CHAUDHARY RANBIR SINGH UNIVERSITY, JIND

(A Haryana State Government University)

(Established by the Haryana State Legislature Act 28 of 2014 and recognized by UGC Act 1956 U/S 2(f) & 12-B)

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 2023-24 (in phased manner)

DEPARTMENT OF MATHEMATICS

CHAUDHARY RANBIR SINGH UNIVERSITY, JIND-126102

HARYANA, INDIA

Chaudhary Ranbir Singh University, Jind

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 2023-24 (in phased manner)

Semester	Course Type	Applicable Scheme	Course Code	Nomenclature of 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
1	CC-1 MCC-1	Scheme A, B & C	B23-MAT-101	CALCULUS	4	3	1	3	2	5	20	10	50	20	100	3	3
	[illegible]	Scheme C	B23-MAT-102	ADVANCED CALCULUS	4	3	1	3	2	5	20	10	50	20	100	3	3
	CC-MI	Scheme A, B & D	B23-MAT-103	BASIC CALCULUS	2	1	1	1	2	3	10	5	20	15	50	3	3
	[illegible]	Scheme A, B, C & D	B23-MAT-104	INTRODUCTORY MATHEMATICS	3	2	1	2	2	4	15	5	35	20	75	3	3
2	CC-2 MCC-3	Scheme A, B & C	B23-MAT-201	ALGEBRA AND NUMBER THEORY	4	3	1	3	2	5	20	10	50	20	100	3	3
	DSE-C [illegible]	Scheme C	B23-MAT-202	PROGRAMMING IN C	4	3	1	3	2	5	20	10	50	20	100	3	3

21/07/23

	CC-M2	Scheme A, B & D	B23-MAT-203	BASIC ALGEBRA	2	1	1	1	2	3	10	5	20	15	50	3	3
	MDC-3	Scheme A, B, C & D	B23-MAT-204	MATHEMATICS FOR COMMERCE & SOCIAL SCIENCES	3	2	1	2	2	4	15	5	35	20	75	3	3
3	CC-3 MCC-4	Scheme A, B & C	B23-MAT-301	DIFFERENTIAL EQUATIONS-I	4	3	1	3	2	5	20	10	50	20	100	3	3
	MCC-5	Scheme B & C	B23-MAT-302	GROUPS AND RINGS	4	3	1	3	2	5	20	10	50	20	100	3	3
	MDC-4	Scheme A, B, C & D	B23-MAT-303	MATHEMATICS FOR ALL	3	2	1	2	2	4	15	5	35	20	75	3	3
4	CC-4 MCC-6	Scheme A, B & C	B23-MAT-401	ANALYTICAL GEOMETRY & VECTOR CALCULUS	4	3	1	3	2	5	20	10	50	20	100	3	3
	MCC-7	Scheme B & C	B23-MAT-402	LINEAR ALGEBRA	4	3	1	3	2	5	20	10	50	20	100	3	3
	MCC-8	Scheme B & C	B23-MAT-403	DIFFERENTIAL EQUATIONS-II	4	3	1	3	2	5	20	10	50	20	100	3	3
	DSE-1	Scheme B & C	B23-MAT-404	PROBABILITY THEORY & STATISTICS	4	3	1	3	2	5	20	10	50	20	100	3	3
			Or															

21/07/23

		Scheme B & C	B23-MAT-405	SPECIAL FUNCTIONS	4	3	1	3	2	5	20	10	50	20	100	3	3
5	CC-5 MCC-9	Scheme A, B & C	B23-MAT-501	SEQUENCES AND SERIES	4	3	1	3	2	5	20	10	50	20	100	3	3
	MCC-10	Scheme B & C	B23-MAT-502	MECHANICS-I	4	3	1	3	2	5	20	10	50	20	100	3	3
		Scheme B & C	B23-MAT-503	LINEAR PROGRAMMING	4	3	1	3	2	5	20	10	50	20	100	3	3
			Or														
		Scheme B & C	B23-MAT-504	COMPUTER PROGRAMMING	4	3	1	3	2	5	20	10	50	20	100	3	3
		Scheme B & C	B23-MAT-505	NUMBER THEORY & CRYPTOGRAPHY	4	3	1	3	2	5	20	10	50	20	100	3	3
			Or														
		Scheme B & C	B23-MAT-506	INTEGRAL TRANSFORMS AND FOURIER ANALYSIS	4	3	1	3	2	5	20	10	50	20	100	3	3
6	CC-6 MCC-11	Scheme A, B & C	B23-MAT-601	NUMERICAL ANALYSIS	4	3	1	3	2	5	20	10	50	20	100	3	3
	MCC-12	Scheme B & C	B23-MAT-602	REAL ANALYSIS	4	3	1	3	2	5	20	10	50	20	100	3	3

