Indira Gandhi University, Meerpur

(A State University, Established under Haryana Act No. 29 of 2013)

Scheme of Examination

for

Mathematics Subject

in

Under Graduate Programmes

as per NEP 2020

Curriculum and Credit Framework for Undergraduate Programmes

(Multiple Entry-Exit, Internships and Choice Based Credit System LOCF)

With effect from the session 2024-25 (in phased manner)

DEPARTMENT OF MATHEMATICS

INDIRA GANDHI UNIVERSITY, MEERPUR -122502

HARYANA, INDIA

Indira Gandhi University, Meerpur

Scheme of Examination for the Mathematics Subject in Under Graduate Programmes

as per NEP 2020 Curriculum and Credit Framework for Undergraduate Programmes

(Multiple Entry-Exit, Internships and Choice Based Credit System LOCF) with effect from the session 2024-25 (in a phased manner)

Semester-1

Course Type	Applicable Scheme	Course Code	Nomenclature of the Course	Credits			Contact hours L: Lecture P: Practical T: Tutorial			Internal Assessment Marks		End term Examination Marks		Total Marks	Examination hours	
				Total	Theory (T)	Practical (P)	L	P	Total	T	P	T	P		T	P
CC-1 MCC-1	Scheme A, B & C	24L4.5-MAT-101	Calculus	4	3	1	3	2	5	20	10	50	20	100	3	3
MCC-2	Scheme C	24L4.5-MAT-102	Advanced Calculus	4	3	1	3	2	5	20	10	50	20	100	3	3
*CC-M1	Scheme A,B & D	24L4.5-MAT-103	Basic Calculus	2	1	1	1	2	3	10	5	20	15	50	3	3
CC-M1	Scheme C	From Available CC-1/MCC-1 of 4 credits as per NEP														
MDC 1	Scheme A, B & C	From Available pool of Multidisciplinary Courses from a subject of different discipline as per NEP.														
AEC-1	A, B & C	From Available pool of Ability Enhancement Courses as per NEP														
SEC-1	A, B & C	From Available pool of Skill Enhancement Courses as per NEP														
VAC-1	A, B & C	From Available pool of Value Added Courses as per NEP														

*For students who opt Mathematics as a minor subject

Semester-2

Course Type	Applicable Scheme	Course Code	Nomenclature of the Course	Credits			Contact hours L: Lecture P: Practical T: Tutorial			Internal Assessment Marks		End term Examination Marks		Total Marks	Examination hours	
				Total	Theory (T)	Practical (P)	L	P	Total	T	P	T	P		T	P
CC-2 MCC-3	Scheme A, B & C	24L4.5-MAT-201	Algebra and Number Theory	4	3	1	3	2	5	20	10	50	20	100	3	3
DSEC-1	Scheme C	24L4.5-MAT-202	Programming in C	4	3	1	3	2	5	20	10	50	20	100	3	3
*CC-M2	Scheme A, B & D	24L4.5-MAT-203	Basic Algebra	2	1	1	1	2	3	10	5	20	15	50	3	3
CC-M2	Scheme C	From Available CC-2/MCC-3 of 4 credits as per NEP														
MDC-2	A, B & C	From Available pool of Multidisciplinary Courses from a subject of different discipline as per NEP														
AEC-2	A, B & C	From Available pool of Ability Enhancement Courses as per NEP														
SEC-2	A, B & C	From Available pool of Skill Enhancement Courses as per NEP														
VAC-2	A, B & C	From Available pool of Value Added Courses as per NEP														
Internship	A, B & C	24L4.5-MAT-204	Internship of 4 Credits of 4-6 weeks duration after 2nd Semester (Mandatory in case of exit)													

*For students who opt Mathematics as a minor subject

Semester-3

Course Type	Applicable Scheme	Course Code	Nomenclature of the Course	Credits			Contact hours L: Lecture P: Practical T: Tutorial			Internal Assessment Marks		End term Examination Marks		Total Marks	Examination hours	
				Total	Theory (T)	Practical (P)	L	P	Total	T	P	T	P		T	P
CC-3 MCC-4	Scheme A, B & C	24L5.0-MAT-301	Differential Equations-I	4	3	1	3	2	5	20	10	50	20	100	3	3
MCC-5	Scheme B & C	24L5.0-MAT-302	Groups and Rings	4	3	1	3	2	5	20	10	50	20	100	3	3
MCC-2	Scheme B	24L4.5-MAT-102	Advanced Calculus	4	3	1	3	2	5	20	10	50	20	100	3	3
CC-M3	Scheme A & C	From Available CC-3/MCC-4 of 4 credits as per NEP														
CC-M3(V)	Scheme B	From Available pool of Minor (Vocational) Courses VOC-1														
MDC 3	Scheme A, B & C	From Available pool of Multidisciplinary Courses from a subject of different discipline as per NEP														
AEC-3	Scheme A, B & C	From Available pool of Ability Enhancement Courses as per NEP														
SEC-3	Scheme A, B & C	From Available pool of Skill Enhancement Courses as per NEP														
VAC-3	Scheme C only	From Available pool of Value Added Courses as per NEP														

Semester-4

Course Type	Applicable Scheme	Course Code	Nomenclature of the Course	Credits			Contact hours L: Lecture P: Practical T: Tutorial			Internal Assessment Marks		End term Examination Marks		Total Marks	Examination hours	
				Total	Theory (T)	Practical (P)	L	P	Total	T	P	T	P		T	P
CC-4 MCC-6	Scheme A, B & C	24L5.0-MAT-401	Analytical Geometry & Vector Calculus	4	3	1	3	2	5	20	10	50	20	100	3	3
MCC-7	Scheme B & C	24L5.0-MAT-402	Linear Algebra	4	3	1	3	2	5	20	10	50	20	100	3	3
MCC-8	Scheme B & C	24L5.0-MAT-403	Differential Equations-II	4	3	1	3	2	5	20	10	50	20	100	3	3
DSE-1	Scheme B & C	24L5.0-MAT-404	Probability Theory & Statistics	4	3	1	3	2	5	20	10	50	20	100	3	3
		Or														
		24L5.0-MAT-405	Special Functions	4	3	1	3	2	5	20	10	50	20	100	3	3
CC-M4(V)	A,B & C	From Available pool of Minor (Vocational) Courses VOC-2														
AEC-4	A, B & C	From Available pool of Ability Enhancement Courses as per NEP														
VAC-3	A & B	From Available pool of Value Added Courses as per NEP														
VAC-4	C	From Available pool of Value Added Courses as per NEP														
Internship	A,B& C	24L5.0-MAT-406	Internship of 4 Credits of 4-6 weeks duration after 4th Semester (Mandatory in case of exit if not done after 2nd Semester)													

Semester-5

Course Type	Applicable Scheme	Course Code	Nomenclature of the Course	Credits			Contact hours L: Lecture P: Practical T: Tutorial			Internal Assessment Marks		End term Examination Marks		Total Marks	Examination hours	
				Total	Theory (T)	Practical (P)	L	P	Total	T	P	T	P		T	P
CC-5 MCC-9	Scheme A, B & C	24L5.5-MAT-501	Sequences and Series	4	3	1	3	2	5	20	10	50	20	100	3	3
MCC-10	Scheme B & C	24L5.5-MAT-502	Mechanics-I	4	3	1	3	2	5	20	10	50	20	100	3	3
DSE-2	Scheme B & C	24L5.5-MAT-503	Linear Programming	4	3	1	3	2	5	20	10	50	20	100	3	3
		Or														
		24L5.5-MAT-504	Computer Programming	4	3	1	3	2	5	20	10	50	20	100	3	3
DSE-3	Scheme B & C	24L5.5-MAT-505	Number Theory and Cryptography	4	3	1	3	2	5	20	10	50	20	100	3	3
		Or														
		24L5.5-MAT-506	Integral Transforms and Fourier Analysis	4	3	1	3	2	5	20	10	50	20	100	3	3
CC-M5(V)	A & C	From Available pool of Minor (Vocational) Courses VOC-1														
Internship	A, B& C	24L5.5-MAT-507	Internship of 4 Credits of 4-6 weeks duration (if not done after 2nd Semester or 4th Semester)													

Semester-6

Course Type	Applicable Scheme	Course Code	Nomenclature of the Course	Credits			Contact hours L: Lecture P: Practical T: Tutorial			Internal Assessment Marks		End term Examination Marks		Total Marks	Examination hours	
				Total	Theory (T)	Practical (P)	L	P	Total	T	P	T	P		T	P
CC-6 MCC-11	Scheme A, B & C	24L5.5-MAT-601	Numerical Analysis	4	3	1	3	2	5	20	10	50	20	100	3	3
MCC-12	Scheme B & C	24L5.5-MAT-602	Real Analysis	4	3	1	3	2	5	20	10	50	20	100	3	3
DSE-4	Scheme B & C	24L5.5-MAT-603	Mechanics-II	4	3	1	3	2	5	20	10	50	20	100	3	3
		Or														
		24L5.5-MAT-604	Classical Mechanics	4	3	1	3	2	5	20	10	50	20	100	3	3
DSE-5	Scheme B & C	24L5.5-MAT-605	Discrete Mathematics	4	3	1	3	2	5	20	10	50	20	100	3	3
		Or														
		24L5.5-MAT-606	Mathematical Modelling	4	3	1	3	2	5	20	10	50	20	100	3	3
CC-M6	A	From Available CC-6/MCC-11 of 4 credits as per NEP														
CC-M5(V)	B	From Available pool of Minor (Vocational) Courses VOC-3														
CC-M6(V)	C															
CC-M7(V)	A															
SEC-4	C	From Available pool of Skill Enhancement Courses as per NEP														

