questions at the time of practical examination by taking course learning outcomes (CLOs) into consideration. The examinee will be required to solve two problems. The evaluation will be done on the basis of practical record, viva-voce, write up and execution of the program. **The following practicals will be done using MATLAB/ SCILAB software and record of those will be maintained in the practical note book:** 1. Practical to demonstrate components in MATLAB/SCILAB environment. 2. Practical to demonstrate tool boxes in MATLAB/SCILAB environment. 3. Practical to demonstrate windows in MATLAB/SCILAB. 4. Program to generate odd/even numbers. 5. Practical to demonstrate basic matrix operations (addition, subtraction, multiplication, transpose, determinant, concatenation etc.). 6. Practical to find inverse of a matrix using built-in function. 7. Practical to find roots of an equation using built-in function. 8. Practical to add title, axis labels, line style, color, annotations etc. to a figure/graph. 9. Practical to demonstrate integration and differentiationscommands. 10. Practical problems for solving differential equations. 11. Practical to demonstrate integration and differentiations commands. 12 Practical Problems for solving differential equations.	30

Suggested Evaluation Methods	
Internal Assessment: ➢ **Theory 15** • Class Participation: 4 • Seminar/presentation/assignment/quiz/class test etc.: 4 • Mid-Term Exam: 7 ➢ **Practicum 5** • Class Participation: • Seminar/Demonstration/Viva-voce/Lab records etc.: 5 • Mid-Term Exam:	**End Term Examination:** ➢ **Theory 35** Written Examination ➢ **Practicum 20** Lab record, viva-voce, write up and execution of the program

Part C-Learning Resources

Recommended Books:

1. Stephan J. Chapman (2020). *MATLAB Programming for Engineers* (6th edition). Cengage Learning.
2. William Palm Lii (2017). *A concise introduction to MATLAB* (2nd edition). Tata Mcgraw-Hill Education.
3. R.S.Gupta (2015). *Elements of Numerical Analysis* (2nd edition). Cambridge University Press.
4. Steven C. Chapra (2011). *Applied Numerical Methods W/ MATLAB* (3rd edition).Tata Mcgraw-Hill Education.
5. Rudra Pratap (2010). *Getting Started with MATLAB:A quick introduction for scientists and engineers.* Oxford University Press.
6. R. K. Bansal, A. K. Goel, M. K. Sharma (2009). *MATLAB and Its applications in Engineering*. Pearson Education India.
7. Dolores Etter (2008). *Introduction to MATLAB 7, 1e* (1st edition). Pearson Education India.
8. Marc E. Herniter (2000). *Programming in MATLAB* (1st edition). Cengage Learning.

SEC-3

Session: 2024-25	
Part A – Introduction	
Subject	Mathematics
Semester	III
Name of the Course	Quantitative Aptitude
Course Code	B23-SEC-326
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	SEC
Level of the course	200-299
Pre-requisite for the course (if any)	NA
Course Learning Outcomes(CLOs): CLO 5 is related to the practical component.	**After completing this course, the learner will be ableto:** 1. Comprehend the formulation of equations for specific mathematical problems and use mathematical skills to solve those. 2. Acquire the procedural knowledge to analyze and solve problems related to trains, boats and streams and apply those in real life situations. 3. To get deeper knowledge and understanding of concepts of Simple interest, Compound Interest, Partnership and use this procedural knowledge to perform assigned tasks of solving suchproblems. 4. Familiarize and get acquainted with various measures of central tendency and using cognitive skills to choose better of these for the available data and draw the inferences/results. 5. Attain a range of cognitive and technical skills to analyze and comprehend various numerical concepts, e.g., Formulation of equations, S.I. & C.I., Set theory etc. and apply these learned skills and techniques to solve daily life mathematical problems

	accurately, logically and well in time.		
Credits	Theory	Practical	Total
Contact Hours	2	1	3
Internal Assessment Marks	2	2	4
End Term Examination Marks	15	5	20
Examination Time	35	20	55
	3 Hours	3 Hours	

Max. Marks: 75

Part B- Contents of the Course

Instructions for Paper- Setter

Note: The examiner will set 9 questions asking two questions from each unit and one compulsor question by taking course learning outcomes (CLOs) into consideration. The compulsory questio (Question No. 1) will contain 7 parts covering entire syllabus. The examinee will be required t attempt 5 questions, selecting one question from each unit and the compulsory question.

