	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology**	Year of Regulation	**2019-20**
Department	**Mathematics**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
MA 534	**Numerical solution to partial differential equations**	**MA 409**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives	To provide an idea about the numerical solution techniques of PDE's using finite difference methods To derive and discuss the methods in detail, and worked examples.	Course Outcomes	**CO1**	Able to understand basic introduction of partial differential equations and finite difference representation of derivatives.
			CO2	Able to understand numerical solution techniques to solve first order hyperbolic equation
			CO3	Able to understand numerical solution techniques to solve parabolic equation.
			CO4	Able to understand numerical solution techniques to solve hyperbolic equation.
			CO5	Able to understand numerical solution techniques to solve elliptic equation
			CO6	Able to understand convergence and von-Neumann stability analysis of various numerical schemes.

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1															
2	CO2															
3	CO3															
4	CO4															
5	CO5															
6	CO6															

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to Partial Differential Equations:** Well posed PDE; first order hyperbolic equation, initial and boundary conditions, role of characteristics. Classification of second order PDE's, finite difference representation of derivatives.	**04**	**CO1**
II	**Numerical solutions to first order hyperbolic PDE's:** Analytical solution of first oder hyperbolic PDE's. Numerical integration along characteristics, Upwind method, Lax-Wendroff method and worked examples with comparison with analytical solutions	**06**	**CO2**
III	**Numerical solutions to parabolic equation:** Solution of one dimensional heat equation, forward time central space (FTCS),backward time central space (BTCS), Schmidt explicit method and Crank-Nicolson implicit method, convergence and von-Nuemann stability analysis.	**12**	**CO3** **CO6**
IV	**Numerical solutions to hyperbolic equation:** Explicit and implicit methods for solving wave equation, stability and convergence analysis.	**07**	**CO4** **CO6**
V	**Numerical solutions to elliptic equation:** Laplace equation and Poisson equation, five point formula, successive over relaxation (SOR) method and the alternating direction implicit (ADI) scheme.	**07**	**CO5**
Total Hours		**36**	

Essential Readings

1. G. D. Smith, “Numerical Solution of Partial Differential Equations: Finite Difference methods”, Oxford University Press.
2. E. Isaacson and H. B. Keller, “Analysis of Numerical Methods”, Dover Publications, Revised edition , 2012.

Supplementary Readings

1. M. K. Jain, S.R.K. Iyengar and R.K. Jain, “Computational Methods for Partial Differential Equations”, New Age International Pvt. Ltd, 2016.
2. L. Fox, “Numerical Solution of Ordinary & Partial Differential Equation”, Literary Licensing (LLC), 2013.
3. S. S. Sastry, “Introductory Methods of Numerical Analysis”, PHI Learning Pvt. Ltd, 5th edition, 2012