Numerical Methods And Applications
(Effective from the Academic Year 2024 - 2025)
VII SEMESTER

Course Code	**21MA741**	CIA Marks	50
Number of Contact Hours/Week (L: T: P: S)	4:0:0:0	SEE Marks	50
Total Hours of Pedagogy	**40L**	Exam Hours	03

CREDITS – 3

COURSE PREREQUISITES:

- Basic understanding of Mathematics Concepts

COURSE OBJECTIVES:

- To learn various numerical techniques.
- To solve Numerical differentiation and integration Engineering problems.
- Apply numerical techniques to solve Engineering problems.

TEACHING - LEARNING STRATEGY:

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Case Studies

COURSE CONTENTS

MODULE - I

Solution of Equations and Eigen value Problems: Historical development of Numerical techniques, role in investigations, research and design in the field of Engineering Development of algorithm/ flow charts for following methods for the solution of linear simultaneous equation Solution of algebraic and transcendental equations 1. Fixed point iteration method, 2. Newton Raphson method. Solution of linear system of equations 1. Gauss elimination method, 2. Gauss Jordan method 2. Iterative methods of Gauss Jacobi and Gauss Seidel 3. Matrix Inversion by Gauss Jordan method.	**8 Hours**

MODULE - II

Interpolation and Approximation: Development of algorithm and application of solution for Interpolation with unequal intervals - Lagrange's interpolation – Newton's divided difference interpolation – Cubic Splines - Interpolation with equal intervals - Newton's forward and backward difference formulae.	**8 Hours**

MODULE - III

Numerical differentiation and integration: Approximation of derivatives using interpolation polynomials – Numerical integration using Trapezoidal, Simpson's 1/3 rule – Romberg's Method – Two-point and three-point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules. Trapezoidal rule, Simpson's one third and their applications	**8 Hours**

MODULE - IV

Initial Value Problems for Ordinary Differential Equations: Development of algorithm and application of solution of ordinary differential equation to engineering problems by Single Step methods - Taylor's series method - Euler's method - Modified Euler's method – Fourth order Runge-Kutta method for solving first order equations.	**8 Hours**

MODULE - V

Boundary Value Problems in Ordinary and Partial Differential Equations: Finite difference methods for solving two-point linear boundary value problems - Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain. One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods.	**8 Hours**

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

CO No.	Course Outcome Description	Bloom's Taxonomy Level
CO1	Develop and apply numerical techniques, including iterative and direct methods, for solving algebraic, transcendental, and linear simultaneous equations, with an understanding of their historical development and role in engineering research and design	CL6
CO2	Develop and apply algorithms for solving interpolation and approximation problems in both equal and unequal intervals to address various engineering challenges.	CL6
CO3	Develop and apply algorithms for numerical differentiation and integration to solve single and double integral problems in engineering.	CL6
CO4	Develop and apply algorithms for solving initial value problems of ordinary differential equations to address engineering problems.	CL6
CO5	Develop and apply finite difference methods to solve boundary value problems in ordinary and partial differential equations	CL6

CO-PO-PSO MAPPING

CO No.	Programme Outcomes (PO)												Programme Specific Outcome (PSO)	
	1	2	3	4	5	6	7	8	9	10	11	12		
CO1														
CO2														
CO3														
CO4														

3: Substantial (High)	2: Moderate (Medium)	1: Poor (Low)

ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

Sl. No.	Assessment Description	Weightage (%)	Max. Marks
1	**Continuous Internal Assessment (CIA)**	**100 %**	**50**
	Continuous Internal Evaluation (CIE)	60 %	30
	Assignments	40 %	20
2	**Semester End Examination (SEE)**	**100 %**	**50**

ASSESSMENT DETAILS

Continuous Internal Assessment (CIA) (50%)				Semester End Exam (SEE) (50%)
Continuous Internal Evaluation (CIE) (60%)			Assignment/ Activities (40%)	
I	II	III		
Syllabus Coverage			Syllabus Coverage	Syllabus Coverage

20%	40%	40%	100%	100%
MI			MI	MI
	MII		MII	MII
	MIII		MIII	MIII
		MIV	MIV	MIV
		MV	MV	MV

ASSIGNMENT TYPES WITH WEIGHTAGES

Sl. No.	Assignment Description	Max. Weightage (%)	Max. Marks
1	Written Assignments	25 %	05
2	Quiz	10 %	02
3	Case Studies	25 %	05
4	Seminar/Presentation	15 %	03
5	Peer - to - Peer Learning	10 %	02
6	Activity Based Learning	50 %	10
7	Project Based Learning	50 %	10
8	Field Work + Report	50 %	10
9	Industry Visit + Report	50 %	10
10	NPTEL/MOOC Courses – Registration and Assignment Submissions	50 %	10
	NPTEL Certification	75 %	15
11	Any other Innovative Assignments (CL4 and above)	50 %	10

Note: The assignments mentioned above may be provided appropriately to the students belonging to different bands

SEE QUESTION PAPER PATTERN:

- The question paper will have TEN full questions from FIVE Modules.
- There will be 2 full questions from each module. Every question will carry a maximum of 20 marks.
- Each full question may have a maximum of four sub-questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

TEXT BOOKS:

1. Grewal. B.S. and Grewal. J.S., “Numerical methods in Engineering and Science”, Khanna Publishers, 9th Edition, New Delhi
2. Gerald. C. F., and Wheatley. P. O., “Applied Numerical Analysis”, Pearson Education, Asia, 6th Edition, New Delhi

REFERENCE BOOKS:

1. Chapra. S.C. and Canale. R. P., "Numerical Methods for Engineers, Tata McGraw Hill, New Delhi.
2. Brian Bradie. "A friendly introduction to Numerical analysis", Pearson Education, Asia, New Delhi.
3. Sankara Rao. K., "Numerical methods for Scientists and Engineers", Prentice Hall of India Private, New Delhi.

REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES):

1. https://nptel.ac.in/courses/111107105
2. https://www.coursera.org/learn/numerical-methods-engineers
3. https://cosmolearning.org/courses/numerical-methods-and-programing/video-lectures/.