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UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

END Semester Examination – April, 2017

Program/course :	**Mechanical**	**Semester :**	**VIII**
Subject :	**Computational Fluid Dynamics**	**Max. Marks :**	**100**
Code :	**ASEG403**	**Duration :**	**3 Hrs**

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Section – A (20 marks).

Q.1: Brief the methodology involved in solving a PDE's equation using numerical method with proper notation system used in space and time domain. **(5)**

Q.2: Explain the LAX method for solving one dimensional wave equation with the CFL condition. **(5)**

Q.3: Enlist any four types of element used in FEM along with the interpolation function **(5)**

Q.4: Explain the terms consistency, convergence, stability for numerical simulation. **(5)**

Section – B (40 marks)

Q.5: Using Taylor series expansion, deduce the discretization for $\frac{\partial^2 u}{\partial x \partial y}$. **(10)**

Q.6: Develop an algorithm to solve 2-D unsteady heat conduction equation given below using BTCS scheme.

$$\frac{\partial^2 T}{\partial x^2}+\frac{\partial^2 T}{\partial y^2}=\alpha \frac{\partial T}{\partial t}$$ **(10)**

Q.7: Develop the tri-diagonal matrix for one dimensional heat conduction equation solved using implicit scheme.

Or

Compute the stability analysis for one dimensional heat conduction equation for implicit scheme. **(10)**

Q.8: Enlist the different types of boundary conditions and their discretization method used in CFD. **(10)**

Section C (40 marks)

Q.9. Discretize and deduce the FVM equations for orthogonal 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 structure curved mesh to 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. **(20)**

Q. 10. Derive the stiffness matrix for equation given below using FEM method. Select a three node element with suitable interpolation function.

$K\nabla^2 T+Q=0$, Where notations have their usual meanings. **(20)**