18UMAC200	Engineering Mathematics-II	(3-2-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

The purpose of the course **is** to facilitate the students with concrete foundation of vector calculus, ordinary and partial differential equations, infinite series and numerical methods enabling them to acquire the knowledge of these mathematical tools.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1-12)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO 1	**Explain** various physical models through higher order differential equations and solve such linear ordinary differential equations.		1,2	
CO 2	**Solve** problems on partial differential equations by method of separation of variables.		1,2	
CO 3	**Describe** the applications of infinite series and obtain series solution of ordinary differential equations.			1
CO 4	**Apply** the knowledge of numerical methods to fit an interpolating curve to the experimental data and obtain solution of transcendental equation and use numerical methods for engineering application.		1,2	
CO 5	**Compute** Gradient, Divergence, Curl vector valued functions and illustrate the Engineering applications through vector calculus.			1,2

POs	1	2	3	4	5	6	7	8	9	10	11	12
Mapping Level	1.6	1.4	-	-	-	-	-	-		-	-	-

Pre-requisites: A basic course on: 1.Differentiation of functions.
2. Integration of functions.

Contents:

Unit-I

Differential Equations of Higher Order:

Second order linear ODE's with constant coefficients-Inverse differential operators, Method of Variation of Parameters; Legendre's homogeneous equations. Applications to oscillations of a spring and L-C-R circuits.

Self Study: Cauchy's homogeneous equations. **8L+ 2T**

Unit-II

Partial Differential Equations (PDE's):

Formation of PDE's by elimination of arbitrary constants /functions. Solution of PDE by variable separable method. Derivation of one dimensional heat and wave equations and solution of wave equation by the method of separation of variables. Numerical solution of Laplace equation by Five-point formula and Diagonal formula.

Self Study: Solution of heat equation by the method of separation of variables. **10L+ 2T**

Unit-III

Infinite Series: Convergence and divergence of infinite series- Comparison test, D'Alembert's ratio test (without proof)-Cauchy's root test (without proof)- and Illustrative examples.

Special functions. Series solution of Bessel's differential equation leading to $J_n(x)$-Bessel's function of first kind, Recurrence relations, orthogonality of Bessel's function

Self Study: Generating function of Bessel's functions. **8L+ 2T**

Unit-IV

Elementary Numerical Methods:

Solution of polynomial and transcendental equations– Newton-Raphson's and Regular-Falsi methods (only formulae) -Illustrative examples.

Finite differences. Interpolation using Newton's forward and backward difference formulae, Newton's divided difference and Lagrange's formulae (All formulae without proof).

Numerical integration: Simpson's $(1/3)^{rd}$rule, Weddle's rule (without proof).Problems.

Self Study: Numerical integration by Simpson's $(3/8)^{th}$rule. **8L+ 2T**

Unit-V

Vector Calculus:

Vector Differentiation: Scalar point function and vector point functions. Gradient, Directional Derivative; Curl and Divergence-physical interpretation. Solenoidal and irrotational vectors. Illustrative problems.

Vector Integration: Line integrals, Surface integrals and volume integrals. Green's theorem, Gauss divergence theorem and Stoke's theorem(only statements). Illustrative examples.

Self Study: Applications to work done by a force. **8L+ 2T**

Reference Books:

1. **B.S. Grewal**: Higher Engineering Mathematics, Khanna Publishers, 44^{th} edition, 2017.
2. **E. Kreyszig**: Advanced Engineering Mathematics, John Wiley &Sons, 10^{th} edition, (Reprint), 2016.
3. **Srimanta Pal and Subodh Chandra Bhunia:** Engineering Mathematics, Oxford University Press, 2015.
4. **B.V. Ramana** : Higher Engineering Mathematics, 11^{th} edition, Tata McGraw- Hill, 2010.