Course code	Course Name	L-T-P-Credits	Year of Introduction
CH367	**NUMERICAL METHODS FOR PROCESS ENGINEERS**	**3-0-0-3**	**2016**

Prerequisite : Nil

Course Objectives

- To impart the basic concepts of numerical analysis
- To develop understanding about numerical techniques for solution of engineering problems

Syllabus

Errors in numerical calculations. Numerical solution of polynomial and transcendental equations - iteration based on second degree equation-Solution of system of linear algebraic equations. Direct methods, Solution of system of nonlinear equations by Newton-Raphson method, Power method for the determination of Eigen values-Polynomial interpolation- Numerical differentiation, Numerical integration. Numerical solution of ordinary differential equations (IVP problems for ODE). Solution of boundary value problems in ordinary differential equations. Solution to PDE's

Expected Outcome

After successful completion of the course the students will be able to

i. Understand basic concepts of error, convergence etc.in numerical methods
ii. Choose and apply appropriate numerical schemes to solve various chemical engineering problems.
iii. Solve system of equations using different numerical methods
iv. Use suitable interpolation methods to deal with the data in hand.
v. Understand and use various numerical schemes used for solving ODE (IVP& BVP) and PDE.

References:

1. Ajay K. Ray, Mathematical Methods in Chemical & Environmental Engineering, Thomson-Learning
2. Froberg C.E., Introduction to Numerical Analysis, Addison Wesley
3. Gerald C.F., Applied Numerical Analysis, Addison Wesley
4. Hildebrand F.B., Introduction to Numerical Analysis, T.M.H.
5. James M.L., Smith C.M. & Wolford J.C., Applied Numerical Methods for Digital Computation, Harper & Row
6. Mathew J.H., Numerical Methods for Mathematics, Science and Engineering, P.H.I

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Errors in numerical calculations,Sources of errors, significant digits and numerical instability - numerical solution of polynomial and transcendental equations - bisection method - method of false position - Newton-Raphson method - fixed-point iteration - rate of convergence of these methods - iteration based on second degree equation - the Muller's method - Chebyshev method - Graeffe's root squaring method for polynomial equations - Bairstow's method for quadratic factors in the case of polynomial equations	7	15%

II	Solutions of system of linear algebraic equations. Direct methods - gauss and gauss - Jordan methods - Crout's reduction method - error analysis - iterative methods - Jacobi's iteration - Gauss-seidel iteration - the relaxation method - convergence analysis - solution of system of nonlinear equations by Newton-Raphson method - power method for the determination of Eigen values - convergence of power method	7	15%
FIRST INTERNAL EXAMINATION			
III	Polynomial interpolation. Lagrange's interpolation polynomial - divided differences Newton's divided difference interpolation polynomial - error of interpolation - finite difference operators - Gregory – Newton forward and backward interpolations - Stirling's interpolation formula -	7	15%
IV	Numerical differentiation - differential formulas in the case of equally spaced points - numerical integration - trapezoidal and Simpson's rules - Gaussian integration - errors of integration formulas	7	15%
SECOND INTERNAL EXAMINATION			
V	Numerical solution of ordinary differential equations. The Taylor series method - Euler and modified Euler methods - Runge–Kutta methods (2nd order and 4th order only) - multistep methods - Milne's predictor - corrector formulas - Adam-Bashforth & Adam-Moulton formulas	7	20%
VI	Solution of boundary value problems in ordinary differential equations - finite difference methods for solving two dimensional Laplace's equation for a rectangular region - finite difference method of solving heat equation and wave equation with given initial and boundary conditions	7	20%
END SEMESTEREXAMINATION			

Question Paper Pattern:

Maximum Marks: 100 Exam Duration: 3 Hours

Part A: There shall be **Three questions** uniformly covering Modules 1 and 2, each carrying 15 marks, of which the student has to answer any **Two questions**. At the most 4 subdivisions can be there in each main question with a total of 15 marks for all the subdivisions put together. (2 x15= 30 Marks)

Part B: There shall be **Three questions** uniformly covering Modules 3 and 4, each carrying 15 marks, of which the student has to answer any **Two questions**. At the most 4 subdivisions can be there in each main question with a total of 15 marks for all the subdivisions put together. (2 x15= 30 Marks)

Part C: There shall be **Three questions** uniformly covering Modules 5 and 6, each carrying 20 marks, of which the student has to answer any **Two questions**. At the most 4 subdivisions can be there in each main question with a total of 20 marks for all the subdivisions put together. (2 x20= 40 Marks)