NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

DEPARTMENT OF MATHEMATICS

COURSE PLAN – PART I			
Name of the programme and specialization	**B.Tech. / Instrumentation and Control Engineering / 2nd Year**		
Course Title	**Numerical Methods**		
Course Code	**ICPE51**	**No. of Credits**	**3**
Course Code of Pre-requisite subject(s)	**-**		
Session	**Jan 2022**	**Section**	**A & B**
Name of Faculty	**Dr. R.Sathya**	**Department**	**Mathematics**
Official Email	**sathyar@nitt.edu**	**Telephone No.**	**9944474850**
Name of Course Coordinator(s)	**-**		
Official E-mail	**-**	**Telephone No.**	**-**
Course Type	☐ **Core course**	☑ **Elective course**	

Syllabus (approved in BoS)

Digital representation of numbers, Finite precision arithmetic, Machine Precision, Measuring errors, convergence of iterative sequences, Taylor series, Order Notation. Numerical Solution of $f(x) = 0$: Bisection method, Secant method, Newton's method, Newton's method for $f(x, y) = 0$, $g(x, y) = 0$. Order of convergence.

Solution of linear system of equations –Direct method: Gaussian elimination, Gauss-Jordan methods, LU Decomposition method-Crout's method. Algorithm for tri-diagonal system, Iterative method: Jacobi and Gauss-Seidal's method -Sufficient conditions for convergence -Eigen Value problems- Power method.

Interpolation: Lagrange's method, Newton's divided difference, forward and backward difference interpolation method. Least squares fitting of a curve to data-Polynomial curve fitting, exponential curve ($y = ae^b$) fitting to data.

Numerical Differentiation based on interpolation and finite difference. Numerical Integration-Closed and open type integration rules -Trapezoidal rule, Simpson's 1/3 rule and 3/8 rule, mid-point and two-point rule. Adaptive integration based on Simpson's rule. Gauss quadrature methods, Integrals with infinite limits ($\int_0^\infty e^{-x}(x)dx$).

Numerical solution of ordinary differential equations: Taylor's series method, Single step method- Euler's method, Euler's modified method, Fourth order Runge-Kutta method. Fourth order R-K methodfor simultaneous equations and 2nd order ODE. Multi step methods: Milne's and Adams method.

ESSENTIAL READINGS : Textbooks, reference books, Website addresses, journals, etc

1. Jain, M.K., Iyengar, S.R. and Jain, R.K., Numerical Methods for Scientific and EngineeringComputation, New Age International, 2012.
2. S.S. Sastry, Introductory methods of numerical Analysis, 4/e, Prentice Hall of India, NewDelhi, 2005.
3. David Kincaid and Ward Cheney, Numerical Analysis\, 3rd edition, American MathematicsSociety, (Indian edition) – 2010.
4. Gerald, C.F., and Wheatley, P.O., 'Applied Numerical Analysis', Addison-Wesley PublishingCompany, 1994.

COURSE OBJECTIVES

To introduce

1. Numerical methods for Solving Linear Systems
2. Numerical methods to solve equations of one variable as well as system of equations with twovariables.
3. Interpolating Polynomials and best curve fitting methods for the given data.
4. Numerical differentiation and integration
5. Numerical solutions of Ordinary Differential Equations.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

Course Outcomes (CO)	Aligned Programme Outcomes (PO)
On completion of this course students will be able to: 1. Compute numerical solution of given system AX=B by direct and iterative methods. 2. Compute largest eigenvalue and its corresponding eigenvector of matrix A. 3. Compute numerical solution of f(x)=0 and nonlinear equations with two variables, 4. Interpolate function and approximate the function by polynomial. 5. Compute numerical differentiation and integration of f(x). 6. Compute best curve fit for the given data by curve fitting method. 7. Compute numerical solution of ordinary differential equations by finite difference method.	1 and 5

COURSE PLAN – PART II

COURSE OVERVIEW

1. This course is a study of mathematical techniques used to model engineering systems.
2. It focus on accuracy and efficiency of numerical algorithms.
3. To explore complex systems physicists, engineers, financiers and mathematicians require computational methods. This course based upon sound computational mathematics.
4. It contains solution of system of linear equations, roots of non-linear equations, interpolation, numerical differentiation and integration.
5. It plays an important role in solving many real world application oriented engineering science problems.

