Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

III SEMESTER B.TECH (AERONAUTICAL ENGINEERING)

END SEMESTER EXAMINATIONS, DEC 2015/ JAN 2016

SUBJECT: FLUID MECHANICS [AAE 2105]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitable assumed.

1A. Derive an expression for the velocity distribution for viscous flow between two parallel plates. Also find the ratio of maximum velocity to average velocity and plot the velocity distribution and shear stress distribution across a section of parallel plates. **(05)**

1B. The piston of a hypodermic apparatus (Fig.1) is being withdrawn at 0.30 in/s; air leaks in around the piston at the rate 0.0012 in^3/s. What is the average speed of blood flow in the needle **(02)**

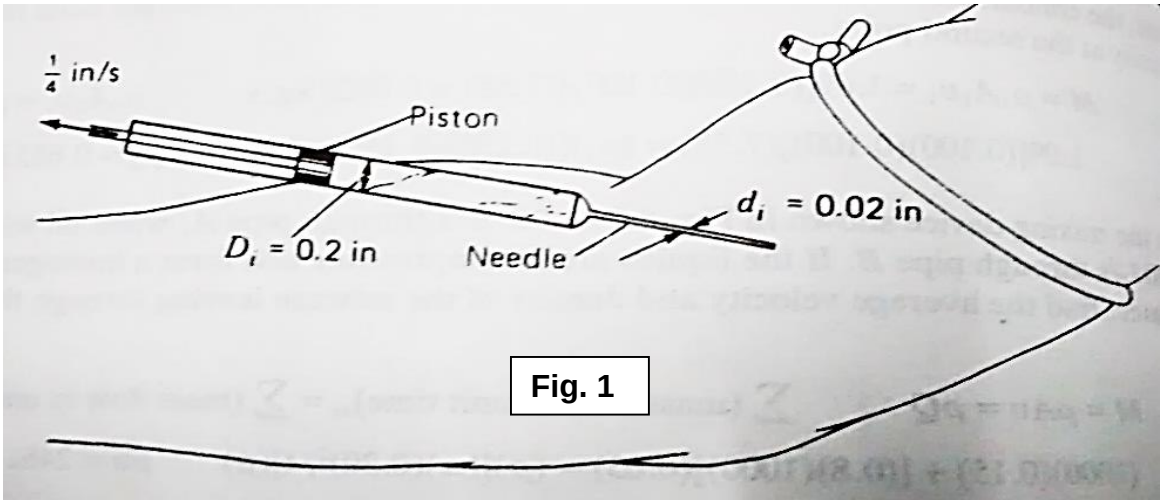

Fig. 1

1C. Define equation of state. Explain about isothermal and adiabatic process. **(03)**

2A. Derive an expression for displacement, momentum and energy thickness. **(05)**

2B. If a bubble is equivalent to an air-water interface with σ = 0.005 lb/ft, what is the pressure difference between the inside and outside of a bubble of diameter 0.003 in? **(02)**

2C. Air at 20^{o}c forms a boundary layer near a solid wall, in which the velocity profile is sinusoidal (fig. 2). The boundary-layer thickness is 7mm and the peak velocity is 9m/s. Compute the shear stress in the boundary layer at y equal to (i) 0, (ii) 3.5mm (iii) 7mm. **(03)**

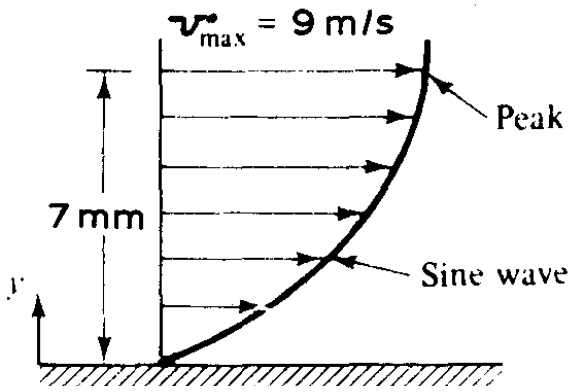

Fig. 2

3A. Assuming the velocity distribution is laminar boundary layer along a flat plate is given by eq. what are the displacement and energy thickness. **(03)**

$$\frac{u}{U} = 2\frac{y}{\delta} - \left[\frac{y}{\delta}\right]^2$$

3B. Gate ABC in (fig. 3) is 2m square and hinged at B. How large must h be for the gate to open? **(03)**

