

Module title: Numerical Methods for Partial Differential Equations

Module Code: 2810200-01

Module Credit: 3

Term: Second term 1404-1405

Lecturer: Dr. M. Arab-Ameri (arabameri@math.usb.ac.ir)

Lecturing time and place: Saturday (7:30 – 9:30) class no. 29 and Tuesday

Assessments: 20% mid-term1 exam (1405/1/29)

20% mid-term2 exam (1405/2/26)

50% final exam (1405/3/30)

5% home works

5% class attendance

Reference: Numerical Methods for Partial Differential Equations (3th Edition,2002) J. Smith

Module Subjects:

Introduction and finite difference formula

1th week: Descriptive treatment of elliptic, parabolic and hyperbolic equations, Finite difference approximations to derivatives, Notations for functions of several variables

Parabolic equations

2th week: An explicit finite difference approximation

3th week: Crank-Nicolson implicit method, BTCS implicit method

4th week: Derivative boundary conditions, Local truncation error, Consistency

5th week: Stability and convergence, lax equivalence theorem

6th week: Finite difference approximations to $\frac{\partial U}{\partial t} = \nabla^2 U$ cylindrical and spherical polar co-ordinates

7th week: System of ordinary differential equations, Pade approximations to e^θ , standard finite difference equations via the pade approximations

8th week: The eigenvalue-eigenvector solution of $\frac{dV}{dt} = AV$

9th week: Use of three-time level difference equations, Deferred correction method

10th week: Solution of non-linear parabolic equations, Newton's linearization method

Hyperbolic equations and characteristics

11th week: Numerical integration along a characteristic

12th week: Finite difference methods on a rectangular mesh for first order equations

13th week: Reduction of first order equation to a system of ordinary differential equations

Elliptic equations and systematic iterative methods

14th week: A torsion problem, a heat conduction problem with derivative boundary conditions

15th week: Finite differences in polar co-ordinates, formulate for derivatives near a curved boundary

16th week: Improvement of accuracy of solutions