# NATIONAL INSTITUTE OF TECHNOLOGY TIRUCHIRAPPALLI

## DEPARTMENT OF MATHEMATICS

| COURSE PLAN | | | |
|---|---|---|---|
| **Name of the programme and specialization** | **M. Sc. MATHEMATICS** | | |
| **Course Title** | **Numerical Analysis** | | |
| **Course Code** | **MA710** | **No. of Credits** | **03** |
| **Course Code of Pre-requisite subject(s)** | **NIL** | | |
| **Session** | **Jan 2022** | **Section (if, applicable)** | **-** |
| **Name of Faculty** | **Dr. K. Murugesan** | **Department** | **Mathematics** |
| **Email** | **murugu@nitt.edu** | **Telephone No.** | **9443785050** |
| **Name of Course Coordinator(s) (if, applicable)** | - **Nil** | | |
| **E-mail** | **-** | **Telephone No.** | **-** |
| **Course Type** | √ **Core course** | ☐ **Elective course** | |

## SYLLABUS (APPROVED IN BOS)

**Error Analysis:** Exact and approximate numbers, rounding of numbers, Significant digits, Correct digits, various types of errors encountered in computations, Propagation of errors

**Solution of system of linear equations:** (i) Direct methods: Gauss elimination method, Gauss Jordon method, LU- decomposition method. (ii) Iterative methods: Jacobi and Gauss-Seidel methods.

**Eigen values and Eigen vectors:** Dominant and smallest Eigen values/Eigen vectors by power method.

**Roots of non-linear equations:** Bisection method, Regula-Falsi method, Newton-Raphson method, direct iterative method with convergence criteria, Graeffe's root squaring method, Newton-Raphson method for solution of a pair of non-linear equations.

**Interpolation:** Finite difference operator and their relationships, difference tables, Newton, Bessel and Stirling's interpolation formulae, divided differences, Lagrange interpolation and Newton's divided difference interpolation.

**Numerical differentiation:** First and second order derivatives by various interpolation formulae.

**Numerical integration:** Trapezoidal, Simpsons 1/3 and 3/8 rules with errors and their combinations, Gauss Legendre 2-points and 3-points formulae

**Solution of first and second order ordinary differential equations:** Taylor's series method, Euler, Modified Euler, Picard's method, Runge – Kutta methods and Milne's and Adam's method. Stability Analysis for single-step and multi-step method

**ESSENTIAL READINGS : (Textbooks, reference books etc.)**

**Reference Books:**
1. David Kinciad & Ward Cheney, Numerical Analysis and mathematics of scientific computing, Brooks/Cole, 1999
2. K. Atkinson, Elementary Numerical Analysis, Jhon Wiley & Sons, 2004
3. Curtis E Gerald &Partrock O Whealtley, Applied Numerical Analysis, Pearson edu. 2004
4.M.K.Jain, S.R.K.Iyengar, R.K.Jain, NuericalMethodd:For Scientific and Engineering Computation, New Age International, 7thedn, 2019
5. John H. Mathews, Kurtis K. Fink, Nuerical Methods Using Matlab, 4thEdn, Pearson, 2004

**COURSE OUTCOMES (CO)**

| Course Outcomes | Aligned Programme Outcomes (PO) |
|---|---|
| On completion of this course students will be able to | |
| 1. Find the numerical solution of the linear system of equations $AX=b$ and also error computations for all the numerical methods covered in this course | (i) progress the critical analysis and problem solving skills required for R & D organization and industry.<br><br>(ii) engage independent and lifelong learning with a high level of enthusiasm and commitment to improve knowledge and competence continuously.<br><br>(iii) contribute significantly in academics through teaching and research. |
| 2. Find the roots of transcendental and polynomial equations | |
| 3. Approximate the function and interpolate function and its derivatives | |
| 4. Find numerical differentiation of the function and the numerical solution of ordinary differential equation. | |
| 5. Find the single and double integral numerically. | |

**COURSE TEACHING AND LEARNING ACTIVITIES**

| S.No. | Week/Contact Hours | Topic | Mode of Delivery |
|---|---|---|---|
| 1. | 1st , 2nd & 3rd week | Error Analysis- Linear Systems of Equations- Direct Methods-Gauss and Gauss Jordan Method – LU decomposition method –Iteration Methods -Gauss Jacobi and Gauss - Seidal iterative methods – Eigen Value Problems: power method | On-line mode |
| 2. | 4th , 5th & 6th week | Bisection method- Regula-Falsi method-Newton-Raphson method-direct iterative method with convergence criteria-Graeffe's root squaring method-Newton- | On-line mode |

| | | | |
|---|---|---|---|
| | | Raphson method for solution of a pair of non-linear equations | |
| 3. | 7th Week | **Assessment - 1** | |
| 4. | 7th& 8th week | Finite difference operator and their relationships, difference tables, Newton, Bessel and Stirling's interpolation formulae, Divided differences, Lagrange interpolation and Newton's divided difference interpolation. | On-line mode |
| 5. | 9th, 10th & 11th week | Numerical differentiation and integration-open and closed type formulae. | On-line mode |
| 6. | 12th Week | **Assessment - 2** | |
| 7. | 13th week | **Compensation Assessment** | |
| 7. | 13th & 14th Week | Numerical solution of ordinary differential equation- single and multi-step methods for IVP. Stability analysis. | On-line mode |
| 8. | After 14th Week | **Assessment-4 (End Semester Exam)** | |

**COURSE ASSESSMENT METHODS (shall range from 4 to 6)**

| S.No. | Mode of Assessment | Week / Date | Duration | % Weightage |
|---|---|---|---|---|
| 1. | Assessment - 1 | 7th Week | $1\frac{1}{2}$ hour | 25% |
| 2. | Assessment - 2 | 12th Week | $1\frac{1}{2}$ hour | 25% |
| 3. | (Assignment/Seminar) Assessment - 3 | 6th week and 12th week | - | 20% |
| 4. | Compensation Assessment | 13th Week | $1\frac{1}{2}$ hour | 25% |
| 5. | Assessment-4 (End Semester Exam) | after 14th Week | 2 hours | 30% |

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

1. Students can meet the faculty (with prior appointment) at any stage in the course duration in case he/she finds difficulty in understanding the topic.
2. Feedback form will be issued to students to express their comments about the course 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 (preferred mode of correspondence with students, compensation assessment policy to be specified)**

**MODE OF CORRESPONDENCE (email / phone etc)**

Students can meet the course faculty by fixing appointment through E-mail (murugu@nitt.edu) between 9:30 am to 5:30 pm from Monday to Friday.

**COMPENSATION ASSESSMENT POLICY**

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 **25 marks** comprising the syllabus of both assessment 1 and assessment 2.

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

4. 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.

5. There will be one Reassessment for the students who have secured "F" in this course and will be conducted within a month from reopening of institute for next semester. Students should register their names with course teacher to appear for reassessment within three days from reopening of institute for next semester.

**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: -**

**FOR APPROVAL:**

| Dr. K. MURUGESAN | Dr. R.Tamil Selvi | Dr. V.L. Gomathi Nayagam |
|---|---|---|
| **Course Faculty** | **CC-Chairperson** | **HOD** |