Semester-7 (Honours/Honours with Research)

Course Type	Applicable Scheme	Course Code	Nomenclature of the Course	Credits			Contact hours L: Lecture P: Practical T: Tutorial			Internal Assessment Marks		End term Examination Marks		Total Marks	Examination hours	
				Total	Theory (T)	Tutorial/ Practical (P)	L	T	Total	T	P	T	P		T	P
CC-H1	Scheme B & C	24L6.0-MAT-701	Mathematical Analysis	4	3	1	3	1	4	30	-	70	-	100	3	-
CC-H2	Scheme B & C	24L6.0-MAT-702	Complex Analysis	4	3	1	3	1	4	30	-	70	-	100	3	-
CC-H3	Scheme B & C	24L6.0-MAT-703	Theory of Ordinary Differential Equations	4	3	1	3	1	4	30	-	70	-	100	3	-
DSE-6	Scheme B & C	24L6.0-MAT-704	Mechanics of Solids	4	3	1	3	1	4	30	-	70	-	100	3	-
		Or														
		24L6.0-MAT-705	Differential Geometry	4	3	1	3	1	4	30	-	70	-	100	3	-
PC-H1	Scheme B & C	24L6.0-MAT-706	Programming with MATLAB	4	2	2 Practical	2	4 P	6	15	15	35	35	100	3	3
CC-HM1	B & C	From Available Core Courses in Minor Subject of 4 credits as per NEP														

Semester-8 (Honours)

Course Type	Applicable Scheme	Course Code	Nomenclature of the Course	Credits			Contact hours L: Lecture P: Practical T: Tutorial			Internal Assessment Marks		End term Examination Marks		Total Marks	Examination hours	
				Total	Theory (T)	Tutorial/ Practical	L	T	Total	T	P	T	P		T	P
CC-H4	Scheme B & C	24L6.0-MAT-801	Abstract Algebra	4	3	1	3	1	4	30	-	70	-	100	3	-
CC-H5	Scheme B & C	24L6.0-MAT-802	Topology	4	3	1	3	1	4	30	-	70	-	100	3	-
CC-H6	Scheme B & C	24L6.0-MAT-803	Measure and Integration	4	3	1	3	1	4	30	-	70	-	100	3	-
DSE-7	Scheme B & C	24L6.0-MAT-804	Field Theory	4	3	1	3	1	4	30	-	70	-	100	3	-
		Or														
		24L6.0-MAT-805	Fluid Mechanics	4	3	1	3	1	4	30	-	70	-	100	3	-
PC-H2	Scheme B & C	24L6.0-MAT-806	Mathematical Softwares	4	0	4 Practical	0	8 P	8	-	30	-	70	100	-	3
CC-HM2	B & C	From Available Core Courses in Minor Subject of 4 credits as per NEP														

Semester-8 (Honours with Research)

Course Type	Applicable Scheme	Course Code	Nomenclature of the Course	Credits			Contact hours L: Lecture P: Practical T: Tutorial			Internal Assessment Marks		End term Examination Marks		Total Marks	Examination hours	
				Total	Theory (T)	Tutorial (T)	L	T	Total	T	P	T	P		T	P
CC-H4	Scheme B & C	24L6.0-MAT-801	Abstract Algebra	4	3	1	3	1	4	30	-	70	-	100	3	-
CC-H5	Scheme B & C	24L6.0-MAT-802	Topology	4	3	1	3	1	4	30	-	70	-	100	3	-
Research	Scheme B & C	24L6.0-MAT-807	Dissertation	12								300		300	-	-
CC-HM2	B & C	From Available Core Courses in Minor Subject of 4 credits as per NEP														

Scheme of MDC, VAC, SEC and VOC courses

Semester	Course Type	Applicable Scheme	Course Code	Nomenclature of the Course	Credits			Contact hours L: Lecture P: Practical			Internal Assessment Marks		End term Examination Marks		Total Marks	Examination hours	
					Total	Theory (T)	Practical (P)	L	P	Total	T	P	T	P		T	P
1	MDC-1	Scheme A, B, C & D		Introductory Mathematics	3	2	1	2	2	4	15	5	35	20	75	3	3
2	MDC-2	Scheme A, B, C & D		Mathematics for Commerce & Social Sciences	3	2	1	2	2	4	15	5	35	20	75	3	3
3	MDC-3	Scheme A, B, C & D		Mathematics for all	3	2	1	2	2	4	15	5	35	20	75	3	3
3	VAC-3	Scheme C only		Mathematics in India: From Vedic Period to Modern Times	2	2	0	2	0	2	15	0	35	-	50	3	-
4	VAC-3	Scheme A, B & D		Mathematics in India: From Vedic Period to Modern Times	2	2	0	2	0	2	15	0	35	-	50	3	-
4	VAC-4	Scheme C only		Mathematics in Everyday Life	2	2	0	2	0	2	15	0	35	-	50	3	-
2	SEC-2	Scheme A, B, C & D		Calculation Skills with Vedic Mathematics-I	3	2	1	2	2	4	15	5	35	20	75	3	3

2	SEC-2	Scheme A, B, C & D		Numerical Ability Enhancement Skills	3	2	1	2	2	4	15	5	35	20	75	3	3
3	SEC-3	Scheme A, B, C & D		Calculation Skills with Vedic Mathematics-II	3	2	1	2	2	4	15	5	35	20	75	3	3
3	SEC-3	Scheme A, B, C & D		Learning MATLAB Skills	3	2	1	2	2	4	15	5	35	20	75	3	3
3	SEC-3	Scheme A, B, C & D		Quantitative Aptitude	3	2	1	2	2	4	15	5	35	20	75	3	3
6	SEC-4	Scheme C only		Basic Mathematical Techniques	2	1	1	1	2	3	10	5	20	15	50	3	3

Course composition- Theory/ Theory +Tutorial			
Course Credit	Internal Assessment marks	End term exam marks	Total marks
2	15	35	50
3	25	50	75
4	30	70	100

Course composition- Theory + Practical					
Course Credit	Theory		Practical		Total marks
Theory +Practical	Internal Assessment marks	End term exam marks	Internal Assessment marks	End term exam marks	
1+1	10	20	5	15	50
2+1	15	35	5	20	75
2+2	15	35	15	35	100
3+1	20	50	10	20	100
0+4	NA	NA	30	70	100

1. **Internal assessment (30%) shall be broadly based on the following defined components of;**
    a. **Class participation**
    b. **Seminar/Presentation/Assignment/Quiz/class test, etc.**
    c. **Mid Term Exam**

Total Internal Assessment Marks (Theory)	Class Participation	Seminar/Presentation/Assignment/Quiz/class test, etc.	Mid-Term Exam
10	4	-	6
15	4	4	7
20	5	5	10
25	5	7	13
30	5	10	15
Total Internal Assessment Marks (Practicum)	Class Participation	Seminar/Demonstration/Viva-Voce/Lab record, etc.	Mid-Term Exam
5		5	NA
10		10	NA
15	5	10	NA
30	5	10	15

CC-1 /MCC-1

Session: 2024-25	
Part A – Introduction	
Subject	Mathematics
Semester	I
Name of the Course	Calculus
Course Code	24L4.5-MAT-101
Course Type:	CC/MCC
Level of the course	100-199
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 concepts and theory of limit, continuity and differentiability of functions. Attain skills of calculating the limit of functions and examining the continuity and differentiability of different types of functions, and perform successive differentiation of functions. To apply the procedural knowledge to obtain the series expansions of functions which find multidisciplinary applications. 2. Understand concepts of asymptotes and curvature, the geometrical meaning of these terms and to have procedural knowledge to solve related problems. 3. Determine singular points of a curve and classify them. Understand the concept of rectification of curves and derive the reduction formulae. 4. Have theoretical knowledge and practical skills to evaluate the area bounded by the curves, and volume and surface area of solids formed by revolution of curves.
CLO 5 is related to the practical component of the course.	5. Attain cognitive and technical skills required for solving different problems of calculus associated with tracing of curves, determination of curvature, and rectification of curves, volume and surface area of solids of revolution. Have technical and practical skills of solving calculus problems related to differentiation and integration of functions by using MAXIMA software.

