D 23515 (Pages : 2) Name.....

Reg. No.....

THIRD SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION DECEMBER 2011

ME 04 303—FLUID OF MECHANICS

Time : Three Hours Maximum : 100 Marks

Part A

I. (a) Define surface tension and explain with neat sketch.

(b) What is the difference between U-tube differential manometer and inverted U-tube differential manometer ? Where are they used ?

(c) Explain the working principle of a triangular notch.

(d) List the application of the momentum and energy equations for the one dimensional flow.

(e) Define : Steady flow, Non-Uniform flow, Laminar flow, Two-dimensional flow and Turbulent flow.

(f) Define velocity potential function and stream function.

(g) Explain about mechanism of transition.

(h) What is skin friction ? How it occurs ? Explain.

($8 \times 5 = 40$ marks)

Part B

II. (a) A flat plate of area 1.5×10^6 mm^2 is pulled with a speed of 0.4 m/s relative to another plate located at a distance of 0.15 mm from it. Find the force and power required to maintain this speed, if the fluid separating them is having viscosity as 1 poise.

Or

(b) Calculate the capillary rise in a glass tube of 2.5 mm diameter when immersed vertically in (i) water and (ii) mercury. Take surface tension $\sigma = 0.0725$ N/m for water and $\sigma = 0.52$ N/m for mercury in contact with air. The specific gravity for mercury is given as 13.6 and angle of contact = 130°.

III. (a) A jet propelled boat with an absolute velocity of 8.7 m/s is moving upstream in the river. The stream is flowing with a velocity of 2.3 m/s. A jet of water is ejected behind at a relative velocity of 18 m/s. If the flow in there is 1.4 m^3/s,, what thrust is developed on the boat ? Find also the power required to drive the boat and the efficiency of the propulsion device.

Or

(b) A jet issuing from a 30 mm, nozzle held at 0.6 m, above the round at an angle of 30° to the horizontal strikes the ground 4 m away. Determine :

(i) The maximum height reached.

(ii) The range of the jet.

(iii) Discharge.

Turn over

IV. (a) The diameter of a water pipe is suddenly enlarged from 350 mm to 700 mm. The rate of flow through it is 0.25 m^3/s and the pressure in the smaller pipe is 7.5 N/m^2. Calculate :

(i) The loss of head in the enlargement.

(ii) The power lost due to enlargement and

(iii) The pressure in the larger pipe if the pipe line is horizontal.

Or

(b) (i) Explain what is meant by source and sink. (5 marks)

(ii) The difference in water surface levels in two tanks which are connected by three pipes in series of lengths 400 m, 180 m, 205 m of diameters 300 mm, 200 mm, 400 mm, respectively is 16 m. Determine the rate of flow of water if the friction factor for the three lengths are 0.025, 0.026 and 0.024 respectively considering : (i) minor losses and (ii) neglecting minor losses.

(10 marks)

V. (a) (i) Describe the boundary layer growth on a flat plate held parallel to flow. (7 marks)

(ii) Assuming the velocity distribution in a boundary layer as :

$$u/v = 2(y/8) - (y/8)^2$$

find the thickness of the boundary layer and the shear at 2 m from the leading edge of a plate 3 m long and 1.25 m wide immersed in water moving at a velocity of 30 cm/s. Find also the drag force on one side of the plate. The viscosity of water may be assumed as 0.01 poise.

(8 marks)

Or

(b) (i) With neat sketch explain the development of a boundary layer along a thin flat smooth plate held parallel to a uniform flow and explain the salient features.

(7 marks)

(ii) A tree stream flowing at 1 m/s, density 1000 kg/m^3 and dynamic viscosity 0.01 kg/s, flows steadily over a horizontal flat plate. Calculate the Reynolds number and the boundary layer thickness at 0.1 m from the leading edge.

(8 marks)

[4 × 15 = 60 marks]