Name: **Enrolment No:**	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May, 2019

Program: M Tech / RE **Semester – II**

Subject : Computational fluid dynamics **Max. Marks : 100**

Course Code: MERE7007 **Duration : 3 Hrs**

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Instructions:

SECTION A (20 marks)

S. No.		Marks	CO
Q 1	The SIMPLE and SIMPLEC method are used in Finite volume method. Write your comments on both scheme.	**5**	**CO1**
Q 2	Differentiate between explicit and implicit methodology using one dimensional wave equation	**5**	**CO3**
Q 3	Define the terms consistency, convergence, stability for numerical simulation.	**5**	**CO1**
Q4	Emphasis on the advantages and limitation of Finite Difference, Finite Element and Finite Volume Method.	**5**	**CO4**

SECTION B (40 marks)

Q 5	Derive interpolation functions using FEM method for 2D heat conduction equation given below $K\nabla^2 T + Q = 0$, Where notations have their usual meanings. (Note: Use three node element for interpolation function)	**10**	**CO2**
Q 6	Discuss the stability criteria for one dimensional first order wave equation. To have the stability discuss any two methodology used in brief OR Compute the stability analysis for one dimensional heat conduction equation for implicit scheme.	**10**	**CO2**

Q7	(a) Using Taylor series expansion derive the equation of Forward, Backward and Central difference scheme to discretize a first order PDE with order of error.	**10**	**CO3**
Q8	Deduce the discretization for $\frac{\partial^2 u}{\partial x \partial y}$ using Taylor series expansion for central difference scheme, also comment on the order of error.	**10**	**CO4**

SECTION-C (40 marks)

Q 9	The compact vector form of Naiver Stokes equation for incompressible fluid is given as $$\frac{\partial E}{\partial t}+\frac{\partial F}{\partial x}+\frac{\partial G}{\partial y}=0$$ Where, E, F and G vectors compromising continuity, momentum and energy equation. Discretize and deduce the equations for structured orthogonal structural mesh to solve the above equation using Finite volume method for the cell-volume P with unit thickness in direction perpendicular the paper plane. The four boundary conditions are constant temperature, constant heat flux, convection and radiation. **OR** Discretize and deduce the above FVM equations for curved mesh to solve steady state heat conduction equation with heat generation for a cell volume P with unit thickness in direction perpendicular to the paper plane. The boundary conditions are constant temperature, constant heat flux, convection and radiation.	**20**	**CO4**
Q 10	Deduce the local stiffness matrix for $K\nabla^2 T+Q=0$, using interpolation function for 2D heat conduction equation having 2-node element. Use Galerkins weighted residual approach and the four boundary (a) constant wall temperature, (b) constant flux (c) convective and (d) radiative heat transfer	**20**	**CO4**