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

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	ε-δ definition of limit and continuity of a real valued function, Basic properties of limits, Types of discontinuities, Differentiability of functions, Application of L'Hospital rule to indeterminate forms, Successive differentiation, Leibnitz theorem, Taylor's and Maclaurin's series expansion with different forms of remainder.	12
II	Asymptotes: Horizontal, vertical and oblique asymptotes for algebraic curves, Asymptotes for polar curves, Intersection of a curve and its asymptotes, Curvature and radius of curvature of curves (cartesian, parametric, polar & intrinsic forms), Newton's method, Centre of curvature and circle of curvature.	12

III	Multiple points, Node, Cusp, Conjugate point, Tests for concavity and convexity, Points of inflexion, Tracing of curves, Reduction formulae.	12
IV	Rectification, intrinsic equation of a curve, Quadrature, Area bounded by closed curves, Volumes and surfaces of solids of revolution**.**	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 (CLO) 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 their record will be maintained in the Practical Notebook: 1. Problems of curve tracing when equation is given in Cartesian coordinates. 2. Problems of curve tracing when equation is given in Parametric form. 3. Problems of curve tracing when equation is given in Polar coordinates. 4. Problem of determination of length of a curve expressed in Cartesian coordinates. 5. Problem of determination of length of a curve expressed in Polar coordinates.	30

	6. Problem of determination of radius of curvature expressed in Cartesian coordinates. 7. Problem of determination of radius of curvature expressed in Polar coordinates. 8. Problem of determination of radius of curvature expressed in Parametric form. 9. Problem of determination of volumes and surfaces of solids of revolution for Cartesian curve. 10. Problem of determination of volumes and surfaces of solids of revolution for Parametric curve. 11. Problem of determination of volumes and surfaces of solids of revolution for Polar curve. **(B)The following practicals will be done using MAXIMA software and their record will be maintained in the practical note book:** 1. Learn to use basic operators and functions in Maxima software. 2. Simplify algebraic expressions and expressions containing radicals, logarithms, exponentials and trigonometric functions. 3. Expand algebraic, rational, trigonometric and logarithmic expressions. 4. Find derivatives of algebraic, trigonometric, exponential and logarithmic functions. 5. Find derivatives of functions involving above mentioned functions. 6. Problems of successive differentiation. 7. Find indefinite integrals of different functions. 8. Find definite integrals of different functions. 9. To plot curves involving Cartesian, parametric and polar forms. 10. To demonstrate singular points.	
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. Howard Anton, I. Bivens & Stephan Davis (2021). *Calculus* (12th edition). J. Wiley & Sons. 2. Gabriel Klambauer (1986). *Aspects of Calculus* (4th edition). Springer. 3. Wieslaw Krawcewicz & Bindhyachal Rai (2003). *Calculus with Maple Labs*. Alpha Science Int'l Ltd. 4. Gorakh Prasad (2016). *Differential Calculus* (19th edition). Pothishala Pvt. Ltd. 5. George B. Thomas Jr., Joel Hass, Christopher Heil & Maurice D. Weir (2018). *Thomas' Calculus* (14th edition). Pearson Education. 6. Monty J. Strauss, Gerald L. Bradley & Karl J. Smith (2002). *Calculus* (3rd edition). Dorling Kindersley (India) Pvt. Ltd.

MCC-2

Session: 2024-25	
Part A – Introduction	
Subject	Mathematics
Semester	I
Name of the Course	Advanced Calculus
Course Code	24L4.5-MAT-102
Course Type:	MCC
Level of the course	100-199
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. Have theoretical knowledge about various mean value theorems and their geometrical interpretations. 2. Learn conceptual variations while advancing from dealing with functions of one variable to several variables in calculus and discuss limit and continuity of such functions. Have deeper understanding of Euler's theorem and Taylor's theorem and practice to attain skill in multidisciplinary contexts. 3. Know about differentiability of real valued functions of two variables and understand Young's, theorem Schwarz's theorem and implicit function theorem. Determine maxima and minima of functions of two variables, learn Lagrange's method of undetermined multipliers and exploit this procedural knowledge for various realistic optimization problems. 4. Understand and acquire theoretical knowledge about Jacobians, Beta and Gamma functions, with acquisition of skill to analyse various methods of integration and evaluate double and triple integrals which find application in the determination of areas and volumes.

CLO 5 is related to the practical component.	5. Attain cognitive skills required for solving problems associated with continuity, differentiability of functions of several variables and applications of double and triple integrals. Have technical and practical skills of solving problems related to plotting of curves in two and three dimensions and evaluating double and triple integrals 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

<u>Instructions for Paper- Setter</u>

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	Continuous functions, Sequential criterion for continuity, Properties of continuous functions, Uniform continuity, Chain rule of differentiability, Mean value theorems: Rolle's Theorem, Lagrange's mean value theorem and their geometrical interpretations, Cauchy mean value theorem. Taylor's theorem with various forms of remainders.	12
II	Limit and continuity of real valued functions of two variables, Partial differentiation. Total Differentials; Composite functions & implicit functions. Change of variables. Homogenous functions & Euler's theorem on homogeneous functions. Taylor's theorem for functions of two variables.	12

III	Differentiability of real valued functions of two variables. Young's theorem, Schwarz's theorem, Implicit function theorem. Extrema of functions of two and more variables: Maxima, minima and saddle points. Lagrange's method of undetermined multipliers.	12
IV	Jacobians. Beta and Gamma functions, Relation between Beta and Gamma functions, Legendre's duplication formula. Double integration over rectangular and non rectangular regions, Double integrals in polar co-ordinates. Change of order of integration. Volume by triple integrals, Triple integration in cylindrical and spherical co-ordinates. Dirichlet integrals, Liouville's extension of Dirichlet's integral.	12
Practical		
	This course has two components, 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 to check continuity of functions of several variables. 2. Problems of checking differentiability of functions of several variables. 3. Problems of finding maxima /minima of functions of two variables. 4. Problems of determination of surface area through application of double integrals in Cartesian and Polar coordinates. 5. Problems of determination of volume using triple integrals.	30

	6. Problem to demonstrate uniform continuity of a function of single variable. 7. Problem to demonstrate the existence of a continuous function which is not uniformly continuous. 8. Problem to demonstrate that for a function f of two variables f_{xy} need not be equal to f_{yx}. **(B)The following practicals will be done using MAXIMA software and record of those will be maintained in the practical note book:** 1. To find partial derivatives of a function. 2. To find total differential of a function of several variables. 3. To plot a curve for a function of two variables. 4. To plot a curve for a function of three variables. 5. To solve practical problems using method of Lagranges multipliers. 6. To evaluate double integrals. 7. To evaluate triple integrals. 8. To demonstrate Young'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. Howard Anton, I. Bivens & Stephan Davis (2021). *Calculus* (12th edition). Wiley India.

2. Gabriel Klambauer (1986). *Aspects of Calculus*. Springer-Verlag.

3. Wieslaw Krawcewicz & Bindhyachal Rai (2003). *Calculus with Maple Labs*. Narosa.

4. Gorakh Prasad (2016). *Differential Calculus* (19th edition). Pothishala Pvt. Ltd.

5. George B. Thomas Jr., Joel Hass, Christopher Heil & Maurice D. Weir (2018). *Thomas*' *Calculus* (14th edition). Pearson Education.

6. Monty J. Strauss, Gerald L. Bradley & Karl J. Smith (2011). *Calculus* (3rd edition). Pearson Education. Dorling Kindersley (India) Pvt. Ltd.

7. Jerrold Marsden, Anthony J. Tromba & Alan Weinstein (2009). *Basic Multivariable Calculus*, Springer India Pvt. Limited.

8. James Stewart (2012). *Multivariable Calculus* (7th edition). Brooks/Cole. Cengage.

9. Murray R Spiegel & Robert Wrede (2011). *Schaum's Advanced Calculus*.(3rd edition). McGraw Hill Publication.

CC-M1

Session: 2024-25	
Part A - Introduction	
Subject	Mathematics
Semester	I
Name of the Course	Basic Calculus
Course Code	24L4.5-MAT-103
Course Type:	CC-M
Level of the course	100-199
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 concepts of limit, continuity and differentiability of functions, calculate the limit of functions and examine the continuity and differentiability of different types of functions, and perform successive differentiation of functions and obtain their series expansions, which find multidisciplinary applications within the chosen field of learning. 2. Have deeper understanding of Taylor's and Maclaurin's theorem and use this knowledge for series expansion of various functions, which find multidisciplinary applications within the chosen field of learning. 3. Understand and acquire procedural skills required for accomplishing assigned tasks of determining asymptotes and analyze them geometrically. 4. Comprehend the process of deriving reduction formulae and use this skill to solve typical integrals easily and quickly.

CLO 5 is related to the practical component.	5. Attain cognitive and theoretical skills to find successive derivatives of a function, higher derivative of the product of two functions using Leibnitz' s rule and apply this skill for expansion of functions. Have technical and practical skills of solving problems related to differentiation and integration of functions by using built in functions of MAXIMA software.

