ICE
Dr. Vasuki & Dr. Uma

NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

DEPARTMENT OF MATHEMATICS

COURSE PLAN – PART I			
Name of the programme and specialization	**B.TECH (INSTRUMENTATION & CONTROL ENGINEERING)**		
Course Title	**NUMERICAL METHODS**		
Course Code	**MAIR43**	**No. of Credits**	**3**
Course Code of Pre-requisite subject(s)			
Session	**Jan. 2020**	**Section (if, applicable)**	**A&B**
Name of Faculty	**Dr. A. Purusothaman**	**Department**	**Mathematics**
Official Email	apurusoth@nitt.edu	**Telephone No.**	**9944317732 9788109947**
Name of Course Coordinator(s) (if, applicable)			
Official E-mail		**Telephone No.**	
Course Type (please tick appropriately)	☐ √ **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 ($y = ae^{bx}$) 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 ($\int_0^\infty e^{-x} f(x)dx$).

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 method

for simultaneous equations and 2nd order ODE. Multi step methods: Milne's and Adams method.

Reference Books:

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

COURSE OBJECTIVES

Course objective is to introduce

1. Numerical Methods for Solving Linear Systems
2. Methods to solve equations of One Variable as well as system of equations with two variables.
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 COs with POs

Course Outcomes	Programme Outcomes (PO) (Enter Numbers only)
1. Compute numerical solution of given system AX=B by direct and iterative methods.	1,5
2. Compute largest eigenvalue and its corresponding eigenvector of matrix A.	1,5
3. compute numerical solution of f(x)=0 and nonlinear equations with two variables,	1,5
4. Interpolate function and approximate the function by polynomial.	1,5
5. Compute numerical differentiation and integration of $f(x)$.	1,5
6. Compute best curve fit for the given data by curve fitting method.	1,5
7. Compute numerical solution of ordinary differential equations by finite difference method.	1,5

COURSE PLAN – PART II			
COURSE OVERVIEW			
Course will introduce different numerical algorithm to solve the mathematical equation and validating numerical solution through convergence and stability analysis.			
COURSE TEACHING AND LEARNING ACTIVITIES			(Add more rows)
S.No.	**Week/Contact Hours**	**Topic**	**Mode of Delivery**
1	**Week 1,2,3**	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.	Chalk and Talk
2	**Week 4,5**	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	**Week 6,7,8**	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 ($y = ae^{bx}$) fitting to data.	Chalk and Talk
4	**Week 9,10**	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 ($\int_0^\infty e^{-x} f(x)dx$).	Chalk and Talk

5	**Week 11,12**	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

COURSE ASSESSMENT METHODS (shall range from 4 to 6)

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1	Assessment 1	6th week	1 hour	20
2	Assessment 2	11th Week	1 hour	20
3	Assessment 3	--	--	10
CPA	Compensation Assessment*	12th Week	--	20
4	Assessment – 4 (Final Assessment)	14th week	3 hour	50

***mandatory; refer to guidelines on page 4**

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

1. Students can meet the faculty at any stage in the course duration in case he/she finds difficulty in understanding the concept.
2. Feedback form issued to students to express their comments about the course before assessment - 1 & after completing the syllabus. Students are requested to give genuine feedback about the course.
3. Student knowledge about the topic covered in this course will be judged through marks obtained in examination.

COURSE POLICY (including compensation assessment to be specified)

1. Students who have missed the assessment 1 or assessment 2 or both can register for compensatory assessment which shall be conducted soon after the completion of the assessment 2 and before the regular semester examination. Other students were strictly NOT allowed to register for compensation assessment.

2. The compensation assessment shall be conducted for 20 marks comprising the syllabus of both assessment 1 and assessment 2.

3. Students should submit assignments before last date of submission. In case students fails to submit their assignments, he/she will get zero mark for that particular assignment.

The Institute follows relative grading with flexibility given to class committee to decide the mark ranges for grades. All assessment of a course will be done on the basis of marks

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.
- The above policy against academic dishonesty shall be applicable for all the programmes.

ADDITIONAL INFORMATION, IF ANY

Students can reach course faculty by fixing appointment through E-mail (apurusoth@nitt.edu) or phone (9944317732; 9788109947).
Office address: Department of Mathematics,(first floor of Lyceum), Room No. 206

FOR APPROVAL

Course Faculty (Dr. A. Purusothaman)	CC- Chairperson	HOD
	23/1/2020	23/1/2020