Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23MAL4MA	**Advanced Numerical Computations**	**Minor**	**3**	**0**	**0**	**0**	**3**	**2023**

(i)COURSE OVERVIEW

The objective of the course is to equip the students and enable them to understand the role of approximation theory in engineering problems. Also to familiarize various numerical methods for computation and to make them understand the role of optimization in problem solving.

(ii)COURSE OUTCOMES

After the completion of the course, the student will be able to:

Course Outcomes	Description	Level
CO 1	Apply interpolation techniques and approximation methods	Apply
CO 2	Apply numerical methods to obtain solutions of ordinary differential equations	Apply
CO 3	Apply numerical methods to obtain solutions of partial differential equations	Apply
CO 4	Apply fundamental optimization techniques in non-linear programming problems	Apply
CO 5	Apply search-based methods to solve non-linear optimization problems	Apply

(iii)SYLLABUS

Interpolation and approximation, Numerical solution of Ordinary differential equations and Partial differential equations, Nonlinear programming,

(iv)a) TEXT BOOKS

1. Kendall E Atkinson, An Introduction to Numerical Analysis, Wiley Publications.
2. KW Morton and David Mayers, Numerical Solution of Partial Differential Equations, Cambridge Unvty PRESS .
3. B S Grewal, Numerical methods in Engineering and Science, Khanna Publishers

4. Sastry S.S., Introductory Methods of Numerical Analysis ,Fifth Edition, PHI, 2012
5. Singiresu .S. Rao, Engineering Optimization: Theory and Practice, 3rd edition,New age international publishers.

b) REFERENCES

1. Numerical Methods for Ordinary Differential Equations" – Vuik et al. (Open Text, 2023)

2. Numerical Methods and Optimization: Theory and Practice for Engineers" – Jean-Pierre Corriou (2022/23)

3. P. Kandasamy and K Thilagavathi: Numerical methods: S CHAND Publishers.

4. Stevwn C. Chapra and Raymond R. Canale, Numerical methods for engineer, Seventh Edition, McGraw-Hill, 2015.

(v)COURSE PLAN

Module	Contents	No. of hours
I	Interpolation: Finite difference operators, interpolation using divided difference. Numerical differentiation: derivatives from difference table (finite difference and divided difference). Evaluation of double integrals Trapezoidal and Simpsons rule.	**9**
II	Numerical Solution of Ordinary Differential Equations: Picard's method, Taylor's series method, Euler's method, Modified Euler's method, Runge-Kutta method, Predictor-corrector methods. Simultaneous first order differential equations, Second order differential equations. Boundary-value problems, Finite-difference method, Shooting method	**9**
III	Numerical Solution of Partial Differential Equations: Classification of second order equations, Finite-difference approximations, Elliptic equations to partial derivatives, Solution of Laplace equation, Solution of Poisson's equation, Solution of elliptic equations by relaxation, Parabolic equations method. One dimensional heat equation (Crank Nicholson scheme). Solution of Hyperbolic equation-wave equation.(Method of finite differences)	**9**
IV	Nonlinear programming: One dimensional minimization methods. Unimodal functions. Elimination methods: Unrestricted search method, Fibonacci method, Golden section methods. Interpolation methods: Quadratic interpolation method. Direct root method: Newton method.	**9**
V	Nonlinear programming (Contd.): Unconstrained optimization techniques: Direct search method: Grid search method, Univariate method. Indirect search methods: Conjugate gradient method(Fletcher –Reeves method), Newton's method, Marquardt method	**9**
	Total hours	**45**

(vi) ASSESSMENT PATTERN

Continuous Assessment : End Semester Examination – 40 : 60

Continuous Assessment		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
Total Continuous Assessment	:	**40 marks**
End Semester Examination	:	**60 marks**
TOTAL	:	**100 marks**

(vii)CONTINUOUS ASSESSMENT TEST

- No. of tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

(viii)END SEMESTER EXAMINATION

- Maximum Marks: 60
- Exam Duration: 3 hours