COURSE TEACHING AND LEARNING ACTIVITIES			
S.No.	**Week/Contact Hours**	**Topics**	**Mode of Delivery**
1.	1st, 2nd , 3rd & 4th week	Digital representation of numbers, Finite precision arithmetic, Machine Precision, Measuring errors, convergence of iterative sequences, Taylor series, Order Notation. Numerical Solution of $(x) = 0$: Bisection method, Secant method, Newton's method, Newton's method for $f(x, y) = 0$, $g(x, y) = 0$. Order of convergence.	Chalk and talk
2.	4th, 5th & 6th week	Solution of linear system of equations –Direct method: Gaussian elimination, Gauss-Jordan methods, LU Decomposition method-Crout's method. Algorithm for tri-diagonal system, Iterative method: Jacobi and Gauss-Seidal's method -Sufficient conditions for convergence -Eigen Value problems- Power method.	Chalk and talk
3.	7th week	**Assessment – 1**	
4.	7th , 8th & 9th week	Interpolation: Lagrange's method, Newton's divided difference, forward and backward difference interpolation method. Least squares fitting of a curve to data-Polynomial curve fitting, exponential curve ($y = ae^b$) fitting to data.	Chalk and talk
5.	10th, 11th &12th week	Numerical Differentiation based on interpolation and finite difference. Numerical Integration-Closed and open type integration rules - Trapezoidal rule, Simpson's 1/3 rule and 3/8 rule, mid-point and two-point	Chalk and Talk

		rule. Adaptive integration based on Simpson's rule. Gauss quadrature methods, Integrals with infinite limits $(\int_0^\infty e^{-x}(x)dx)$.	
6.	12th week	**Assessment – 2**	
7.	13th ,14th and 15th week	Numerical solution of ordinary differential equations: Taylor's series method, Single step method- Euler's method, Euler's modified method, Fourth order Runge-Kutta method. Fourth order R-K method for simultaneous equations and 2nd order ODE. Multi step methods: Milne's and Adams method.	Chalk and talk
8.	After 16th week	**Final Assessment**	

COURSE ASSESSMENT METHODS (shall range from 4 to 6)

S.No	Mode of Assessment	Week / Date	Duration	% Weightage
1.	Assessment -1	7th Week	1 hour	20
2.	Assessment – 2	12th Week	1 hour	20
3.	Assessment -3 (Assignments)		Will be announced while distributing the assignments	10
CPA	Compensation Assessment	14th Week	1 hour	(20)
4.	Final Assessment* (Offline Written Exam)	After 16th Week	3 hours	50

COURSE EXIT SURVEY (mention the ways in which the feedback about the course shall be assessed)

1. Feedback from the students during class committee meetings and in the class after the assessments 1 and 2.
2. Online feedback through questionnaire before the final assessment.
3. Student knowledge about the topics covered in this course will be judged through marks obtained in examination.

COURSE POLICY (preferred mode of correspondence with students, compensation assessment policy to be specified)

MODE OF CORRESPONDENCE (email / phone etc)

Students can ask the course faculty for clarifying doubts by fixing appointment through E-mail via Ms – teams.

COMPENSATION ASSESSMENT POLICY

a) Students who have missed either Assessment-1 or Assessment-2 or both (only on genuine reasons) can register for Compensation Assessment which shall be conducted soon after the completion of the Assessment-2 and before the Final Assessment.

b) The Compensation Assessment shall be conducted for the weightage of 25% comprising the syllabus of both Assessment -1 & Assessment - 2.

ATTENDANCE POLICY (A uniform attendance policy as specified below shall be followed)

- **At least 75% attendance in each course is mandatory.**
- **A maximum of 10% shall be allowed under On Duty (OD) category.**
- Students with **less than 65% of attendance** shall be prevented from writing the final assessment and **shall be awarded 'V' grade.**

ACADEMIC DISHONESTY & PLAGIARISM

- Possessing a mobile phone, carrying bits of paper, talking to other students, copying from others during an assessment will be treated as punishable dishonesty.
- Zero mark to be awarded for the offenders. For copying from another student, both students get the same penalty of zero mark.
- The departmental disciplinary committee including the course faculty member, PAC chairperson and the HOD, as members shall verify the facts of the malpractice and award the punishment if the student is found guilty. The report shall be submitted to the Academic office.

FOR APPROVAL

(Dr. R.Sathya)		
Course Faculty	CC-Chairperson	HOD Dr.Dhanalakshmi K.