Credits	Theory	Practical	Total
	1	1	2
Contact Hours	1	2	3
Internal Assessment Marks	10	5	15
End Term Examination Marks	20	15	35
Examination Time	3 Hours	3 Hours	

Max. Marks:50

Part B- Contents of the Course

<u>Instructions for Paper- Setter</u>

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 4 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	Limit and continuity of a real valued function, basic properties of limits, types of discontinuities, Differentiability of functions. Application of L'Hospital rule to Indeterminate forms.	4
II	Successive differentiation, Leibnitz theorem (statement only), Taylor's and Maclaurin's series expansions with different forms of remainder.	4
III	Asymptotes: Horizontal, vertical and oblique asymptotes for algebraic curves, Asymptotes for polar curves, Intersection of a curve and its asymptotes.	4

IV	Reduction formulae.	4
	Practical	
	This course has two components, 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 (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 their record will be maintained in the Practical Notebook: 1. Practical problems to check the limit and continuity of a function. 2. Practical problems to check the differentiability of a function. 3. Practical problems of finding derivatives of algebraic, trigonometric, exponential and logarithmic functions. 4. Practical problems of finding n^{th} derivatives using Leibnitz theorem. 5. Practical problems related to application of Taylor's theorem. 6. Practical problems to find the asymptotes of a given algebraic curve. 7. Practical application of L'Hospital rule to evaluate indeterminate forms. 8. Practical problems to find the asymptotes of a polar curve. 9. Practical problems to find Maclaurin's series expansion of various functions. 10. Practical problems based on reduction formulae	30

<table>
<tr><td></td><td>(B)The following practicals will be done using MAXIMA software and record of those will be maintained in the practical note book:

1. Introduce basic operators and functions in Maxima software.
2. Simplify algebraic expressions and expressions containing radicals, logarithms, exponentials and trigonometric functions.
3. Expand algebraic, rational, trigonometric and logarithmic expressions.
4. Find derivatives of algebraic, trigonometric, exponential and logarithmic functions.
5. Find derivatives of functions involving above mentioned functions.
6. Find indefinite integrals of different functions.
7. Find definite integrals of different functions.</td><td></td></tr>
<tr><td colspan="3" align="center">Suggested Evaluation Methods</td></tr>
<tr><td colspan="2">Internal Assessment:
➢ Theory 10
● Class Participation: 4
● Seminar/presentation/assignment/quiz/class test etc.:
● Mid-Term Exam: 6
➢ Practicum 5
● Class Participation:
● Seminar/Demonstration/Viva-voce/Lab records etc.: 5
● Mid-Term Exam:</td><td>End Term Examination:
➢ Theory 20
Written Examination
➢ Practicum 15
Lab record, viva-voce, write up and execution of the program</td></tr>
<tr><td colspan="3" align="center">Part C-Learning Resources</td></tr>
</table>

Recommended Books:

1. Howard Anton, I. Bivens & Stephan Davis (2021). *Calculus* (12th edition). Wiley India.
2. Gabriel Klambauer (1986). *Aspects of Calculus*. Springer-Verlag.
3. Wieslaw Krawcewicz & Bindhyachal Rai (2003). *Calculus with Maple Labs*. Narosa.
4. Gorakh Prasad (2016). *Differential Calculus* (19th edition). Pothishala Pvt. Ltd.
5. George B. Thomas Jr., Joel Hass, Christopher Heil & Maurice D. Weir (2018). *Thomas*' *Calculus* (14th edition). Pearson Education.
6. Monty J. Strauss, Gerald L. Bradley & Karl J. Smith (2011). *Calculus* (3rd edition). Pearson Education. Dorling Kindersley (India) Pvt. Ltd.
7. Jerrold Marsden, Anthony J. Tromba & Alan Weinstein (2009). *Basic Multivariable Calculus*, Springer India Pvt. Limited.
8. James Stewart (2012). *Multivariable Calculus* (7th edition). Brooks/Cole. Cengage.
9. Murray R Spiegel & Robert Wrede (2011). *Schaum's Advanced Calculus*. (3rd edition). McGraw Hill Publication.

MDC-1

Session: 2024-25	
Part A– Introduction	
Subject	Mathematics
Semester	I
Name of the Course	Introductory Mathematics
Course Code	24L4.5-MDC-MAT-101
Course Type:	MDC
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 the knowledge of set theory, types of sets and operations on sets. Understand various concepts of matrices and determinants, and acquire the cognitive skills to apply different operations on matrices and determinants. 2. Have the knowledge of the basic concepts of complex numbers and acquire skills to solve linear inequalities and quadratic equations. 3. Gain the knowledge of the concepts of Arithmetic progression, Geometric progression and Harmonic progression, and find A.M., G.M. and H.M. of given numbers. 4. Have the conceptual knowledge of straight lines and circles. Find out the slope of a line, angle between two lines, and know about various forms of a straight line and the standard form of a circle.
CLO 5 is related to the practical components of the course.	5. Attain the skills to make use of the learnt concepts of Introductory Mathematics in multidisciplinary learning contexts and to know their applications.

	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	3 Hrs	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	Sets and their representations, Empty set, Finite and infinite sets, Subsets, Equal sets, Power sets, Universal set, Union and intersection of sets, Difference of two sets, Complement of a set, Venn diagram, De-Morgan's laws and their applications. An introduction to matrices and their types, Operations on matrices, Symmetric and skew-symmetric matrices, Minors, Co-factors. Determinant of a square matrix, Adjoint and inverse of a square matrix, Solutions of a system of linear equations up to order 3.	8
II	Complex numbers, Operations on complex numbers, Modulus and argument of a complex number. Linear inequalities, Algebraic solutions of linear inequalities in two variables and their graphical representation. Quadratic equations, Solution of quadratic equations.	8

III	Arithmetic progression, Geometric progression, Harmonic progression, Arithmetic mean (A.M.), Geometric mean (G.M.), Harmonic mean (H.M.), Relation between A.M., G.M. and H.M.	8
IV	Straight lines: Slope of a line and angle between two lines, Different forms of equation of a line: Parallel to co-ordinate axes, Point-slope form, Slope-intercept form, Two-point form, General form; Distance of a point from a straight line. Standard form of a circle and its properties.	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 problems based on following topics will be worked out and record of those will be maintained in the Practical Note Book: 1. Problems related to union, intersection, difference and complement of sets. 2. Problems based on De Morgan's Laws. 3. Problems related to Venn diagrams. 4. Problems to find inverse of a matrix. 5. Problems to find determinant of a square matrix of order 3. 6. Problems to find nth term of A.P., G.P. and H.P. 7. Problems to find sum of n terms of A.P., G.P. and H.P. 8. Problems to find A.M., G.M. and H.M. of given numbers.	30

	9. Problems to find modulus and argument of a complex number. 10. Problems involving formulation and solution of quadratic equations in one variable. 11. Problems to represent solutions of linear inequalities graphically. 12. Problems based on angle between two lines. 13. Problems involving straight lines and their slope. 14. Problems related to a circle.	

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. C. Y. Young (2021). *Algebra and Trigonometry*. Wiley.
2. S.L. Loney (2016). *The Elements of Coordinate Geometry (Cartesian Coordinates)*(2nd Edition). G.K. Publication Private Limited.
3. Seymour Lipschutz and Marc Lars Lipson (2013). *Linear Algebra.* (4th Edition) Schaum's Outline Series, McGraw-Hill.
4. C.C. Pinter (2014). *A Book of Set Theory*. Dover Publications.
5. J. V. Dyke, J. Rogers and H. Adams (2011). *Fundamentals of Mathematics* (10th Edition), Brooks/Cole.
6. A.Tussy, R. Gustafson and D. Koenig (2010). *Basic Mathematics for College Students* (4th Edition). Brooks Cole.

CC-2/MCC-3

Session: 2024-25	
Part A – Introduction	
Subject	Mathematics
Semester	II
Name of the Course	Algebra and Number Theory
Course Code	24L4.5-MAT-201
Course Type:	CC/MCC
Level of the course	100-199
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 concepts of symmetric, skew-symmetric, Hermitian, skew-Hermitian, Orthogonal and Unitary matrices, Linear dependence and independence of rows and columns of a matrix. Have knowledge of procedure and cognitive skills used in calculating rank of a matrix, eigen values, characteristic equation, minimal polynomial of a matrix and technical skills used in solving problems based on Cayley- Hamilton theorem. 2. Have knowledge of the concepts used in solving problems based on relations between the roots and coefficients of general polynomial equation

	in one variable, solutions of polynomial equations having conditions on roots, common roots and multiple roots. Understand Descarte's rule of signs and learn cognitive and technical skills required in assessing nature of the roots of an equation and solving problems based on these. 3. Have deeper and procedural knowledge required for solving cubic and biquadratic equations used in Mathematics as well as many other learning fields of study. To understand the basic concepts of number theory and their applications in problem solving and life- long learning. 4. Have knowledge of concepts, facts, principles and theories of Linear Congruences, Fermat's theorem, Euler's theorem, Wilson's theorem and its converse, Chinese Remainder theorem. Attain cognitive skills used in solving linear Diophantine equations in two variables.
CLO 5 is related to the practical component of the course.	5. Attain cognitive and technical skills required to formulate and solve practical problems involving rank of a matrix, inverse of a matrix, Cardon's method, Ferrari's method, Descarte's method, Cayley-Hamilton theorem, Euler's theorem and Chinese Remainder theorem. Have technical and practical skills required for solving algebraic equations, finding inverse and eigen values of matrices by using built in functions of MAXIMA software.