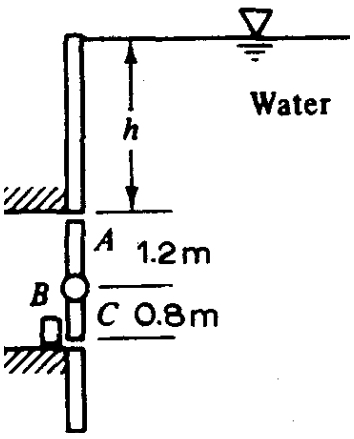

Fig. 3

3C. Define critical Reynolds number, stream tube and derive the continuity equation in three dimensions. **(04)**

4A. Flow through a converging nozzle can be approximated by a one-dimensional velocity distribution u = u(x). For the nozzle shown in fig.4 assume the velocity varies linearly from $u = v_o$ at the entrance to $u = 3v_o$ at the exit: $u(x) = v_o(1 + 2x/L)$; $\partial u/\partial x = 2v_o/L$. **(03)**

a) compute the acceleration du/dt as a general function of x, and

(b) evaluate du/dt at the entrance and exit if v_o = 10 ft/s and L = 1ft.

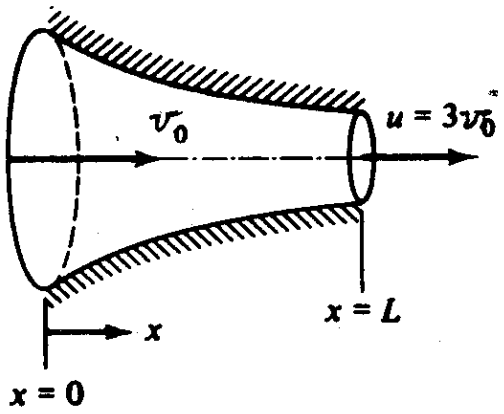

Fig. 4

4B. Derive an equation for free & forced vortex flows. **(04)**

4C. Derive the equations to determine the pressure difference in U-tube manometer with neat sketches. a) Two pipes are at different levels b) Two pipes are at same level. **(03)**

5A. State Bernoulli's theorem for steady flow of an incompressible fluid. Derive an expression for Bernoulli's equation from first principle and state assumptions made for such derivation. **(04)**

5B. A force of 460N is exerted on lever AB, as shown in fig.5 End B is connected to a piston which fits into a cylinder having a diameter of 60mm. What force FD acts on the large piston, if the volume between C and D is filled with water. **(02)**

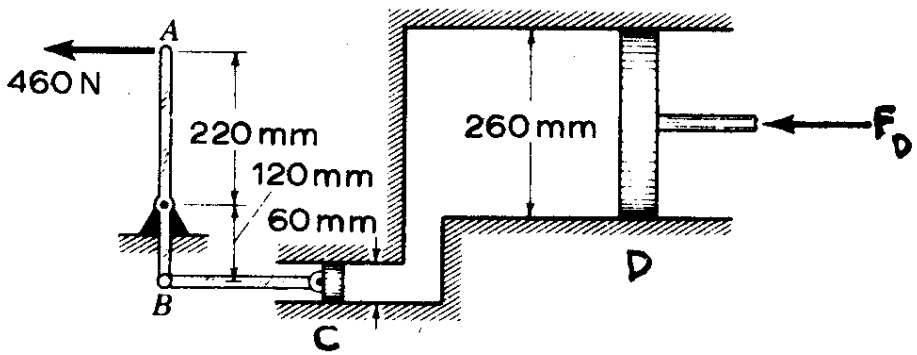

Fig. 5

5C. A jet plane which weighs 29.43 kN and having a wing area of 20 m^2 flies at a velocity 950 km/hr, when the engine delivers 7357.5 kw power. 65% power is used to overcome the drag resistance of the wing. Calculate the co-efficients of lift and drag for the wing. The density of the atmospheric air is 1.21kg/m^3. **(04)**