Unit	Topics	Contact Hours
I	Linear Equations, Quadratic equations, System of algebraic equations in two variables and their applications in simple problems.	8
II	Time and distance: Problems based on trains, Boats and Streams, Pipes and Cistern.	8
III	Simple interest, Compound Interest, Partnership. Basic idea of set theory to solve practical problems.	8
IV	Basic idea of Permutations and Combinations. Events and sample space, Probability. Data interpretation: Raw and grouped data, Bar Graph, Pie Chart, Mean, Median and Mode.	8

	Practical	
	The examiner will set 4 questions at the time of practical examination by taking course learning outcomes (CLOs) into consideration. The examinee will be required to solve 2 questions. The evaluation will be done on the basis of practical record, viva-voce, written examination. **Problem Solving-** Questions related to the following problems will be solved and their record will be maintained in the Practical Notebook: 1. To solve problems related to clocks. 2. To write the date of birth of your family members and determine the day of their birth. 3. Compare the simple interest and compound interest for a given amount deposited for fixed time at a fixed rate. 4. Problems related to upstream and downstream of boat. 5. Write down the sample space for tossing three coins one by one and determine the probabilities of occurrence of all possibilities of heads. 6. Problems related to partnership. 7. Draw Venn Diagram for the following (i)Union of sets (ii) Intersection of sets (iii)Difference of sets (iv) Symmetric difference (iv) Complement of a set. 8. Draw a bar-graph for the percentage of expenditure occurred on miscellaneous heads (atleast 5 items) for your family income and write your observation in respect of bar-	30

graph.

9. Draw a pie-chart by taking data of problem (8).

10. Taking the annual export data for three companies for last six years , draw a line- graph.

11. Write atleast two different practical problems related to set theory and solve them with the help of venn-diagram/formula.

12. Problem solving related to pipes and cisterns.

13. Problem solving related to determination of time taken by two trains of given lengths, to cross each other, when their speeds are given.

14. Problem solving related to permutation and combination.

15. Problems involving formulation and solution of quadratic equations in one variable.

16. Formulation and solution of realistic problems to solve system of linear equations.

17. Draw the following:

(i) linear equation $x = a$

(ii)) linear equation $y = a$

(iii) linear equation $a x + b y = c$.

18. Draw a graph for system of equations $a x + by = c$; $d x + e y = f$ (a, b, c, d are real numbers) taking suitable values for a, b, c, d , e, f and depict the

(i)Unique Solution

(ii) No Solution

(iii) Infinitely many solution.

Also state the condition for general system $a x + by = c$; $d x + e y = f$ to have all three possibilities for solution (Unique Solution, No Solution &Infinitely many solution).

Suggested Evaluation Methods	
Internal Assessment: ➢ **Theory 15** • Class Participation: 4 • Seminar/presentation/assignment/quiz/class test etc.: 4 • Mid-Term Exam: 7 ➢ **Practicum 5** • Class Participation: • Seminar/Demonstration/Viva-voce/Lab records etc. 5	**End Term Examination:** ➢ **Theory** 35 Written Examination ➢ **Practicum** 20 Lab record, viva-voce, write up.

Part C-Learning Resources

Recommended Books:

1. R. S. Aggarwal (2022). *Quantitative Aptitude.* S Chand & Company Limited, New Delhi.
2. A. Guha (2020). *Quantitative Aptitude* (7th Edition). Mc Graw Hill Publications.
3. V. Dyke, J. Rogers and H. Adams (2011). *Fundamentals of Mathematics,* Cengage Learning.
4. A.S. Tussy, R. D. Gustafson and D. Koenig (2010). *Basic Mathematics for College Students*. Brooks Cole.
5. C. C. Pinter (2014). *A Book of Set Theory*. Dover Publications.
6. G. Klambauer (1986). *Aspects of calculus*. Springer-Verlag.