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

<u>Instructions for Paper- Setter</u>

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	Symmetric, Skew symmetric, Hermitian and skew Hermitian matrices, Elementary operations on matrices, Rank of a matrix, Inverse of a matrix, Linear dependence and independence of rows and columns of matrix, Row rank and column rank of a matrix, Eigen values, Eigen vectors and characteristic equation of a matrix, Minimal polynomial of a matrix, Cayley-Hamilton theorem and its use in finding the inverse of a matrix, Unitary and orthogonal matrices.	12
II	Relations between the roots and coefficients of general polynomial equation in one variable, Solutions of polynomial equations having conditions on roots, Common roots and multiple roots, Transformation of equations, Nature of the roots of an equation, Descarte's rule of signs.	12

III	Solutions of cubic equations (Cardon’s method), Biquadratic equations and their solutions. Divisibility, Greatest common divisor (gcd), Least common multiple (lcm), Prime numbers, Fundamental theorem of arithmetic.	12
IV	Linear congruences, Fermat’s theorem, Euler’s theorem, Wilson’s theorem and its converse, Chinese Remainder theorem, Linear Diophantine equations in two variables.	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 (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 worked out and record of those will be maintained in the Practical Notebook:** 1. Problems to find the row rank and column rank of a matrix. 2. Problems to find the eigen values and eigen vectors of a matrix. 3. Problems to find the minimal polynomial of a matrix.	30

	4. Problems of finding inverse of a matrix using Cayley-Hamilton theorem. 5. Problems of solving cubic equations by Cardon's method. 6. Problems of solving biquadratic equations by Descarte's method. 7. Problems of solving biquadratic equations by Ferrari's method. 8. Problems to find gcd and lcm of two integers. 9. Problems to find solution of linear congruence using Euler's theorem. 10. Problems to find common solution of congruences using Chinese remainder theorem. **B) The following practicals will be done using MAXIMA Software and their record will be maintained in the practical note Book:** 1. To find roots of algebraic equations using MAXIMA. 2. To find multiple roots of algebraic equations using MAXIMA 3. To find the value of a determinant using MAXIMA. 4. To compute inverse of a square matrix using MAXIMA. 5. To find Eigen values of a square matrix using MAXIMA. 6. To find Eigen vectors of a square matrix using MAXIMA. 7. To solve system of linear equations using MAXIMA. 8. Problems to find gcd and lcm of two or more	

	integers using MAXIMA. 9. Problems of solving biquadratic equations by Ferrari's method using MAXIMA.	

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/e-resources:

1) Stephen H. Friedberg, Arnold J. Insel & Lawrence E. Spence (2022). *Linear Algebra* (5th edition). Prentice Hall of India Pvt. Ltd.
2) Seymour Lipschutz and Marc Lars Lipson (2013). *Linear Algebra*. (4th Edition) Schaum's Outline Series, McGraw-Hill.
3) K. B. Dutta (2004). *Matrix and Linear Algebra*. Prentice Hall of India Pvt. Ltd.
4) Vivek Sahai & Vikas Bist (2013). *Linear Algebra* (2nd edition). Narosa Publishing House.
5) I. Niven (1991). *An Introduction to the Theory of Numbers* (5th edition). John Wiley & Sons.
6) H.S. Hall and S.R. Knight (2023). *Higher Algebra* (7th edition). Arihant Publications.
7) Leonard Eugene Dickson (2009). *First Course in the Theory of Equations*. The Project Gutenberg EBook (http://www.gutenberg.org/ebooks/29785).

DSEC-1

Session: 2024-25	
Part A – Introduction	
Subject	Mathematics
Semester	II
Name of the Course	Programming in C
Course Code	24L4.5-MAT-202
Course Type:	DSEC
Level of the course	100-199
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 knowledge and understanding of the concepts of C programming language. Learn elements of C, data types, constants and variables, operations and operators, statements and expressions. Attain the skills to write C programs. 2. Have the conceptual knowledge of Input/ Output functions in C, decision making statements in C. Acquire the technical skills to develop C programs for practical problems. 3. Gain the knowledge of loops and arrays, their types, characteristics and structures. Attain the skills to write C programs with loops and arrays for solving mathematical and realistic problems.

<table>
<tr><td>CLO 5 is related to practical component of the course</td><td colspan="3">4. Have the procedural knowledge required for performing skilled task associated with C language. Learn strings of characters, their declaration, input/output, operations on strings and functions which handle strings. Acquire knowledge of the concepts of user defined functions in C. Attain the skills to write codes in C using functions.

5. Attain cognitive and technical skills for solving problems with the C programming language. Have hands-on experience to run and debug programs in C for different mathematical and other practical problems of daily or scientific use.</td></tr>
<tr><td></td><td>Theory</td><td>Practical</td><td>Total</td></tr>
<tr><td>Credits</td><td>3</td><td>1</td><td>4</td></tr>
<tr><td>Contact Hours</td><td>3</td><td>2</td><td>5</td></tr>
<tr><td>Internal Assessment Marks</td><td>20</td><td>10</td><td>30</td></tr>
<tr><td>End Term Examination Marks</td><td>50</td><td>20</td><td>70</td></tr>
<tr><td>Examination Time</td><td>3Hrs</td><td>3Hrs</td><td></td></tr>
<tr><td colspan="4">Max. Marks:100</td></tr>
<tr><td colspan="4">Part B-Contents of the Course</td></tr>
<tr><td colspan="4"><u>Instructions for Paper- Setter</u>
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.</td></tr>
</table>

Unit	Topics	Contact Hours
I	Overview of C: Introduction and importance of C, Basic structure of a C program, Executing a C program. Elements of C: C character set, C tokens, Identifiers and keywords, Constants and variables, Data types, Assignment statement, Symbolic constants. Operators and expressions: Arithmetic, relational, logical, bitwise, unary, assignment, conditional and special operators. Arithmetic expressions, Evaluation of arithmetic expression, Type casting and conversion, Operators hierarchy.	12
II	Input/output: Unformatted and formatted I/O functions, Input functions viz. scanf(), getch(), getche(), getchar(), gets(), Output functions viz. printf(), putch(), putchar(), puts(). Decision making and branching: Decision making with IF statement, if-else statement, Nested IF statement, else-if ladder, switch statement, goto statement.	12
III	Looping: For, while and do-while loops, Jumps in loops, break, continue statement. Arrays: Definition, Types, Initialization, Processing an array.	12
IV	Character Strings: Declaration and initialization, Reading and writing, Arithmetic operations on characters, Putting strings together, Comparison of strings, String handling functions. User defined functions: Need for user defined functions, Form of C functions, Return values and their types, Calling a function,	12

<table>
<tr><td></td><td>Category of functions, Nesting of functions, Recursion, Functions with arrays, Scope of variables in functions, ANSI C functions.</td><td></td></tr>
<tr><td colspan="3" align="center">Practical</td></tr>
<tr><td></td><td>
The practical component will involve coding based on Programming in C for mathematical and scientific problems. The examiner will set 4 programs at the time of practical examination by taking course learning outcomes (CLOs) into consideration. The examinee will be required to execute two programs. The evaluation will be done on the basis of practical record, viva-voce, write-up and execution of the program.
Practical: The following practicals will be done using the programming language C and record of those will be maintained in the practical Note Book:

To find greatest and smallest of three numbers.
To find the roots of a quadratic equation.
To check whether a given year is leap year or not.
To prepare electricity bill.
To calculate the Letter grades and Grade points of a student according to marks obtained in 4 subjects on the basis of following table:

<table>
<tr><td>Marks</td><td>Grade Point</td><td>Letter Grade</td></tr>
<tr><td>>85</td><td>10</td><td>O (Outstanding)</td></tr>
<tr><td>>75</td><td>9</td><td>A+ (Excellent)</td></tr>
<tr><td>>65</td><td>8</td><td>A (Very Good)</td></tr>
<tr><td>>55</td><td>7</td><td>B+ (Good)</td></tr>
<tr><td>>50</td><td>6</td><td>B (Above Average)</td></tr>
<tr><td>>40</td><td>5</td><td>C (Average)</td></tr>
<tr><td>40</td><td>4</td><td>P (Pass)</td></tr>
<tr><td><40</td><td>0</td><td>F (Fail)</td></tr>
</table>
</td><td>30</td></tr>
</table>

<table>
<tr><td></td><td>

6. To check a given number for being palindrome or Armstrong.
7. To generate Fibonacci sequence.
8. Write a function to check a given number for being prime number. Use the same to generate the prime numbers less than or equal to a given number m.
9. To find area of circle, triangle and rectangle depending on choice using switch statement.
10. To find sum of cosine series and sine series up to n terms.
11. To find sum of any n numbers.
12. To find transpose of a matrix.
13. To find sum and product of two matrices.
14. To find factorial of a number using (a) iteration (b) function.
15. To sort given numbers in ascending/descending order using (a) selection sort (b) bubble sort

</td><td></td></tr>
<tr><td colspan="3">Suggested Evaluation Methods</td></tr>
<tr><td colspan="2">

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:

</td><td>

End Term Examination:

➢ **Theory 50**
Written Examination

➢ **Practicum 20**
Lab record, viva-voce, write-up and execution of programs.

</td></tr>
<tr><td colspan="3">Part C-Learning Resources</td></tr>
<tr><td colspan="3">

Recommended Books:

1) E. Balagurusamy (2019). *Programming in ANSI C* (8^{th} Edition). Tata McGraw-Hill Publishing Co. Ltd.
2) R. Threja (2016). *Computer Fundamentals and Programming in C* (2^{nd} Edition), Oxford University Press.
3) B. S. Gottfried (1998). *Theory and Problems of Programming with C*. Tata McGraw-Hill Publishing Co. Ltd.
4) V. Rajaraman (1994). *Computer Programming in C.* Prentice Hall of India.
5) B.W. Kernighan and D.M. Ritchie (1988). The C Programming Language (2nd Edition). Pearson.

