Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

VI SEMESTER B.TECH (AERONAUTICAL/AUTOMOBILE ENGINEERING)

END SEMESTER EXAMINATIONS, MAY 2016

SUBJECT: COMPUTATIONAL AERODYNAMICS [AAE 334]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ANY FIVE FULL** questions.
- Missing data may be suitable assumed.

1A. Write a note on substantial derivative. **(02)**

1B. Explain with sketches, the four different models of flow. **(02)**

1C. Derive the expressions for Navier- Stokes equation in non-conservative form. **(06)**

2A. Explain the types of boundary conditions used in numerical analysis. **(02)**

2B. Differentiate between **(08)**

I. Conservative and non-conservative forms of governing equations
II. Finite difference and finite volume method
III. Explicit and implicit approaches in numerical scheme
IV. Transportiveness and Boundedness

3A. Write the solution capsule for ADI method. **(04)**

3B. Describe Von – Newmann stability criteria. Check for the stability of Simple Implicit finite difference method used in unsteady heat conduction equation. **(06)**

4A. Classify 2^{nd} order partial differential equations based on their Eigen values. **(02)**

4B. Write a brief note on: **(08)**

I. Peclet number
II. Physical meaning of divergence of a velocity
III. Numerical False diffusion
IV. SIMPLE

5. Two plates are 5 cm apart as shown in figure (1). Initially, both plates and the fluid are still. The top plate is moved at constant velocity of 7cm/s. The governing equation of motion of fluid is: **(10)**

$$\frac{\partial v}{\partial t} = \mu \frac{\partial^2 v}{\partial x^2}$$

What is the velocity of the fluid at distances x= 2, 4, 6 and 8 from the bottom plate at t = 0.5 sec. Note: Use Crank-Nicolson method with Δt = 0.5s, μ=3cp.

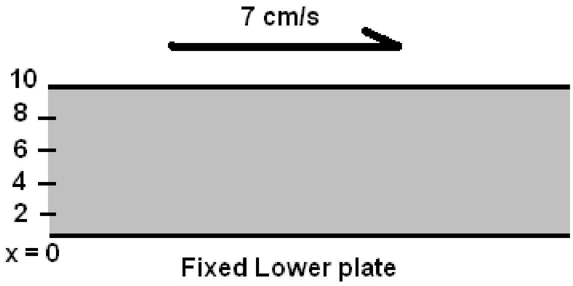

Fig. (1)

6. Convective heat transfer along the length of a cylindrical fin of uniform cross-sectional area, A is shown in figure (1). Its base is at a temperature of 100℃ (T_B) and the end is insulated. The fin is exposed to an ambient temperature of 20℃. One-dimensional heat transfer is governed by **(10)**

$$\frac{d}{dx}\left(kA\,\frac{dT}{dx}\right) - hP\,(T - T_\infty) = 0$$

Where 'h' is convective heat transfer coefficient, 'p' is perimeter, 'k' is thermal conductivity of the material, $'T_\infty'$ the ambient temperature and length of the fin, 'L'= 1 m. Calculate the temperature distribution along the fin using **control volume approach.**

Take $n^2 = \frac{Ph}{kA} = 25\,m^{-2}$ (note kA= constant) and δx=0.2 m.

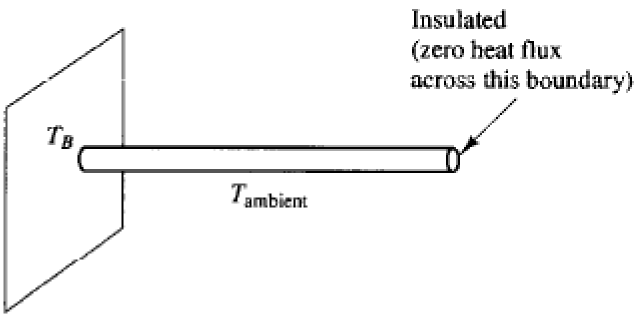

Fig. (2)