Course code	Course Name	L-T-P-Credits	Year of Introduction
IC361	NUMERICAL METHODS	3-0-0-3	2016

Prerequisite : Nil

Course Objectives

- To introduce numerical techniques used for the solution of linear systems.
- To know the numerical interpolation methods.
- To understand the numerical techniques used for the solution of ordinary differential equations.

Syllabus

Methods to solve nonlinear equations, methods to solve linear systems, determination of Eigen values, interpolation, numerical integration and differentiation, and solution of ordinary differential equations.

Expected Outcome

Students will be able to

i. apply numerical techniques for the solution of linear and non-linear systems, ordinary differential equations, and for interpolations.
ii. apply the numerical techniques for the solution of linear and nonlinear control systems,
iii. find the best curve fit for different characteristics.

Text Books:

1. Gerald.C.F, Introduction to Numerical Analysis, Addison Wesley.
2. S.S.Sastry, Introductory Methods of Numerical Analysis, PHI.

References:

1. Bikas Chandra Bhui & Dipak Chatterjee, Numerical Methods and Programming, Vikas Publishing House
2. Froberg.C.V, Introduction to Numerical Analysis, Addison Wesley.
3. Hildebrand.F.B, Introduction to Numerical Analysis, TMH.
4. James.M.L, Smith.C.M & Wolford.J.C, Applied Numerical Methods for Digital Computation, Harper and Row Publications.
5. Mathew.J.H, Numerical Methods for Mathematics, Science and Engineering, PHI.

Note on internal evaluation:

Assignments may be given to solve problems in numerical analysis using open source software for a maximum of 10 marks.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction to Numerical analysis, distinction between analytical solution, steps to be followed for NA, interval halving or bisection method.	1	15%
	Solution of nonlinear equations: Linear interpolation methods	2	

	(secant method and false position method), newton's method, relation between Newton's methods with interpolation method.		
	Fixed point iteration, Muller's method	2	
	Programming.	2	
II	Solution of linear systems: Direct method, Gaussian elimination method, Gaussian Jordan method, LU method.	3	**15%**
	Iterative method: Jacobi iteration, Gauss Seidel iteration.	1	
	Relaxation method	1	
	Programming.	2	
FIRST INTERNAL EXAM			
III	Finite difference interpolation: finite differences, forward differences, backward differences, central differences.	1	**15%**
	Newton's forward difference interpolation formula, Newton's backward difference interpolation formula.	2	
	Gauss forward central difference formula, Gauss backward central difference formula, Stirling's formula.	2	
	Programming.	2	
IV	Lagrangian polynomial	1	**15%**
	Divided differences and their properties, Newton's general interpolation formula	3	
	Interpolation with a cubic spline (case study)	1	
	Programming.	2	
SECOND INTERNAL EXAM			
V	Numerical differentiation: differential formula in the case of equally spaced points.	1	**20%**
	Numerical integration: trapezoidal and Simpson's rules.	2	
	Numerical solution of ordinary differential equations: the Taylor series method, Euler and modified Euler method, Runge Kutta Methods (2^{nd} and 4^{th} order only)	2	
	Programming.	2	
VI	Numerical solution of ordinary differential equations: multi step methods, Milne's predictor corrector formula, Adam-Bash forth and Adam -Moulton formula	2	**20%**
	Solution of boundary value problems in ordinary differential equations.	1	
	Finite difference methods for solving two dimensional Laplace's equation for a rectangular region.	2	
	Programming.	2	
END SEMESTER EXAM			

QUESTION PAPER PATTERN:

Maximum Marks: 100 Exam Duration: 3 Hours

Part A

Answer any two out of three questions uniformly covering Modules 1 and 2. Each question carries 15 marks and can have not more than four sub divisions. (15 x 2 = 30 marks)

Part B

Answer any two out of three questions uniformly covering Modules 3 and 4. Each question carries 15 marks and can have not more than four sub divisions. (15 x 2 = 30 marks)

Part C

Answer any two out of three questions uniformly covering Modules 5 and 6. Each question carries 20 marks and can have not more than four sub divisions. (20 x 2 = 40 marks)