NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

DEPARTMENT OF MATHEMATICS

COURSE PLAN – PART I			
Name of the programme and specialization	**M. Sc. / Mathematics/ 2nd Year**		
Course Title	**Numerical Methods for Differential Equations**		
Course Code	**MA727**	**No. of Credits**	**3**
Course Code of Pre-requisite subject(s)	**-**		
Session	**January 2021**	**Section**	**-**
Name of Faculty	**Dr. M. Sivanesan**	**Department**	**Mathematics**
Official Email	**sivanesan@nitt.edu**	**Telephone No.**	**9941109594**
Name of Course Coordinator(s)	**-**		
Official E-mail	**-**	**Telephone No.**	**-**
Course Type	**Elective course**		

Syllabus (approved in BoS)

Ordinary differential equations-Boundary-value problems-shooting method, finite difference - methods convergence analysis.

Parabolic equation: One dimensional parabolic equations -Explicit and implicit finite difference scheme Stability and convergence of difference scheme. Two dimensional parabolic equations - A.D.I. methods with error analysis.

Hyperbolic equations-First order quasi-linear equations and characteristics - Numerical integration along a characteristic - Lax-Wendroff explicit method - Second order quasi-linear hyperbolic equation - Characteristics - Solution by the method of characteristics.

Elliptic equations-Solution of Laplace and Poisson equations in a rectangular region - Finite difference in Polar coordinate Formulas for derivatives near a curved boundary when using a square mesh - Discretisation error - Mixed Boundary value problems.

Finite Element Method: types of integral formulations, one and two dimensional elements, Galerkin formulation, application to Dirichlet and Neumann problems.

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

1. G. Evans, J. Blackledge, P. Yardley, Numerical Methods for Partial Differential Equations, Springer Science & Business Media, 2012

2. K. W. Morton, D. F. Mayers, Numerical Solution of Partial Differential Equations: An Introduction, Cambridge University Press, 2005

3. John A. Trangenstein, Numerical Solution of Elliptic and Parabolic Partial Differential Equations, Cambridge University Press, 2013.

4. M.K.Jain, Numerical solution of Differential Equations, New Age International Publishers, 2008.

5. J.N. Reddy, An Introduction to Nonlinear Finite Element Analysis: With Applications to Heat Transfer, Fluid Mechanics, and Solid Mechanics, Oxford Unversity Press, 2015.

COURSE OBJECTIVES

Objective of the course is to

1. give an understanding of numerical methods for the solution boundary value problem of ordinary differential equations, their derivation, analysis and applicability.

2. Introduce finite difference methods for partial differential equations (PDEs).

3. discuss stability, consistency and convergence of the scheme for initial and initial boundary value problems.

4. basic idea of finite element analysis.

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

Course Outcomes (CO)	Aligned Programme Outcomes (PO)
Completion of course, student will be able to 1. solve the boundary value problem in ordinary differential equations numerically. 2. write numerical scheme for parabolic, elliptic and hyperbolic equations and solve numerically. 3. discuss the convergence of numerical scheme for differential equations. 4. apply finite element method for differential equations.	1 and 2.

COURSE PLAN – PART II

COURSE OVERVIEW

1. We will discuss various numerical schemes to solve boundary value problems governed by ordinary differential equations
2. Study various Numerical Techiques for the solution of problems governed by partial differential equations equations
3. Discuss the finite element method and its application.

COURSE TEACHING AND LEARNING ACTIVITIES

S.No.	Week/Contact Hours	Topics	Mode of Delivery
1.	1st , 2nd & 3rd week	Ordinary differential equations-Boundary-value problems-shooting method, finite difference - methods convergence analysis. Parabolic equation: One dimensional parabolic equations	Online mode
2.	4th, 5th & 6th week	Explicit and implicit finite difference scheme, Stability and convergence of difference scheme. Two dimensional parabolic equations - A.D.I. methods with error analysis.	Online mode
3.	6th Week	**Assessment - 1**	
4.	7th , 8th & 9th week	Hyperbolic equations-First order quasi-linear equations and characteristics - Numerical integration along a characteristic - Lax-Wendroff explicit method - Second order quasi-linear hyperbolic equation - Characteristics - Solution by the method of characteristics.	Online mode

5.	10th, 11th &12th week	Elliptic equations-Solution of Laplace and Poisson equations in a rectangular region - Finite difference in Polar coordinate Formulas for derivatives near a curved boundary when using a square mesh - Discretisation error - Mixed Boundary value problems	Online mode
6.	12th Week	**Assessment - 2**	
7.	13th & 14th Week	Finite Element Method: types of integral formulations, one and two dimensional elements, Galerkin formulation, application to Dirichlet and Neumann problems.	Online mode
8.	After 14th Week	**Final Assessment**	

COURSE ASSESSMENT METHODS (shall range from 4 to 6)

S.No	Mode of Assessment	Week / Date	Duration	% Weightage
1.	Assessment- 1 (Presentation/Written Exam)	6th Week	Will be announced	25%
2.	Assessment -2 (Presentation/Written Exam)	12th Week	Will be announced	25%
3.	Assessment -3 (Assignments and attentiveness)		Will be announced	20%
CPA	Compensation Assessment	13th Week	Will be announced	25%
4.	Final Assessment* (Written Exam)	After 14th Week	Will be announced	30%

* **Minimum 30% must be secured in the Final Assessment for passing the course.**

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 meet the course faculty for clarifying doubts by fixing appointment through E-mail (sivanesan@nitt.edu) or mobile (9941109594).

COMPENSATION ASSESSMENT POLICY

a) Students who have missed either Assessment-1 or Assessment-2 or both 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

Course Faculty	CC-Chairperson	HOD