25MA102: Mathematics-II

w. e. f. Academic Year:	**2025-26**
Semester:	**2**
Category of the Course:	**Basic Science**
Prerequisite:	▪ A foundational understanding of basic algebra, trigonometry, and coordinate geometry. ▪ Prior knowledge of differential and integral calculus (as covered in Engineering Mathematics-I). ▪ Basic exposure to vector operations and properties. ▪ Familiarity with fundamental matrix operations and system of linear equations. ▪ Logical reasoning and analytical thinking skills for interpreting mathematical relationships and problem-solving.
Rationale:	▪ Mathematics-II is designed to build upon the concepts introduced in Mathematics-I, expanding students' analytical capabilities and problem-solving techniques with a focus on advanced mathematical tools essential for engineering disciplines.

Course Outcomes:

After Completion of the Course, Students will be able to:

	Course Outcome (CO)	**RBT Level (Cognitive Domain)**
CO1	Understand and apply matrix operations including echelon forms, inverse, and rank for solving systems of linear equations.	Understand, Apply
CO2	Compute eigenvalues and eigenvectors; apply Cayley-Hamilton theorem and perform matrix diagonalization to analyze quadratic forms.	Apply, Analyze
CO3	Represent and manipulate complex numbers and complex functions and apply De Moivre's theorem in mathematical expressions.	Understand, Apply
CO4	Evaluate line, surface, and volume integrals using Green's, Stokes', and Gauss's theorems for physical and geometrical applications.	Apply, Analyze
CO5	Solve first-order ordinary differential equations using analytical methods like separation of variables, integrating factors, and exact methods.	Apply, Analyze
CO6	Solve first-order ordinary differential equations using numerical methods such as Euler and Runge-Kutta methods.	Apply, Analyze

Teaching and Evaluation Scheme:

Teaching Scheme					**Examination Scheme**				
L	**T**	**P**	**C**	**Hrs/Week**	**IE**	**Theory**	**CIA**	**Practical**	**Total Marks**
03	01	-	04	04	40	60	30	-	130

IE: Internal Evaluation Theory: Theory Exam (End Semester)

CIA: Continuous Internal Assessment Practical: Practical Exam (End Semester)

Detailed Syllabus:

Topic		Hrs.	% of Weightage
UNIT: 1	**Matrix Theory and Applications of Matrices:**	**10**	**22%**
Definition and Special Types of matrices, Determinant, Rank, Inverse, Row Echelon Form and Reduce Row Echelon Form, Homogeneous and non-homogeneous System of linear equation. **Applications:** Solution of System of linear equations			
UNIT: 2	**Eigenvalue and Eigenvector:**	**06**	**13%**
Definition, Properties, Algebraic Multiplicity, Geometric Multiplicity, Cayley-Hamilton theorem, Similarity of Matrices, Diagonalization, Applications: Quadratic form			
UNIT: 3	**Complex Numbers and Complex Functions**	**06**	**13%**
Basic Concepts of Complex Numbers and Elementary functions (Exponential, Trigonometric, Logarithmic function and Complex Exponent function, Hyperbolic functions), De Moivre's Theorem (without proof).			
UNIT: 4	**Vector Integral Calculus**	**08**	**20%**
Line Integral, Surface integral, Volume Integral, Green's Theorem (without proof), Stoke's Theorem (without proof) and Gauss's Divergence Theorem (without proof).			
UNIT: 5	**First Order Ordinary Differential Equations:**	**10**	**22%**
Basic concepts- formation and solution, Variable Separable, Homogeneous equation, Exact differential equations, Reduction of Non exact differential equation using Integrating factor, Linear differential equations, Bernoulli equations.			
UNIT: 6	**Numerical solutions of Differential Equations:**	**05**	**10%**
Euler Method, Modified Euler Method and Runge-Kutta Method of fourth order			
Total		**45**	**100**

Text/Reference Books:

1) Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, 2006.
2) W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edn., Wiley India, 2009.
3) D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
4) S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
5) E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
6) E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.
7) J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc-Graw Hill, 2004.
8) B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
9) Howard Anton, Irl Bivens, Stephens Davis, Calculus, 10e, Wiley, 2016.
10) AICTE's Prescribed Textbook: Mathematics-II (Calculus, Ordinary Differential Equations and Complex Variable), Khanna Book Publishing Co.

11) Shanti Narayan and P.K. Mittal, A textbook of matrices, S Chand publications, 2010.
12) Ruel V. Churchill, Complex variable and Applications, 9th edition, Mc Graw Hill education, 2013.
13) Daniel A. Murray, Introduction course in differential equations, Khosla publishing house, 2021.

List of Tutorials:

Sr. No.	Tutorial Content	Hours
1	Problem solving on "Matrix Theory and Applications of Matrices".	**3**
2	Problem solving on "Eigenvalue and Eigenvector".	**3**
3	Problem solving on "Complex Numbers and Functions"	**2**
4	Problem solving on "Vector Integral Calculus".	**3**
5	Problem solving on "First Order Ordinary Differential Equations"	**3**
6	Problem solving on "Numerical solutions of Differential Equations"	**1**
	Total	**15 Hrs.**

Course Outcomes Mapping:

CO	Course Outcome (CO)	POs/ PSOs Mapped	Cognitive Level (RBT)	Knowledge Category	Lecture Sessions	Tutorial Sessions
CO1	Understand and apply matrix operations including echelon forms, inverse, and rank for solving systems of linear equations.	PO1, PO2, PO4, PSO1, PSO2	Understand, Apply	Conceptual	10	3
CO2	Compute eigenvalues and eigenvectors; apply Cayley-Hamilton theorem and perform matrix diagonalization to analyze quadratic forms.	PO1, PO2, PO4, PSO1, PSO2	Apply, Analyze	Procedural	6	3
CO3	Represent and manipulate complex numbers and complex functions and apply De Moivre's theorem in mathematical expressions.	PO1, PO2, PSO1, PSO2	Understand, Apply	Conceptual	6	2
CO4	Evaluate line, surface, and volume integrals using Green's, Stokes', and Gauss's theorems for physical and geometrical applications.	PO1, PO2, PO3 PO4, PO12, PSO1	Apply, Analyze	Procedural	8	3

CO5	Solve first-order ordinary differential equations using analytical methods like separation of variables, integrating factors, and exact methods.	PO1, PO2, PO4, PO12, PSO1, PSO2	Apply, Analyze	Conceptual	10	3
CO6	Solve first-order ordinary differential equations using numerical methods such as Euler and Runge-Kutta methods.	PO1, PO2, PO3, PO12, PSO1, PSO2	Apply, Analyze	Procedural	5	1

Mapping of COs with POs & PSOs:

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	0	3	0	0	0	0	0	0	0	0	3	3
CO2	3	3	0	3	0	0	0	0	0	0	0	0	3	3
CO3	3	3	0	0	0	0	0	0	0	0	0	0	3	3
CO4	3	3	2	3	0	0	0	0	0	0	0	3	3	0
CO5	3	3	0	3	0	0	0	0	0	0	0	3	3	3
CO6	3	3	2	0	0	0	0	0	0	0	0	3	3	3

3: High, 2: Medium, 1: Low