</td></tr>
</table>

CC-M2

Session: 2024-25	
Part A – Introduction	
Subject	Mathematics
Semester	II
Name of the Course	Basic Algebra
Course Code	24L4.5-MAT-203
Course Type:	CC-M
Level of the course	100-199
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 facts, principles and theories to determine rank of a matrix, eigen values, eigen vectors, characteristic equation and minimal polynomial of square matrices. 2. Have procedural knowledge, cognitive and technical skills of solving problems based on Cayley-Hamilton theorem. Gain knowledge about unitary and orthogonal matrices and have skills to solve problems related to them. 3. Understand consistency of homogeneous and non-homogeneous system of linear equations and to learn cognitive and technical skills required for solving such type of problems

CLO 5 is related to the practical component of the course.	using matrices. 4. Have procedural knowledge to determine relation between roots and coefficients of a general polynomial and find solutions of polynomial equations having conditions on roots. 5. Attain cognitive and technical skills required for using relevant methods and procedures to solve algebraic equations, finding inverse and eigen values of matrices. Have technical and practical skills of solving algebraic equations, finding inverse and eigen values of matrices by using built in functions of MAXIMA software.

Credits	Theory	Practical	Total
	1	1	2
Contact Hours	1	2	3
Internal Assessment Marks	10	5	15
End term Examination Marks	20	15	35
Examination Time	3 Hours	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 4 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	Rank of a matrix, Row rank and column rank of a matrix, Eigen values, Eigen vectors and the characteristic equation of a matrix, Minimal polynomial of a matrix.	4
II	Cayley-Hamilton theorem and its use in finding the inverse of a matrix, Unitary and orthogonal matrices.	4
III	Applications of matrices to a system of linear (both homogeneous and non–homogeneous) equations, Theorems on consistency of a system of linear equations.	4
IV	Relations between the roots and coefficients of general polynomial equation in one variable, Solutions of polynomial equations having conditions on roots.	4
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 (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 practical applications based on following problems will be worked out and record of those will be maintained in the Practical Note Book:	30

<table>
<tr><td></td><td>

Problems to find the row rank and column rank of a matrix.
Problems to find the eigen values and eigen vectors of a matrix.
Problems of finding inverse of a matrix using Cayley-Hamilton theorem.
Problems to find the minimal polynomial of a matrix.
Problems to check the consistency of a system of linear equations.

B) The following practicals will be worked out using MAXIMA Software and their record will be maintained in the Practical Notebook:

To find roots of algebraic equations using MAXIMA.
To find the value of determinant using MAXIMA.
To compute inverse of a square matrix using MAXIMA.
To find Eigen values and Eigen vectors of a square matrix using MAXIMA.
To solve system of linear equations using MAXIMA.

</td><td></td></tr>
<tr><td colspan="3">Suggested Evaluation Methods</td></tr>
<tr><td colspan="2">
Internal Assessment:
➢ Theory 10

Class Participation: 4
Seminar/presentation/assignment/quiz/class test etc.:-
Mid-Term Exam: 6

➢ Practicum 5

Class Participation:
Seminar/Demonstration/Viva-voce/Lab records etc.: 5
Mid-Term Exam:

</td><td>
End Term Examination:
➢ Theory 20
Written Examination
➢ Practicum 15
Lab record, viva-voce, write up and execution of the program
</td></tr>
</table>

Part C-Learning Resources

Recommended Books/e-resources:

1. Stephen H. Friedberg Arnold J. Insel Lawrence E. (2022). *Linear Algebra* (5^{th} edition). Prentice Hall of India Pvt. Ltd.
2. Seymour Lipschutz and Marc Lars Lipson (2013). *Linear Algebra.* (4^{th} Edition) Schaum's Outline Series, McGraw-Hill.
3. K. B. Dutta (2004). *Matrix and Linear Algebra*. Prentice Hall of India Pvt. Ltd.
4. H.S. Hall and S.R. Knight (2023). *Higher Algebra (*7^{th} edition). Arihant Publications.
5. Leonard Eugene Dickson (2009). *First Course in the Theory of Equations.*
6. The Project Gutenberg EBook (http://www.gutenberg.org/ebooks/29785).

MDC-2

Session: 2024-25	
Part A – Introduction	
Subject	Mathematics
Semester	II
Name of the Course	Mathematics for Commerce and Social Sciences
Course Code	24L4.5-MDC-MAT-201
Course Type:	MDC
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. Understand and have the procedural knowledge of the concepts of matrices and determinants to solve simultaneous linear equations. 2. Gain the knowledge to find derivatives and integration of simple functions related to commerce and social sciences. Acquire skills to make use of derivatives and integration in realistic problems of the discipline. 3. Have the conceptual knowledge of compound interest, annuity, loan, debenture and sinking funds and attain skills to use these concepts in problem solving. 4. Gain the knowledge and understanding of the concepts of Linear programming and develop skills of formulating and solving linear programming problems based on real world problems.
CLO 5 is related to practical components of the course.	5. Attain the cognitive and technical skills required for accomplishing assigned tasks relating to the chosen fields of learning in the context of broad multidisciplinary contexts to solve commercial and social real world problems using Mathematics

	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	Matrices and Determinants: Definition of a matrix, Order, Equality, Types of matrices, Operations on matrices: addition, multiplication and multiplication with a scalar and their simple properties. Minors, Co-factors, Determinant, Properties of determinants and applications of determinants in finding the area of a triangle, Adjoint and inverse of a square matrix, Solutions of simultaneous linear equations.	8

II	Differentiation, Derivatives of simple functions and other functions having applications in business and social studies, Maxima and minima of a function and their applications to Revenue, Cost, Demand, Production, Profit functions and other functions related to commercial and social Problems. Integration of simple functions and its applications in commercial and economic problems.	8
III	Simple interest and compound interest. Annuities: Types of annuities, Present value and amount of an annuity (including the case of continuous compounding), Valuation of simple loans and debentures, Problems related to sinking funds.	8
IV	Linear Programming: Formulation of linear programming problems (LPP) and their solution by graphical and Simplex methods. Applications of linear programming in solving social science and business problems.	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 Note Book: 1. Problems to find sum of matrices. 2. Problems to find product of matrices.	30

<table>
<tr><td></td><td>
3. Problems to find determinant of a matrix.
4. Problems to find inverse of a matrix.
5. Problems to find solution of system of linear equations.
6. Problems to find derivatives of simple functions related to commerce and social sciences.
7. Problems to find integration of simple functions related to economic problems.
8. Problems to find maxima of profit function, production, demand function and minima of cost function.
9. Problems to find simple and compound interest.
10. Problems based on annuity.
11. Formulation of real life commercial and social science problems (LPP) related to maximizing profits, minimizing costs, minimal usage of resources etc. and their solutions.
</td><td></td></tr>
<tr><td colspan="3">Suggested Evaluation Methods</td></tr>
<tr><td colspan="2">
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:
</td><td>
End Term Examination:
➢ Theory 35
Written Examination
➢ Practicum 20
Lab record, viva-voce, written examination.
</td></tr>
<tr><td colspan="3">Part C-Learning Resources</td></tr>
<tr><td colspan="3">
Recommended Books:
1. E.T. Dowling(2020). Schaum outlines of Calculus for Business, Economics and the Social Sciences. McGraw Hill.
2. S.C. Gupta and V.K. Kapoor (2014). Fundamentals of Mathematical Statistics. S. Chand & Sons, Delhi.
3. Seymour Lipschutz and Marc Lars Lipson (2013). Linear Algebra. (4th Edition) Schaum's Outline Series, McGraw-Hill.
</td></tr>
</table>

4. D.C. Sancheti and V.K. Kapoor (2011). *Business Mathematics*. Sultan Chand and Sons.

5. Holden(2010). *Introductory Mathematics for Business and Economics*. Ane/pal Exclusive.

6. E.T. Dowling(2009). *Schaum outlines of Mathematical methods for Business and Economics*. McGraw Hill.

7. E. Don and J. Lerner(2009). *Schaum's outline of Basic Business Mathematics* (2nd Edition). McGraw Hill.

8. L.N.Paul (2002). *Linear Programming: an introductory analysis*. Tata Mcgraw Hill. New Delhi.

CC-3/ MCC-4

Session: 2024-25	
Part A – Introduction	
Subject	Mathematics
Semester	III
Name of the Course	Differential Equations-1
Course Code	24L5.0-MAT-301
Course Type:	CC/MCC
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

CLO 5 is related to the practical component.	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. 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

<u>Instructions for Paper- Setter</u>

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

<table>
<tr><td colspan="3">Practical</td></tr>
<tr><td></td><td>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</td><td>30</td></tr>
</table>

	method. **(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* (10^{th} 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* (3^{rd} edition). Wiley India Pvt. Ltd.
4. George F. Simmons (2017). *Differential Equations with Applications and Historical Notes* (3^{rd} 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	24L5.0-MAT-302
Course Type:	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

<u>Instructions for Paper- Setter</u>

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:

- **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. 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	24L5.0-MDC-MAT-301
Course Type:	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, Solution of simultaneous linear equations up to three variables. Arithmetic progression, Geometric progression.	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. Integration of simple algebraic, trigonometric and exponential functions.	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. Measures of dispersion: Concept of dispersion, Mean deviation and its coefficient, Range, Variance and its coefficient, Standard deviation.	8
IV	Correlation: Concept and types of correlation, Methods of finding correlation: Scatter diagram, Karl Pearson's coefficients of correlation, Rank correlation. Linear regression: Principle of least square, Fitting of straight line, Two lines of regression, Regression coefficients. Solution of differential equations of first order and degree one with variable separable.	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

<table>
<tr><td></td><td>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. Demonstrate skills of finding integration of simple functions.
10. Representation of data using Bar and pie diagrams.
11. Representation of data using Histogram, Frequency polygon, Frequency curves and Ogives.
12. Problems to compute measures of central tendency.
13. Problems to calculate measures of dispersion.
14. Problem to calculate Karl Pearson’s coefficient of correlation.
15. Problem to fit the straight line for the given data.
16. Problem to find lines of regression.
17. Practical problems involving solution of simple first order differential equations.</td><td></td></tr>
<tr><td colspan="3">Suggested Evaluation Methods</td></tr>
<tr><td colspan="2">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:</td><td>End Term Examination:
➢ Theory 35
Written Examination
➢ Practicum 20
Lab record, viva-voce, written examination.</td></tr>
<tr><td colspan="3">Part C-Learning Resources</td></tr>
</table>

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.

