M.Sc. Course					Numerical Methods and Computer Programming					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	0	0	2	2	25	50	25	--	--	100

COURSE OBJECTIVES

- To provide a basic understanding of numerical methods to solve roots of equations and linear algebraic equations.
- To introduce the basics of numerical interpolation and curve fitting.
- To provide the knowledge about to obtain solutions of mathematical operations like differentiation and integration.
- To introduce the methods to solve ordinary differential equations, boundary value problems and also providing the knowledge about Monte Carlo technique

7 Hrs.

UNIT 1: ROOTS OF EQUATIONS AND SYSTEMS OF EQUATIONS

Root Finding: Bisection method, Newton-Raphson method, Secant method, Fixed-point iteration, False position method; Linear equations: Gauss-elimination method, Gauss-Jordan method, LU decomposition, Matrix inversion by Gauss-Jordan method, Iterative methods: Gauss-Jacobin method and Gauss-Seidel method, Methods for solution of Eigen value problems.

UNIT 2: INTERPOLATION AND LEAST SQUARES **6 Hrs.**

Interpolation: Newton's forward and backward interpolation formulae, Lagrange's interpolation formula, Newton's divided difference formula, Inverse interpolation, Spline interpolation, Chebyshev Interpolation; Least Squares Approximation: Linear regression, Polynomial regression, Multiple linear regression, Exponential regression.

UNIT 3: NUMERICAL DIFFERENTIATION AND INTEGRATION **7 Hrs.**

Numerical differentiation: Forward, backward and centred difference formulae, Richardson extrapolation; Numerical integration: Midpoint rule, Trapezoidal rule, Simpson's rule, Romberg formula, Gauss-Legendre integration, Gaussian quadrature formulae (2-point, 3-point and 4-point).

UNIT 4: ORDINARY DIFFERENTIAL EQUATIONS, BOUNDARY VALUE AND RANDOM NUMBERS **8 Hrs.**

Numerical solution of ordinary differential equation: Initial value problems, Euler's method, Modification of Euler's method, Picard's method, Taylor Series method, Second and fourth order Runge-Kutta methods; Boundary value problems: finite difference method, Shooting Method; Stochastic methods: Random Numbers and Generators, Monte Carlo technique of numerical integration.

Max. <28> Hrs.

COURSE OUTCOMES

After completion of this course students will be able to;

CO1: Derive the solution of roots of polynomial equations and linear algebraic equations by using numerical methods.
CO2: Demonstrate the understanding of numerical interpolation and least squares approximations.
CO3: Understand and perform numerical integration and differentiation.
CO4: Develop and implement stable numerical methods to solve ordinary differential equations
CO5: Identify and apply the appropriate numerical techniques for solving boundary value problems.
CO6: Acquire the knowledge about the random numbers generators and Monte Carlo technique.

TEXT/REFERENCE BOOK

1. Numerical Methods in Engineering with Python, Jaan Kiusalaas, Cambridge University Press, 2010 (Second Edition).
2. Numerical Analysis, Timothy Sauer, Pearson, 2018 (Third Edition).
3. Numerical Methods for Engineers, Steven C. Chapra and Raymond P. Canale, McGraw-Hill Edution, 2015 (Seventh Edition).
4. Numerical Methods in Engineering & Science, B. S. Grewal, Khanna Publishers, 2013 (Eleventh Edition)
5. Numerical Methods: Fundamentals and Applications, Rajesh Kumar Gupta, Cambridge University Press, 2019.

Course Delivery Methods	
Lecture by use of boards/LCD projectors/OHP projectors	Yes
Tutorials/Assignments	Yes
Seminars	Yes
Mini projects/Projects	No
Laboratory experiments/teaching aids	No
Industrial/guest lectures	Yes
Industrial visits/in-plant training	No
Self- learning such as use of NPTEL materials and internets	Yes
Simulation	No

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment:

Assessment Tool		**% Contribution during CO Assessment**	**Maximum Marks**	**Exam Duration**
Internal Assessment	Assignment	10 %	-	-
	Quiz	15%	-	-
Examiantion	Mid Semester Examination	25%	50	2 hours
	End Semester Examination	50%	100	3 hours

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**	**CO6**
Mid Sem Examination Marks	YES	YES	NO	NO	NO	NO
End Sem Examination Marks	YES	YES	YES	YES	YES	YES
Assignment	YES	YES	YES	YES	YES	YES

Indirect Assessment :

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	**Programme Outcome**				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1: Students will be able to derive the solution of roots of polynomial equations and linear algebraic equations by using numerical methods.	**H**	**H**	**M**	**L**	**L**
CO2: Students will be able to demonstrate the understanding of numerical interpolation and least squares approximations.	**H**	**H**	**H**	**M**	**M**
CO3: Students will be able to understand and perform numerical integration and differentiation.	**H**	**H**	**M**	**M**	**L**
CO4: Students will be able to develop and implement stable numerical methods to solve ordinary differential equations.	**H**	**H**	**H**	**M**	**M**
CO5: Students will be able to Identify and apply the appropriate numerical techniques for solving boundary value problems.	**H**	**H**	**M**	**M**	**H**
CO6: Students will be able to acquire the knowledge about the random numbers generators and Monte Carlo technique.	**H**	**M**	**H**	**H**	**H**

Lecture wise Lesson planning Details:

Weak No.	**Lect. No.**	**Unit No.**	**Topics To be covered**	**CO Mapped**	**Remarks by Faculty**
1	1	1	Root Finding: Bisection method, Newton-Raphson method, Secant method	CO1	
	2		Fixed-point iteration, False position method	CO1	
2	3		Linear equations: Gauss-elimination method,	CO1	
	4		Gauss-Jordan method, LU decomposition,	CO1	
3	5		Matrix inversion by Gauss-Jordan method	CO1	
	6		Iterative methods: Gauss-Jacobin method	CO1	
4	7		Gauss-Seidel method, Methods for solution of Eigen value problems,	CO1	

	8	2	Interpolation: Newton's forward and backward interpolation formulae,	CO2	
5	9		Lagrange's interpolation formula, Newton's divided difference formula,	CO2	
	10		Inverse interpolation, Spline interpolation	CO2	
6	11		Chebyshev Interpolation; Least Squares Approximation: Linear regression,	CO2	
	12		Polynomial regression	CO2	
7	13		Multiple linear regression, Exponential regression, Revision	CO2	
	14	3	Numerical differentiation: Forward, backward and centred difference formulae	CO3	
8	15		Richardson extrapolation, Numerical integration: Midpoint rule,	CO3	
	16		Trapezoidal rule	CO3	
9	17		Simpson's rule, Romberg formula	CO3	
	18		Gauss-Legendre integration	CO3	
10	19		Gaussian quadrature formulae (2-point and 3-point),	CO3	
	20		Gaussian quadrature formulae (4-point), Revision	CO3	
11	21	4	Numerical solution of ordinary differential equation: Initial value problems, Euler's method, Modification of Euler's method,	CO4	
	22		Picard's method, Taylor Series method	CO4	
12	23		Second order and fourth Runge-Kutta methods,	CO4	
	24		Boundary value problems: finite difference method,	CO5	
13	25		Shooting Method,	CO5	
	26		Stochastic methods: Random Numbers and Generators	CO6	
14	27		Monte Carlo technique of numerical integration.	CO6	
	28		Revision	CO6	