Applied Mathematics – II
(Civil Engineering)

Contact Hours/ Week:	3+2	Credits:	4
Total Lecture Hours:	40 + 20	CIE Marks:	50
Course Code:	AMC2	SEE Marks:	50

Course objectives:
This course will enable students to:

1.	**Familiarize** the importance of Integral calculus and Vector calculus.
2.	**Analyze** the engineering problems applying Partial Differential Equations
3.	**Develop** the numerical schemes to solve algebraic, transcendental and differential Equations
4.	**Utilize** a modern tool MATLAB for computation and visualization.

Module I: Integral Calculus

Multiple Integrals: Evaluation of double and triple integrals, evaluation of double integrals by change of order of integration, changing into polar coordinates. Applications to find Area and Volume by double integral.
Beta and Gamma functions: Definitions, properties, relation between Beta and Gamma functions.

8 Hours Theory + 4 Hours Tutorial

Module II: Partial Differential Equations

Formation of PDEs by elimination of arbitrary constants and functions. Solution of non-homogeneous PDE by direct integration. Homogeneous PDEs involving derivatives with respect to one independent variable only. Method of Separation of variables. Application of PDE: Derivation of one-dimensional heat equation and wave equation.

8 Hours Theory + 4 Hours Tutorial

Module III: Vector Calculus

Scalar and vector fields. Gradient, directional derivative, divergence and curl - physical interpretation, Solenoidal vector fields, Irrotational vector fields and scalar potential.
Vector Integration: Line integrals, work done by a force and flux, Statements of Green's theorem and Stoke's theorem, problems without verification.

8 Hours Theory + 4 Hours Tutorial

Module IV: Numerical Methods - 1

Solution of algebraic and transcendental equations: Regula-Falsi and Newton-Raphson methods, problems.
Interpolation: Finite differences, Interpolation using Newton's forward and backward difference formulae, Newton's divided difference formula and Lagrange's interpolation formula.
Numerical integration: Trapezoidal, Simpson's $1/3^{rd}$ and $3/8^{th}$ rules.

8 Hours Theory + 4 Hours Tutorial

Module V: Numerical Methods – 2

Numerical solution of ordinary differential equations of first order and first degree: Taylor's series method, Modified Euler's method, Runge-Kutta method of fourth order, Milne's predictor-corrector method and Adams-Bashforth predictor-corrector method.

8 Hours Theory + 4 Hours Tutorial

TEXT BOOKS		
1	B.S. Grewal	Higher Engineering Mathematics, Khanna Publishers, 44th Ed., 2021.
2	E. Kreyszig	Advanced Engineering Mathematics, John Wiley & Sons, 10th Ed., 2018.
3	M.K. Jain, S.R.K. Iyengar and R.K. Jain	Numerical Methods for Scientific and Engineering Computation, New Age International Publishers, 8thEd., 2022.

REFERENCE BOOKS		
1	B. V. Ramana	Higher Engineering Mathematics, McGraw-Hill Education, 11th Ed., 2017.
2	Srimanta Pal & Subodh C. Bhunia,	Engineering Mathematics, Oxford University Press, 3rd Ed., 2016.
3	N. P. Bali and Manish Goyal	A Textbook of Engineering Mathematics, Laxmi Publications, 10th Ed., 2022.
4	H. K. Dass and Er. Rajnish Verma	Higher Engineering Mathematics, S. Chand Publication, 3rd Ed., 2014.
5	Steven V. Chapra and Raymond P. Canale	Applied Numerical Methods with Matlab for Engineers and Scientists, McGraw-Hill, 3rd Ed., 2011.
6	Richard L. Burden, Douglas J. Faires and A. M. Burden	Numerical Analysis, 10th Ed.,2010, Cengage Publishers.
7	S. S. Sastry	Introductory Methods of Numerical Analysis, PHI Learning Private Limited, 5th Ed., 2012.

Course Outcomes:
Upon completion of this course the student will be able to:

CO1	Apply the concepts of integral calculus to model and solve problems in civil engineering applications using MATLAB.
CO2	Apply the concept of partial differentiation to compute rate of change of multivariate functions and implementation using MATLAB.
CO3	Apply the concept of vector calculus to verify the vector as solenoidal or irrotational. Demonstrate the use of curvilinear coordinates. Implementation using MATLAB.
CO4	Apply numerical techniques to solve algebraic and transcendental equations and to perform interpolation and numerical integration. Implementation using MATLAB.
CO5	Apply appropriate numerical methods to find approximate solutions of ordinary differential equations and implementation using MATLAB.

Course Articulation Matrix

		POs											PSOs	
		1	2	3	4	5	6	7	8	9	10	11	1	2
COs	**CO1**	3	1			1								
	CO2	3	1			1								
	CO3	3	1			1								
	CO4	3	1			1								
	CO5	3	1			1								

Level 3 - Highly Mapped, Level 2 - Moderately Mapped, Level 1 - Low Mapped