	DSE-A	Scheme B & C	B23-MAT-603	MECHANICS-II	4	3	1	3	2	5	20	10	50	20	100	3	3
			Or														
		Scheme B & C	B23-MAT-604	CLASSICAL MECHANICS	4	3	1	3	2	5	20	10	50	20	100	3	3
	DSE-B	Scheme B & C	B23-MAT-605	DISCRETE MATHEMATICS	4	3	1	3	2	5	20	10	50	20	100	3	3
			Or														
		Scheme B & C	B23-MAT-606	MATHEMATICAL MODELLING	4	3	1	3	2	5	20	10	50	20	100	3	3
		Scheme B & C			**Total**	**Theory**	**Tutorial/ Practical**	**L**	**T**	**Total**	**Internal Assessment Marks**		**End term Examination Marks**		**Total Marks**	**Examination hours**	
7		Scheme B & C	B23-MAT-701	REAL ANALYSIS-II	4	3	1	3	1	4	30		70		100	3	
		Scheme B & C	B23-MAT-702	COMPLEX ANALYSIS	4	3	1	3	1	4	30		70		100	3	
		Scheme B & C	B23-MAT-703	THEORY OF ORDINARY DIFFERENTIAL EQUATIONS	4	3	1	3	1	4	30		70		100	3	
	DSE-C	Scheme B & C	B23-MAT-704	MECHANICS OF SOLIDS	4	3	1	3	1	4	30		70		100	3	

		Or												
	Scheme B & C	B23-MAT-705	DIFFERENTIAL GEOMETRY	4	3	1	3	1	4	30	70	100	3	
	Scheme B & C	B23-MAT-706	PROGRAMMING WITH MATLAB	4	2	2 Practical	2	4	6	15(T)+15(P)	35(T)+35(P)	100	3 +3	
	Scheme B & C	B23-MAT-801	ABSTRACT ALGEBRA	4	3	1	3	1	4	30	70	100	3	
8	Scheme B & C	B23-MAT-802	TOPOLOGY	4	3	1	3	1	4	30	70	100	3	
	Scheme B & C	B23-MAT-803	MEASURE AND INTEGRATION	4	3	1	3	1	4	30	70	100	3	
	Scheme B & C	B23-MAT-804	FIELD THEORY	4	3	1	3	1	4	30	70	100	3	
		Or												
	Scheme B & C	B23-MAT-805	FLUID MECHANICS	4	3	1	3	1	4	30	70	100	3	
	Scheme B & C	B23-MAT-806	MATHEMATICAL SOFTWARES	4	0	4 Practical	0	8	8	30	70	100	3	

Research	Scheme B & C	B23-MAT-807	DISSERTATION	12					300	300		

Scheme of 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
3/4	VAC-3	Scheme A, B, C & D	B23-VAC-308	Mathematics in India: From Vedic Period to Modern Times	2	2	0	2	0	2	15	0	35		50	3	
4	VAC-4	Scheme A, B, C & D	B23-VAC-418	Mathematics in Everyday Life	2	2	0	2	0	2	15	0	35		50	3	
2	SEC-2	Scheme A, B, C & D	B23-SEC-203	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	B23-SEC-225	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	B23-SEC-303	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	B23-SEC-324	Learning MATLAB Skills	3	2	1	2	2	4	15	5	35	20	75	3	3
3	SEC-3	Scheme A, B, C & D	B23-SEC-326	Quantitative Aptitude	3	2	1	2	2	4	15	5	35	20	75	3	3
6	SEC-4	Scheme A, B, C & D	B23-SEC-406	Basic Mathematical Techniques	3	2	1	2	2	4	15	5	35	20	75	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: 2023-24	
Part A – Introduction	
Subject	Mathematics
Semester	I
Name of the Course	Calculus
Course Code	B23-MAT-101
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC
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:	End Term Examination:
➢ **Theory 20** • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➢ **Practicum 10** • Class Participation: • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam:	➢ **Theory 50** Written Examination ➢ **Practicum 20** Lab record, viva-voce, write up and execution of the program

