Seat No: _____ **Enrollment No: _____**

PARUL UNIVERSITY

FACULTY OF ENGINEERING & TECHNOLOGY

M.Tech. Summer 2018 - 19 Examination

Semester: 2 **Date: 29/04/2019**
Subject Code: 03210151 **Time: 02:00 pm to 04:30 pm**
Subject Name: Computational Fluid Dynamics **Total Marks: 60**

Instructions:
1. All questions are compulsory.
2. Figures to the right indicate full marks.
3. Make suitable assumptions wherever necessary.
4. Start new question on new page.

Q.1 A) Explain and compare the Analytical, Experimental and Computational methods of analysis. **(05)**

B) Explain *Courant–Friedrichs-Lewy* (CFL) stability criterion for hyperbolic equation **(05)**

$$\frac{\partial u}{\partial t} + c\frac{\partial u}{\partial x} = 0$$

C) Discretize the one dimensional steady state heat conduction equation for a metallic rod of length L whose one end is maintained at T_A and other end is insulated, using Finite Volume Method. **(05)**

Q.2 **Answer the following questions**. (Attempt any three) **(15)**

A) Finite volume discretization equation for scalar variable ∅ is obtained as:

$$-5\emptyset_P = -3\emptyset_E - 2\emptyset_W + 5$$

Is the above discretization expected to yield a physically unrealistic solution? Justify with reasoning.

B) Why do one need to model turbulence while dealing with computational analysis. Also list down the various turbulence model used.

C) Explain the model of energy cascading in turbulent flow.

D) Derive the formula for divergence of velocity and give its physical meaning.

Q.3 A) Classify Partial differential equation with one example of each. **(07)**

B) A large plate of thickness L=2 cm with constant thermal conductivity k=0.5 W/m.K and uniform heat generation q= 1000 kW/m^3. The faces A and B are at temperatures of 100 ^{0}C and 200 ^{0}C respectively. Assuming that the dimensions in the y- and z-directions are so large that temperature gradients are significant in the x-direction only, calculate the steady state temperature distribution. the governing equation is **(08)**

$$\frac{d}{dx}\left(k\frac{dT}{dx}\right) + q = 0$$

OR

B) Explain the following terms, **(08)**
(i) Grid independence test, (ii) Conservativeness, (iii) Boundedness and (iv) Transportiveness

Q.4 A) Explain all the major steps involved in CFD analysis. **(07)**

OR

A) Discretize one dimensional convection-diffusion equation using Upwind scheme and explain false diffusion. **(07)**

B) A two-dimensional small-disturbance velocity potential equation for compressible flows **(08)**

$(1 - M_\infty^2)\frac{\partial^2\emptyset}{\partial x^2} + \frac{\partial^2\emptyset}{\partial y^2} = 0$ is given as

(a) Examine whether this equation is parabolic, elliptic, or hyperbolic.
(b) Justify your inference from pure physical arguments.