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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B.Tech II Year II Semester Examinations, May - 2016

MECHANICS OF FLUIDS AND HYDRAULIC MACHINES

(Common to ME, MIE, MSNT)

Time: 3 Hours **Max. Marks: 75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A.
Part B consists of 5 Units. Answer any one full question from each unit.
Each question carries 10 marks and may have a, b, c as sub questions.

PART- A **(25 Marks)**

1.a) Define Viscosity. How it varies with temperature? [2]
b) What is atmospheric pressure, gauge pressure and absolute pressure? Write relationship between them. [3]
c) Explain continuity equation for one dimensional flow. [2]
d) Define stream length and stream tube with neat sketch. [3]
e) What is meant by thickness of boundary layer? [2]
f) Explain about boundary layer separation. [3]
g) What are classifications of turbines? [2]
h) Explain different types of Heads in hydraulic turbines. [3]
i) Define specific speed of centrifugal pump. [2]
j) Explain about characteristics curves of pumps. [3]

PART-B **(50 Marks)**

2.a) Derive an equation for capillary raise and fall of water when a glass tube immersed on it.
b) A U- tube is made up of two capillaries of bores 1.2 mm and 2.4 mm respectively. The tube is held vertical and partially filled with liquid of surface tension 0.06 N/m and zero contact angle. If the estimated difference in the level of two menisci is 15 mm. Determine the mass density of the liquid. [5+5]

OR

3.a) Explain with neat sketch of the following:
i) Simple manometers
ii) U tube manometers
iii) Single column manometers.
b) A liquid is compressed in the cylinder having the volume of 0.0012 m^3 at a pressure of 690 N/cm^2. What would be the new pressure in order to make its volume 0.0119 m^3? Assume bulk modulus of elasticity of the liquid 6.9×10^4 N/cm^2. [5+5]

4.a) State Bernoulli's theorem for steady flow of an incompressible fluid. Derive an expression for Bernoulli's theorem from first principle and state the assumptions made for such a Derivation.
b) Water is flowing through a pipe having diameters 600 mm and 400 mm at the bottom and upper end respectively. The intensity of pressure at the bottom end is 350 kN/m^2 and the pressure at the upper end is 100 kN/m^2. Determine the difference in datum head if the rate of flow through the pipe is 60 litres/s. [5+5]

OR

5.a) 250 litres/sec of water is flowing in a pipe having a diameter of 300 mm. If the pipe is bent by 135^0, find the magnitude and direction of the resultant force on the bend. The pressure of the water flowing is 400 kN/m^2. Take specific gravity of water as 1.

b) State the momentum equation. How will you apply momentum equation or determining the force exerted by a flowing liquid on a pipe bend? [5+5]

6.a) Derive the equation for head loss in pipes due to friction.

b) A Pipeline 0.225 m in diameter and 1580 m long has a slope of 1 in 200 for the first 790 m and 1 in 100 for the next 790 m. The pressure at the upper end of the pipeline is 107.91 kPa and at the lower end is 53.955 kPa. Taking f=0.032 determine the discharge through the pipe. [5+5]

OR

7.a) Derive an expression for Drag force on a flat plate due to boundary layer, that is Von Karman momentum integral equation.

b) For the velocity profile given below, state whether the boundary layer has separated or on the verge of separation or will remain attached with the surface. [5+5]

i) $\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2$ ii) $\frac{u}{U} = \frac{3}{2}\left(\frac{y}{\delta}\right) - 1/2\left(\frac{y}{\delta}\right)^3$.

8.a) What are the uses of a draft tube? Describe with neat sketches different types of draft tubes.

b) A turbine develops 7355 kW under a head of 24.7 m at 210 rpm. What is its specific speed? Indicate the type of turbine suitable for this purpose. If this turbine is tested in the laboratory where the head of water available is only 7.5 m, what power will it develop and at what speed? [5+5]

OR

9.a) What do you understand by the characteristics curves of a turbine? Name the important type of characteristic curve.

b) A turbine is to operate under a head of 25 m at 200 rpm. The discharge is 9 cumec. If the efficiency is 90%, determine the performance of the turbine under a head of 20 metre. [5+5]

10.a) Define centrifugal pump and explain the working of a single-stage centrifugal pump with neat sketch.

b) A centrifugal pump is to discharge 0.118 m^3/sec at a speed of 1450 rpm against head of 25 m. The impeller diameter is 250 mm, its width at outlet is 50 mm and manometer efficiency is 75%. Determine the vane angle at the outer periphery of the impeller. [5+5]

OR

11.a) Explain in detail the various characteristic curves in the case of centrifugal pump.

b) Find the number of pumps required to take water from a deep well under a total head of 89 m. All the pumps are identical and are running at 800 r.p.m. The specific speed of each pump is given as 25 while the rated capacity of each pump is 0.16 m^3/s. [5+5]

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