Part C-Learning Resources

Recommended Books:

1. 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: 2023-24	
Part A – Introduction	
Subject	Mathematics
Semester	I
Name of the Course	Advanced Calculus
Course Code	B23-MAT-102
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	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

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	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.	30

	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. 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: 2023-24	
Part A - Introduction	
Subject	Mathematics
Semester	I
Name of the Course	Basic Calculus
Course Code	B23-MAT-103
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	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
Contact Hours	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	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	30

	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. **(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.	

Suggested Evaluation Methods	
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:	**End Term Examination:** ➢ **Theory 20** Written Examination ➢ **Practicum 15** 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.

MDC-1

Session: 2023-24	
Part A–Introduction	
Subject	Mathematics
Semester	I
Name of the Course	Introductory Mathematics
Course Code	B23-MAT-104
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	MDC
Level of the course	100-199
Pre-requisite for the course (if any)	NA
Course Learning Outcomes(CLOs):	**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

(29)

	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.

(30)

CC-2/MCC-3

Session: 2023-24	
Part A – Introduction	
Subject	Mathematics
Semester	II
Name of the Course	Algebra and Number Theory
Course Code	B23-MAT-201
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC
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

(31)

	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

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	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

(34)

	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: ➢ **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/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: 2023-24	
Part A – Introduction	
Subject	Mathematics
Semester	II
Name of the Course	PROGRAMMING IN C
Course Code	B23-MAT-202
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	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

(37)

CLO 5 is related to practical component of the course	for solving mathematical and realistic problems. 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.

	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	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	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

	Category of functions, Nesting of functions, Recursion, Functions with arrays, Scope of variables in functions, ANSI C functions.	
	Practical	
	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: 1. To find greatest and smallest of three numbers. 2. To find the roots of a quadratic equation. 3. To check whether a given year is leap year or not. 4. To prepare electricity bill. 5. To calculate the Letter grades and Grade points of a student according to marks obtained in 4 subjects on the basis of following table:	30

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

(48)

	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	

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 programs.

Part C-Learning Resources

Recommended Books:

1) E. Balagurusamy (2019). *Programming in ANSI C* (8th Edition). Tata McGraw-Hill Publishing Co. Ltd.

2) R. Threja (2016). *Computer Fundamentals and Programming in C* (2nd 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.

CC-M2

Session: 2023-24	
Part A – Introduction	
Subject	Mathematics
Semester	II
Name of the Course	Basic Algebra
Course Code	B23-MAT-203
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	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

	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 of finding inverse of a matrix using Cayley-Hamilton theorem. 4. Problems to find the minimal polynomial of a matrix. 5. 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:** 1. To find roots of algebraic equations using MAXIMA. 2. To find the value of determinant using MAXIMA. 3. To compute inverse of a square matrix using MAXIMA. 4. To find Eigen values and Eigen vectors of a square matrix using MAXIMA. 5. To solve system of linear equations using MAXIMA.	

Suggested Evaluation Methods

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:	**End Term Examination:** ➢ **Theory** **20** Written Examination ➢ **Practicum** **15** 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. (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. H.S. Hall and S.R. Knight (2023). *Higher Algebra* (7th edition). Arihant Publications. 5. Leonard Eugene Dickson (2009). *First Course in the Theory of Equations*. The Project Gutenberg EBook (http://www.gutenberg.org/ebooks/29785).

MDC-2

Session: 2023-24	
Part A – Introduction	
Subject	Mathematics
Semester	II
Name of the Course	Mathematics for Commerce and Social Sciences
Course Code	B23-MAT-204
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	MDC
Level of the course	100-199
Pre-requisite for the course (if any)	NA
Course Learning Outcomes(CLOs):	**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. 5. Attain the cognitive and technical skills required for accomplishing assigned tasks relating to the chosen
CLO 5 is related to practical	

components of the course.	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

50

	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.	

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. 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.

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.