Name: Enrolment No:	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, April/May 2018

Course: **Computational Fluid Dynamics (MERE7007)** **Semester: II**
Program: **M Tech (RE)**
Time: 03 hrs. **Max. Marks: 100**

Instructions:

SECTION A (20 marks)

S. No.		Marks	CO
Q 1	Emphasis on the advantages and limitation of Finite Difference, Finite Element and Finite Volume Method.	**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	Differentiate between SIMPLE and SIMPLEC methodology using in finite volume method	**5**	**CO5**

SECTION B (40 marks)

Q 5	Using Taylor series expansion, deduce the discretization for $\frac{\partial^2 u}{\partial x \partial y}$	**10**	**CO2**
Q 6	Compute the stability analysis for one dimensional heat conduction equation for implicit scheme. OR Discuss the stability criteria for one dimensional first order wave equation. To have the stability discuss any two methodology used in brief	**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	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**	**CO4**

SECTION-C (40 marks)

Q 9	Discretize and deduce the FVM equations for curved structural 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. Or Discretize and deduce the FVM equations for orthogonal structured grid for solve first order equation $\frac{\partial E}{\partial t}+\frac{\partial F}{\partial x}+\frac{\partial G}{\partial y}=0$ for the cell volume P with unit thickness in direction perpendicular the paper plane. The boundary conditions are constant temperature, constant heat flux, convection and radiation on east, west, south and north faces respectively.	**20**	**CO5**
Q 10	Using interpolation function for 2D heat conduction equation having 3 node element , deduce the local stiffness matrix for $K\nabla^2 T+Q=0$,	**20**	**CO4**