CC-4/MCC-6

Session: 2024-25	
Part A – Introduction	
Subject	Mathematics
Semester	IV
Name of the Course	Analytical Geometry & Vector Calculus
Course Code	24L5.0-MAT-401
Course Type:	CC/MCC
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

CLO 5 is related to the practical component of the course.	cylinder, enveloping cylinder, concepts of conicoids, 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 solving practical problems related to assessing nature of conicoid, their characteristics. Learn skills to 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.

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. Cone: Equation of a cone, right circular cone, quadric cone, enveloping cone. Tangent plane and condition of tangency.	12
III	Cylinder: Right circular cylinder and enveloping cylinder. Central Conicoids: Equation of tangent plane. Director sphere. Normal to the conicoids. Polar plane of a point. Enveloping cone of a conicoid, Enveloping cylinder of a conicoid, confocal conicoid, reduction of second degree equations.	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. 4. Practical problems related to reduction of a general equation to the standard form and to discuss nature of conicoid, when	30

	one root of characteristics roots of discriminant cubic is zero. 5. Formulation and solution of real life situations which uses mathematical knowledge and characteristics of sphere (at least two). 6. Formulation and solution of real life situations which uses mathematical knowledge and characteristics of cone (at least two). 7. Formulation and solution of real life situations which uses mathematical knowledge and characteristics of cylinder (at least two). 8. Practical problems to understand geometrical meanings of gradient, divergence and curl. 9. Practical problems to demonstrate use of vector identities based on gradient, divergence and curl. 10. Practical problems to study applications of Gauss Divergence theorem. 11. Practical problems to study applications of Stoke's theorem. 12. 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.

MCC-7

Session: 2024-25	
Part A - Introduction	
Subject	Mathematics
Semester	IV
Name of the Course	Linear Algebra
Course Code	24L5.0-MAT-402
Course Type:	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

<u>Instructions for Paper- Setter</u>

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: ➢ **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. 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	24L5.0-MAT-403
Course Type:	MCC
Level of the course	200-299
Pre-requisite for the course (if any)	Differential Equations-I (24L5.0-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.		

<table>
<tr><td></td><td>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.</td><td></td></tr>
<tr><td colspan="3">Suggested Evaluation Methods</td></tr>
<tr><td colspan="2">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:</td><td>End Term Examination:
➢ Theory 50
Written Examination
➢ Practicum 20
Lab record, viva-voce, write up and execution of the program</td></tr>
<tr><td colspan="3">Part C-Learning Resources</td></tr>
<tr><td colspan="3">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.</td></tr>
</table>

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	24L5.0-MAT-404
Course Type:	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,

	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.		
CLO 5 is related to the practical component.	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:	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, 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	24L5.0-MAT-405
Course Type:	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.
CLO 5 is related to the practical component.	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.

	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

<table>
<tr><td colspan="3" align="center">Practical</td></tr>
<tr><td></td><td>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</td><td>30</td></tr>
</table>

	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/IV
Name of the Course	Mathematics in India: From Vedic Period to Modern Times
Course Code	24L5.0-VAC-MAT-
Course Type:	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

<u>Instructions for Paper- Setter</u>

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.

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VAC-4

Session: 2024-25	
Part A – Introduction	
Subject	MATHEMATICS
Semester	IV
Name of the Course	MATHEMATICS IN EVERYDAY LIFE
Course Code	24L5.0-VAC-MAT-
Course Type:	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

<u>Instructions for Paper- Setter</u>

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-2

Session: 2024-25			
Part A - Introduction			
Subject	Mathematics		
Semester	II		
Name of the Course	Calculation Skills with Vedic Mathematics-I		
Course Code	24L4.5-SEC-MAT-		
Course Type:	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 of *Sutras* and *Upsutras* from Vedic Mathematics. Perform simple arithmetic calculations with speed and accuracy. 2. Have the procedural knowledge of multiplication of complicated numbers quickly with the aid of Vedic *sutras* and generate tables of any number. 3. Make use of Vedic *sutras* to quickly divide, and find LCM and HCF of many digit numbers. 4. Acquire the cognitive skills to calculate square and cube roots of numbers speedily with accuracy. 5. Attain skills to perform calculations in competitive examinations 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	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 unitand the compulsory question.

Unit	Topics	Contact Hours
I	History of Vedic Mathematics and introduction to its *Sutras* and *Upsutras*. Addition in Vedic Mathematics: Without Carrying, Dot Meth method subtraction in Vedic Mathematics: *Nikhilam Navatashcaramam Dashatah* (All from 9 last 10). Fraction: Addition and Subtraction.	8
II	Multiplication of two numbers of two digits (*Ekadhikena Purvena* method), Multiplication of two numbers of three digits, (*Ekanyunena Purvena* method, *Urdhva Tiryagbhyam* method, *Nikhilam Navatashcaramam Dashatah* method), Combined Operations, Generating Tables (*Nikhilam*).	**8**
III	Division: *Nikhilam Navatashcaramam Dashatah* (two digits divisor), *ParavartyaYojyet* Method (three digits divisor). Divisibility: *Ekadhikena Purvena* Method (two digits divisor), *Eknunen Purvena* Method (two digits divisor) LCM, HCF.	8
IV	Squares of any two digits numbers: Base method, Squares of numbers ending in 5: *Ekadhikena Purvena* Method.	8

	Square Roots: *Dwandwa Yoga* (Duplex) Method, Square root (four digit number). Cubing: *Yavadunam* Method, Cube root (six digit numbers)	
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. Addition of two 5-digit numbers by without carrying and dot method. 2. Subtraction of 5-digit numbers by base method. 3. Multiplication of 2-digit numbers by base method. 4. Multiplication of 3-digit numbers by numbers consisting of all 9s. 5. Multiplication of 3-digit numbers by numbers consisting of all 1s. 6. Multiplication of 3-digit numbers by Vinculum method. 7. Division of 2-digit and 3-digit numbers. 8. Generating table of any number. 9. Square of any 2-digit number by base method. 10. Square of any number ending with 5. 11. Square root of 4-digit numbers. 12. Cube root of 6-digit numbers. 13. LCM and HCF of numbers. 14. Answer checking by digit-sum method.	30
Suggested Evaluation Methods		

<table>
<tr>
<td>
InternalAssessment:
➢ 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:
</td>
<td>
End Term Examination:
➢ Theory
35 Written Examination
➢ Practicum 20
Lab record, viva-voce, written examination.
</td>
</tr>
<tr>
<td colspan="2">Part C-Learning Resources</td>
</tr>
<tr>
<td colspan="2">
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.
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</table>

SEC-2

Session: 2024-25	
Part A - Introduction	
Subject	Mathematics
Semester	II
Name of the Course	Numerical Ability Enhancement Skills
Course Code	24L4.5-SEC-MAT-
Course Type:	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 component.	**After completing this course, the learner will be able to**: 1. Understand real number system, fundamental arithmetical operations, use of BODMAS rule and solve typical expressions accurately and fast. 2. Acquire skill to identify types of given sequences/series and apply suitable method to find a particular term, sum of specific number of terms and practice this learning in real life mathematical problems. 3. To formulate equations for specific mathematical problem and making use of mathematical skills to solve that. 4. Have a deeper and comprehensive understanding of the basic concepts of Percentage, Profit & Loss, Alligation or mixture, Averages and acquire skill to use this knowledge in real life problems 5. Attain cognitive and analytical skills to identify, analyze and generate solutions to realistic problems by exploring procedural knowledge associated with the problems. Have analytical skills to compare and recognize various geometrical figures available in

	surroundings with mathematical figures and determine areas and volumes of the same.		
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

