DEPARTMENT OF MATHEMATICS

Semester : VII	Integrated M.Sc. Mathematics Subject : 060090703 Advanced Numerical Analysis	Academic Year : 2019 -20

Teaching Schedule

Course Objectives: To provide students with the specialist knowledge in advanced numerical analysis. To understand analytical, Developmental and technical principles that relate to numerical methods for solving partial differential equations. Formulate the real practices problem in the form of partial differential equations and implement appropriate numerical methods for solving them.

Course outcomes: Upon completion of the course, students shall be able to

CO1: understand the fundamental characteristics of partial differential equations and their solutions by numerical analysis.

CO2: analyse finite difference approximations of elliptic partial differential equations.

CO3: derive the solution of one dimensional heat partial differential equation using different explicit and implicit numerical approaches.

CO4: get the numerical solution of one dimensional wave equation.

CO5: solve the first-order and second order hyperbolic partial differential equation using numerical methods.

CO6: formulate the various science and engineering problem into mathematical form and get its numerical solution using finite element approximation.

Unit	Sub Unit	No. of Lect.(s)	Topics	Reference Chapter/ Additional Reading	Teaching Methodology to be used	Active Learning Activities	Evaluation Parameter
Unit 1: Numerical Solution of Partial Differential Equations							
[12]	1.1	2	Definitions and Terminology	CH#17 Numerical Methods: Principles, Analysis and Algorithms Srimanta Pal	Chalk & Talk	**For Slow Learner:** At the completion of each numerical method students implement the method to solve similar problems. **For Active Learner:** After the completion of every numerical method students find the real phenomenon problem and solved using that method.	Unit Test-1 Assignment-1
	1.2	2	Classification of Partial Differential Equations				
	1.3	2	Some Standard Partial Differential Equations				
	1.4	3	Methodology to solve Partial Differential Equations				
	1.5	3	Solution of Elliptic PDE				
Unit 2: Numerical Solution of Parabolic Partial Differential Equations							
[11]	2.1	1	Introduction to Parabolic PDE	CH#18	Chalk & Talk	**For Slow Learner:**	Unit Test-1&2 Assignment-2
	2.2	2	One dimensional Heat Equation				

Semester : VII   **Integrated M.Sc. Mathematics**   **Academic Year : 2019 -20**
Subject : 060090703 Advanced Numerical Analysis

	2.3	2	Explicit Method	Numerical Methods: Principles, Analysis and Algorithms Srimanta Pal		At the completion of each numerical method students implement the method to solve similar problems. **For Active Learner:** After the completion of every numerical method students find the real phenomenon problem and solved using that method.	
	2.4	2	Implicit Method				
	2.5	1	Unified Explicit and Implicit Scheme				
	2.6	1	Iterative Methods				
	2.7	1	Improves Partial Accuracy				
	2.8	1	Generalization				
Unit 3: Numerical Solution of Hyperbolic Partial Differential Equations							
[12]	3.1	1	Introduction to Hyperbolic PDE	CH#19 Numerical Methods: Principles, Analysis and Algorithms Srimanta Pal	Chalk & Talk	**For Slow Learner:** At the completion of each numerical method students implement the method to solve similar problems. **For Active Learner:** After the completion of every numerical method students find the real phenomenon problem and solved using that method.	Unit Test-2 Assignment-3
	3.2	2	Derivation of Wave Equation				
	3.3	3	Simple Finite Difference Methods				
	3.4	3	Second Order Hyperbolic Equations				
	3.5	3	Method of Characteristics for Hyperbolic PDE				
Unit 4: The Finite Element Method							
[10]	4.1	1	Introduction to Finite Element Approximation	CH#11 Introductory Methods of Numerical Analysis S. S. Sastry	Chalk & Talk	**For Slow Learner:** At the completion of each numerical method students implement the method to solve similar problems. **For Active Learner:** After the completion of every numerical method students find the real phenomenon problem and solved using that method.	Internal Examination Assignment-4
	4.2	1	Functional				
	4.3	2	Base Functions				
	4.4	2	Rayleigh-Ritz Method				
	4.5	2	Galerkin Method				
	4.6	2	Finite Element Method for One-dimensional Problems				

DEPARTMENT OF MATHEMATICS

Text book:
1. Srimanta Pal, "Numerical Methods: Principles, Analysis and Algorithms", Oxford University Press, 2009. (Printed in India by Radha Press, Delhi 110031)

Reference books:
1. S. S. Sastry , " Introductory Methods of Numerical Analysis"- PHI learning private Ltd.
2. Leon Lapidus, George F. Pinder, "Numerical Solution of Partial Differential Equations in Science and Engineering", A Wiley-Inter science Publication (John Wiley & Sons, Inc.) 1999.
3. Prasad Phoolan, Ravindran, Renuka, "Partial Differential Equations", New Age International Publication, New Delhi, 2009.

Course Objectives and Course Outcomes Mapping:
- To provide students with the specialist knowledge in advanced Numerical Analysis: CO1, CO3, CO4, CO5
- To understand analytical, developmental and technical principles that relate to Numerical methods for solving partial differential equations: CO2, CO3, CO4, CO5
- Formulate the real practices problem in the form of partial differential equations and implement appropriate numerical methods for solving them:CO1, CO6

Course Units and Course Outcomes Mapping:

Unit No.	Unit	Course Outcomes					
		CO1	CO2	CO3	CO4	CO5	CO6
1	**Numerical Solution of Partial Differential Equations**	✓	✓				✓
2	**Numerical Solution of Parabolic Partial Differential Equations**	✓		✓			
3	**Numerical Solution of Hyperbolic Partial Differential Equations**				✓	✓	
4	**The Finite Element Method**	✓		✓			✓

DEPARTMENT OF MATHEMATICS

Programme Outcomes (PO)

PO1: Knowledge

Provides knowledge about the fundamentals of pure, applied and computing mathematics and its applications to students that creates the opportunities in industries and research centers.

PO2: Core Competence

Creates competency in science and mathematics to formulate, analyses and solve problem and/or also to pursue advanced study or research.

PO3: Breadth

Trains students having good knowledge in unearth core of academia and industry by the roots of mathematics.

PO4: Evaluation

Imparts in students to raise trial and error-based curiosity and problem-solving functionality with research based advanced tutorial for higher level decision makings tools.

Programme Outcomes and Course Outcomes Mapping:

Programme Outcomes	Course Outcomes					
	CO1	CO2	CO3	CO4	CO5	CO6
PO1	✓			✓		
PO2		✓	✓	✓		
PO3			✓		✓	✓
PO4					✓	✓