20PMEAC100 Computational Methods in Engineering (4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs): The objective of this course is to make the student aware of, Formulation of mathematical models to simple physical systems, establishing numerical solutions based on extensive computational mathematics for the mathematical models developed and forming the basic algorithms for framing the basis for computer based solutions in modern systems.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1 to 4)** Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Formulate mathematical models for the simple physical systems and evaluate the errors due to approximations.	3	--	1
CO-2	Determine the roots of nonlinear equations and polynomials in Science and Engineering problems.	3	2	--
CO-3	Establish numerical solutions for differentials and integrals functions.	3,4	2	--
CO-4	Establish the numerical solutions for ordinary differential equations.	3,4	2	--
CO-5	Apply the concepts of optimization for constrained and un-constrained engineering problems.	3	2	--

POs	PO1	PO2	PO3	PO4
Mapping Level	1	2	3	3

Prerequisites:
Basics of 1. Differentiation and Integration 2. Linear Algebra.
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Course content:

1. **Mathematical modelling & Error analysis:** Mathematical modelling in engineering problem solving, approximations & round-off errors – error definition, accuracy, precision, round-off errors, truncation errors. Use of programing skills and software for engineering computations. **10Hrs**

2. **Roots of equations:** Mathematical background, Solution of non-linear algebraic equations- Bracketing method, graphical method, bisection method, Newton's Rapson method, Secant method. Use of programming skills and software for establishing the numerical solutions for simple problems. **10Hrs**

3. **Numerical Differentiation & Integration:** Mathematical background, Numerical Differentiation and Numerical Integration: Newton's forward and back ward difference formula. Newton –Cotes and Gauss Quadrature Integration formulae, Integration of Equations, Romberg integration.

   Numerical solutions for differential equations: Mathematical basis, need for numerical solutions, Numerical solution of differential equations Ordinary Differential Equations – Euler, second order, third and fourth order Runge-Kutta methods, **12 Hrs**

4. **Numerical Methods in Linear Algebra:** Direct and iterative solution techniques for simultaneous linear algebraic equations – Gauss elimination, Gauss-Jordon, LU Decomposition, QR Method, Jacobi and Gauss-Seidel Method, Eigenvalues and Eigenvectors – Power method, householder transformation, physical interpretation of eigenvalues and eigenvectors. **12 Hrs**

5. **Optimization:** One dimensional unconstrained optimization –, Constrained optimization-Linear programming, and non-linear constrained optimization. **8 Hrs**

Reference Books:

1. S. S. Sastry, Introductory Methods of Numerical Analysis, PHI, 2005.
2. Steven C. Chapra, Raymond P.Canale, Numerical Methods for Engineers, Tata McGraw Hill, 4th Ed, 2002.
3. M K Jain, S.R.K Iyengar, R K. Jain, Numerical methods for Scientific and engineering Computation, New Age International, 2003.
4. David C. Lay, Linear Algebra and its applications, 3rd edition, Pearson Education, 2002.
5. Taha H A, "Operations research- An Introduction", Mc Milan Publishing Co,1982.