Hall Ticket No | | | | | | | | | | | Question Paper Code: AAE003

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

B.Tech III Semester End Examinations (Regular) - December, 2017

Regulation: IARE – R16

FLUID MECHANICS AND HYDRAULICS

(Aeronautical Engineering)

Time: 3 Hours **Max Marks: 70**

Answer ONE Question from each Unit
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

UNIT – I

1. (a) Explain the Newton's law of viscosity. **[6M]**

   (b) Two horizontal plates are placed 1.25 cm apart, the space between them being filled with oil of viscosity 14 poises. Calculate the shear stress in oil if upper plate is moved with a velocity of 2.5 m/s. **[8M]**

2. (a) State and prove Pascal's law. **[7M]**

   (b) A rectangular plane surface 3 m wide and 4 m deep lies in water in such a way that its plane makes an angle of 30° with the free surface of water. Determine the total pressure force and position of centre of pressure, when the upperedge is 2 m below the free surface. **[7M]**

UNIT – II

3. (a) Define: steady flow, uniform flow, laminar flow and two dimensional flow. **[4M]**

   (b) A 30 cm diameter pipe, conveying water, branches into two pipes of diameters 20 cm and 15 cm respectively. If the average velocity in the 30 cm diameter pipe is 2.5 m/s, find the discharge in this pipe. Also determine the velocity in 15 cm pipe if the average velocity in 20 cm diameter pipe is 2 m/s. **[10M]**

4. (a) The velocity components in a two dimensional flow are $u = \frac{y^3}{3} + 2x - x^2y$ and $v = xy^2 - 2y - \frac{x^3}{3}$. Show that these components represent a possible case of an irrotational flow. **[7M]**

   (b) A stream function is given by $\psi = 5x - 6y$. Calculate the velocity components and also magnitude and direction of the resultant velocity at any point. **[7M]**

UNIT – III

5. (a) A conical tube of length 2 m is fixed vertically with its smaller end upwards. The velocity of flow at the smaller end is 5 m/s while at the lower end it is 2m/s. the pressure head at the smaller end is 2.5 m of liquid. The loss of head in the tube is $0.35(v_1 - v_2)^2/2g$, where v_1 is the velocity at smaller end and v_2 at the lower end respectively. Determine the pressure head at the lower end. Flow takes place in the downward direction. **[7M]**

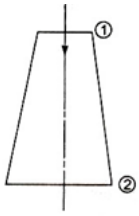

Figure 1

(b) List the practical applications of Bernoulli's equation. **[7M]**

6. (a) What is a venturimeter? Derive an expression for the discharge through a venturimeter. **[8M]**

   (b) The water is flowing through a pipe having diameters 20 cm and 10 cm at a sections 1 and 2 respectively. The rate of flow through pipe is 35 litres/s. The section 1 is 6 m above datum and section 2 is 4 m above datum. If the pressure at section 1 is 39.24 N/cm^2, find the intensity of pressure at section 2. **[6M]**

UNIT – IV

7. (a) Derive Darcy - Weisbach equation. **[4M]**

   (b) Determine the rate of flow of water through a pipe of diameter 20 cm and length 50 m when one end of the pipe is connected to a tank and other end of the pipe is open to the atmosphere. The pipe is horizontal and the height of water in the tank is 4 m above the centre of the pipe. Consider all minor losses and take f = 0.009 in the formula $h_f = \frac{4fLV^2}{d \times 2g}$ **[10M]**

8. (a) Explain briefly boundary layer characteristics. **[7M]**

   (b) A flat plate of 1.2 m wide and 1 m long is held in air flow of velocity 5m/s parallel to the flow. Find the boundary layer thickness at the end of the plate and the drag on the plate. **[7M]**

UNIT – V

9. (a) Define hydraulic efficiency and overall efficiency of pumps. **[6M]**

   (b) The quantity of water available for a hydroelectric power station is 260 m^3/sec and a head of 1.73 m. If the speed of the turbine is to be 50 rpm and the efficiency 82.5%. Find the number of turbines required. Assume specific speed $N_s = 760$. **[8M]**

10. (a) Write the equation for Euler turbo machine. **[7M]**

    (b) A turbine is to operate under a head of 25 m at 200 rpm. The discharge is 9 cm^3/sec. If the efficiency is 90%, determine: **[7M]**

    i. specific speed of the machine

    ii. power generated

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