<u>Instructions for Paper- Setter</u>

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	Real number system, Operations on numbers, Tests for divisibility of natural numbers, Decimals, Fractions, Square roots, Cube roots, Surds and indices, Use of BODMAS.	8
II	HCF, LCM of integers, Ratio and Proportion, Progressions: Arithmetic Progression, Geometric Progression, Harmonic Progression with their simple and basic practical applications, Number series completion.	8
III	Percentage, Profit & Loss, Alligation or mixture, Average, Average speed problems, Calendar.	8
IV	Logarithms, Area of Quadrilaterals (Parallelogram, Square, Rectangle, Rhombus, Trapezium),Volume and surface area of Cube, Cuboid, Cylinder, Cone, Sphere and Hemisphere.	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 the simplification of expression involving fractions having use of BODMAS. 2. Practical problems of salary increment, population increase etc. & apply formula for n^{th} term and sum of n terms based on A.P. and G.P. 3. Working out average speed during a trip from a destination to another destination assuming non uniform speed taking at least three variation in magnitude of speed. 4. Practical problems related to ratio and proportion. 5. Practical problems related to two digit numbers and reversal of digits at unit and ten's places. 6. Draw a chart for quadrilateral (Parallelogram, Square, Rectangle, Rhombus, Trapezium) mentioning their properties, surface area and perimeter. 7. Draw 3-D figures Cuboid, Cube, Cylinder, Cone, Sphere and Hemisphere and problems solving for the surface area and volume of these figures. 8. Derive a formula to determine average speed of a person	30

<table>
<tr><td></td><td>travelling from a destination ‘A’ to another destination ‘B’ with a speed of x km/h and returning back with a speed of y km/h .
9. ‘M’ offers a discount of 25% on a book to ‘A’ and for the same book, he offers ‘B’ a discount of 10% and again an additional discount of 15%. Analyze, which has to pay more for the same book.
10. Problem of determining single discount in percent equivalent to successive discount of x %, y% and z %.
11. Problem of determining loss percent when a person sells two similar items, one at a gain of x % and the other at a loss of x %.
12. To solve problem related to the value of an item after ‘n’ years if it depreciates at the rate of ‘r %’ per annum , when its present value ‘P’ is given.
13. Problem of determining the value of an item ‘n’ years ago if its depreciation rate ‘r %’ per annum and present value ‘P’ is given.
14. Problem of percentage reduction in consumption of a commodity if its price increases ‘r %’ so as not to increase the expenditure.
15. Problem to find the ratio in which two or more ingredients at the given price must be mixed to produce a mixture of a desired price.</td><td></td></tr>
<tr><td colspan="3">Suggested Evaluation Methods</td></tr>
<tr><td colspan="2">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:</td><td>End Term Examination:
➢ Theory 35
Written Examination
➢ Practicum 20
Lab record, viva-voce, write up.</td></tr>
<tr><td colspan="3">Part C-Learning Resources</td></tr>
</table>

Recommended Books:

R. S. Aggarwal (2022). *Quantitative Aptitude.* S Chand & Company Limited, New Delhi.

A. Guha (2020). *Quantitative Aptitude* (7^{th} Edition). Mc Graw Hill Publications.

V. Dyke, J. Rogers and H. Adams (2011). *Fundamentals of Mathematics,* Cengage Learning.

A.S. Tussy, R. D. Gustafson and D. Koenig (2010). *Basic Mathematics for College Students*. Brooks Cole.

C. C. Pinter (2014). *A Book of Set Theory*. Dover 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	24L5.0-SEC-MAT-		
Course Type:	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. Gain the cognitive skills to evaluate determinant, inverse of a matrix, derivative and integration of functions with speed and accuracy using Vedic Mathematics. 4. Have the knowledge and understanding of the concepts of Vedic Geometry and Trigonometry. 5. 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

<u>Instructions for Paper- Setter</u>

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. LCM and HCF of polynomials.	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	Determinant. Inverse of a Matrix. Derivative. Integration.	8
IV	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 half angle. 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 in two or more than two variables. 4. LCM and HCF of algebraic expressions. 5. Solution of linear equations of one and two variables. 6. Solution of quadratic equations. 7. Solution of simultaneous equations. 8. Determinant of order 3 and 4. 9. Derivative of composite functions. 10. Integration of product of two functions without using traditional by-parts method. 11. Trigonometric relation for twice of angle. 12. Trigonometric relation for thrice of angle. 13. Sum and difference of angles using triples 14. Angle between two straight lines. 15. Perpendicular Distance of line from a point.	30
Suggested Evaluation Methods		

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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:

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End Term Examination:

➢ **Theory**
35 Written Examination

➢ **Practicum 15**
Lab record, viva-voce, written examination.

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<tr>
<td colspan="2" align="center">Part C-Learning Resources</td>
</tr>
<tr>
<td colspan="2">

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.

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SEC-3

Session: 2024-25	
Part A – Introduction	
Subject	Mathematics
Semester	III
Name of the Course	Learning MATLAB Skills
Course Code	24L5.0-SEC-MAT-
CourseType:	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, implementation of built-in functions, MATLAB graphic features and its applications. Deeper knowledge and understanding of these tools for interactive computation and able to generate plots and their export for use in reports and presentations. 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 curve fitting, interpolation, numerical differentiation, numerical integration, data statistics 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.

	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	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 Use of matrix built-in functions: det, diag, eig, inv, norm, rank, sqrtm, expm, logm, rank, lu etc. 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. Use of built-in functions plot, subplot, fplot, xlabel, ylabel, title, legend, axis, hold, line, ezplot, ezpolar, ezplot3, ezcontour,	8

	ezcontourf, ezsurf, ezsurfc, ezmesh, ezmeshf, view, meshgrid, rotate3d etc. for plotting.	
III	Polynomials, entering a polynomial, polynomial evaluation, roots of polynomial, polynomial arithmetic, polynomial integration (using MATLAB command), polynomial differentiation (using MATLAB command), Evaluation of polynomials. Computation with MATLAB: Solutions of system of linear algebraic equations in many variables, Root finding by iterative simulations, solution of a transcendental equation. Basic symbolic calculus, solutions of first order linear differential equations, first order linear differential equations with initial conditions, second order linear differential equations Use of built-in functions syms, expand, solve, inline, collect, subs, simplify, roots, fzero, feval, fsolve, ode23, ode45 etc.	8
IV	Curve fitting: Linear, quadratic and cubic, Curve fitting with polynomial function, Interpolation, Numerical differentiation, Numerical integration Data Analysis and Statistics: plotting of statistical measures (mean, mode, median, standard deviation, sum, cumulative sum, largest value, smallest value, cumulative product, difference between the successive data points etc.), plot histogram, pie chart, bar graph etc. Use of built-in functions polyfit, polyval, interp1, interp2, interp3, spline, interpft, diff, trapz, quad, quad1, dblquad, mean, median, std, max, min, sum, cumsum, prod, cumprod, sort, pie, pie3, polar, hist, bar, bar3, diff etc.	8

<table>
<tr><td colspan="3">Practical</td></tr>
<tr><td></td><td>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 determine Eigen values and Eigen vectors of a square matrix using built-in functions.
8. Practical to find roots of an equation using built-in function.
9. Practical to demonstrate fsolve for solution of transcendental equations.
10. Practical to demonstrate built in plotting tools fplot, ezpolar, ezplot, ezcontour, ezsurf, ezcontourf etc.
11. Practical to add title, axis labels, line style, color, annotations etc. to a figure/graph.
12. Practical of solving system of linear equations.
13. Practical to determine a polynomial using method of Least Square Curve Fitting.</td><td>30</td></tr>
</table>

	14. Practical to determine polynomial fit, analyzing residuals, exponential fit and error bounds from the given data. 15. Practical to fit a straight line of the type y=ax+b. 16. Practical to demonstrate statistical toolbox (mean, median, standard deviation, sort etc.). 17. Practical to demonstrate integration and differentiations commands. 18. Practical problems for solving 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, 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	24L5.0-SEC-MAT-
Course Type:	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 able to**: 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 work & time , work and wages and apply those in real life situations. 3. To get deeper knowledge and understanding of concepts of Simple interest, Compound Interest, Partnership, Work and time and use this procedural knowledge to perform assigned tasks of solving such problems. 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., Work & time, Work & Wages, 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
	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

<u>Instructions for Paper- Setter</u>

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: Problems on ages, Clocks.	8
II	Time and distance: Problems based on trains, Boats and Streams, Pipes and Cistern. Work and time: Problems on work and time, Work and wages.	8
III	Simple interest, Compound Interest, Partnership. Basic idea of set theory to solve practical problems. Trigonometric ratios and identities, Height and distance.	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).	

<table>
<tr><th colspan="2">Suggested Evaluation Methods</th></tr>
<tr><td>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</td><td>End Term Examination:
➢ Theory 35
Written Examination 20
➢ Practicum
Lab record, viva- voce, write up.</td></tr>
<tr><th colspan="2">Part C-Learning Resources</th></tr>
</table>

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Recommended Books:

R. S. Aggarwal (2022). *Quantitative Aptitude.* S Chand & Company Limited, New Delhi.

A. Guha (2020). *Quantitative Aptitude* (7^{th} Edition). Mc Graw Hill Publications.

V. Dyke, J. Rogers and H. Adams (2011). *Fundamentals of Mathematics,* Cengage Learning.

A.S. Tussy, R. D. Gustafson and D. Koenig (2010). *Basic Mathematics for College Students*. Brooks Cole.

C. C. Pinter (2014). *A Book of Set Theory*. Dover Publications.