

Advanced Calculus and Numerical Methods (18MAT21)

BLOW UP SYLLABUS

Topics	Topics To be Covered	Hours
MODULE - I		
VECTOR CALCULUS		
1. Vector Differentiation: Scalar and vector fields. Gradient, directional derivative; curl and divergence	Discussion restricted to problems (Article No.8.4, Article No.8.5, Article No.8.6, of Text book 1)	2L
2. Solenoidal and irrotational vector fields	Discussion of problems (Article.No.8.7 of Text book 1)	2L
3.Vector Integration: Line integrals, Theorems of Green, Gauss and Stokes, Applications to work done by a force and flux. (RBT Levels: L1 & L2)	Discussion of Problems (Article No.8.11, 8.13, 8.14 and 8.16 of Text book 1) <i>(Problems related to the evaluation of integrals using the three theorems. No problems on verification of theorems).</i>	4L
Tutorials	Involvement of faculty and students in identifying the solutions to the problems; PPT presentations of Engg. Applications by the faculty, about the module.	2T
Total		10
MODULE - II		
DIFFERENTIAL EQUATIONS OF HIGHER ORDER		
1. Second and higher order linear ODE's with constant coefficients-Inverse differential operator	Discussion of problems(Article No.13.4 and 13.5 (Cases I,II,III only) of Text book 1) (<i>P.I. Restricted to $R(x) = e^{ax}, \sin ax / \cos ax, x^n$ for $f(D)y = R(x)$</i>)	3L
2. Method of variation of parameters; Cauchy's and Legendre's differential equations.	(i) Discussion of problems(Article No.13.8 (1) of Text book 1)) (ii) Discussion of problems (Article No.13.9 of Text book 1)(<i>P.I. Restricted to $R(x) = e^{ax}, \sin ax / \cos ax, x^n$ & $\log x$ for $f(D)y = R(x)$ for Cauchy's and Legendre's equations</i>)	3L
3. Applications to oscillations of a spring and L-C-R circuits (RBT Levels:L1,L2 and L3)	Discussion of problems (Article No.14.4 and 14.5 of Text book 1)	2L

Tutorials	Involvement of faculty and students in identifying the solutions to the problems; PPT presentations of Engg. Applications by the faculty, about the module.	2T
Total		10
MODULE – III		
PARTIAL DIFFERENTIAL EQUATIONS		
1. Formation of PDEs by elimination of arbitrary constants / functions. Solution of non-homogeneous PDE by direct integration	(i) Discussion of problems (Article No.17.2 of Text book 1). (ii) Discussion of problems (Article No.17.4 of Text book 1).	3L
2. Homogeneous PDEs involving derivative with respect to one independent variable only. Solution of Lagrange's linear PDE	(i) Discussion of problems (Article No. 17.4 of Text book 1). (ii) Discussion of problems (Article No.17.5 of Text book 1).	2L
3. Derivation of one dimensional heat and wave equations and solutions by the method of separation of variables functions. (RBT Levels: L1, L2 and L3)	Derivation and solutions [Article No.18.4 (1 & 2), Article No.18.5 (1 & 2) of Text book 1].	3L
Tutorials	Involvement of faculty and students in identifying the solutions to the problems; PPT presentations of Engg. Applications by the faculty, about the module.	2T
Total		10
MODULE - IV		
INFINITE SERIES and POWER SERIES SOLUTIONS		
1. Series of positive terms- convergence and divergence. Cauchy's root test and D'Alembert's ratio test (without proof)- Illustrative examples.	Discussion of problems (Article No. 9.3 (1 & 2), 9.9, 9.11 of Text book 1).	2L
2. Solutions-Series solution of Bessel's differential equation leading to $J_n(x)$ - Bessel's function of first kind- orthogonality.	Series solution of Bessel's differential equation (Article No.16.5 (Case I), 16.11(1) of Text book 1).	3L
3. Series solution of Legendre's differential equation leading to $P_n(x)$ - Legendre polynomials. Rodrigue's formula (without proof), problems (RBT Levels: L1 and L2)	Series solution of Legendre's differential equation (Article No.16.13 and 16.14 (1,2) of Text book 1)	3L
Tutorials	Involvement of faculty and students in identifying the solutions to the problems; PPT presentations of Engg. Applications by the faculty, about the module.	2T
Total		10

MODULE - V		
NUMERICAL METHODS		
1. Finite differences - Interpolation/extrapolation using Newton's forward and backward difference formulae, Newton's divided difference and Lagrange's formulae.	(i)Discussion of problems (Article No.29.6, Article.No.29.10 and Article No. 29.12 of Text book 1).	4L
2. Solution of polynomial and transcendental equations – Newton-Raphson and Regula-Falsi methods	(ii)Discussion of problems (Article No.28.2 (2 & 3) of Text book 1)	2L
3. Numerical integration: Simpson's (1/3)rd and (3/8)th rules, Weddle's rule (without proof) –Problems. (RBT Levels:L1,L2 and L3)	(iii)Discussion of problems (Article 30.7,30.8,30.10 of Text book 1)	2L
Tutorials	Involvement of faculty and students in identifying the solutions to the problems; PPT presentations of Engg. Applications by the faculty, about the module.	2T
Total		10

Text Books:

- 1. B.S. Grewal:** Higher Engineering Mathematics, Khanna Publishers, 43rd Ed., 2015.
- 2. E. Kreyszig:** Advanced Engineering Mathematics, John Wiley & Sons, 10th Ed.(Reprint), 2016.