Detailed Syllabus

I Semester

18PEADC100	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:

1. Formulation of mathematical models to simple physical systems.
2. Establishing numerical solutions based on extensive computational mathematics for the mathematical models developed.
3. Forming the basic algorithms for framing the basis for computer based solutions in modern systems science.

Course Outcomes (COs):

Description of the course outcome: At the end of the course the student will be able to:		Mapping to POs(1-4)		
		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	Apply the fundamentals of linear algebra for engineering problems.	3	2	--
CO 5	Establish the numerical solutions for ordinary differential equations and partial differential equations.	3,4	2	--
CO 6	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

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 **8 Hrs**

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. **10 Hrs**

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. **9 Hrs**

4. Linear algebra 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 and inverse power method, householder transformation, physical interpretation of eigenvalues and eigenvectors. **10 Hrs**

5. Numerical solutions for differential equations: Mathematical basis, need for numerical solutions, Numerical solution of differential equations Ordinary Differential Equations – Euler, Heun's method and Stability criterion, second order, third and fourth order Runge-Kutta methods, Partial Differential Equations – Classification of PDEs, Elliptic equations, Parabolic equations (Transient diffusion equation). **8 Hrs**

6. Optimization – One dimensional unconstrained optimization – Golden section search Newton's method, Constrained optimization- Linear programming, and non-linear constrained optimization. **7 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. Pervez Moin, Fundamentals of Engineering Numerical Analysis, Cambridge, 2010.
5. David C. Lay, Linear Algebra and its applications, 3rd edition, Pearson Education, 2002.
6. Joe D Hoffman, Numerical Methods for Engineers and Scientists, Second Edition, Marcel Dekker (2001)
7. Gilbert Strang, Computational Science and Engineering, Wellesley-Cambridge Press-2007.