CBCS Scheme

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15CT63

Sixth Semester B.E. Degree Examination, June/July 2018
Fluid Mechanics and Hydraulic Structures

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing one full question from each module.

Module-1

1 a. Define: i) Viscosity ii) Surface tension iii) Capillarity. Give their units and dimensions. **(06 Marks)**

b. State and prove Pascal's law. **(04 Marks)**

c. A 90N rectangular solid block slides down a 30° inclined plane, which is lubricated with a 3mm thick oil film of specific gravity 0.9 and viscosity 0.8 Pa-s. If the contact area is $0.3m^2$, estimate the velocity of the block. **(06 Marks)**

OR

2 a. Sketch and explain Bourdon pressure gauge. **(06 Marks)**

b. The specific gravity of an oil is 0.9. What is its density and specific weight? **(02 Marks)**

c. Petrol of specific gravity 0.8 flows up through a vertical pipe from A to B, with B 30cm above A. A differential u-tube manometer containing mercury is connected between A and B. If the pressure difference between A and B is 18kPa, find the manometer liquid level difference. **(08 Marks)**

Module-2

3 a. Derive an expression for total pressure and center of pressure for an inclined plane surface immersed in a liquid of specific weight γ. **(08 Marks)**

b. The diameters at the ends of a 16m long vertical conical pipe conveying water are 0.5m and 1.5m. The loss of head between the ends is 2.65m in either directions when the velocity at the smaller section is 9m/s. If the smaller section is at the top and pressure head at this section is 2.15m of water, find the pressure head at the lower end when the flow is i) downward and ii) upward. **(08 Marks)**

OR

4 a. State and prove Bernoulli's theorem. **(08 Marks)**

b. A circular plate 2.5m diameter is immersed in water with its greatest and least depths below the free surface being 3m and 1m respectively. Find:
i) The total pressure on one face of the plate and
ii) The position of CP. **(08 Marks)**

Module-3

5 a. Derive Darcy-Weisbach equation for friction loss through a pipe. **(06 Marks)**

b. A pipe line of 0.6m diameter is 1.5km long. To increase the discharge, another pipeline of same diameter is introduced parallel to the first one in the second half of the length. Neglecting minor losses, find the increase in discharge if f = 0.01 in $h_f = fLV^2/2gD$. The head at inlet is 30cm. **(10 Marks)**

OR

6 a. Derive an equation for discharge over a rectangular notch. **(05 Marks)**

b. A horizontal venturimeter with inlet diameter 20cm and throat diameter 10cm is used to measure discharge of oil of S = 0.8. The discharge of oil is 60lps. Find the reading of oil-mercury differential manometer. Take $C_d = 0.98$. **(06 Marks)**

c. Water flows through a right-angled triangular weir first and then over a rectangular weir of 1m crest length. C_d for triangular and rectangular weirs is 0.6 and 0.7 respectively. If the depth of water over the triangular weir is 360mm, find the depth of water over rectangular weir. **(05 Marks)**

Module-4

7 a. State Impulse-Momentum equation. Give its applications. **(03 Marks)**

b. Show that the force exerted by a jet of water on a fixed curved vane at its center is $F = \rho a V^2 (1 + \cos\theta)$. **(05 Marks)**

c. A jet of water moving with a velocity of 35m/s impinges on a series of vanes moving with 20m/s. The jet makes an angle of 30° to the direction of motion of vanes at entry and leaves at 120° to the direction of motion of vanes. Draw the velocity triangles at inlet and outlet and find: i) Vane angles at entrance and exit and ii) Hydraulic efficiency. **(08 Marks)**

OR

8 a. Differentiate between pipe flow and open channel flow. **(04 Marks)**

b. Show that for most economical rectangular channel section, hydraulic mean depth equals half the flow depth. **(04 Marks)**

c. A trapezoidal channel with 1:1 side slopes has to be designed to convey $10 m^3/s$ of water so that the amount of lining is minimum. Taking n = 0.015 and bed slope as 0.00056 find the channel dimensions. **(08 Marks)**

Module-5

9 a. Sketch and explain the functioning of Pelton wheel turbine. **(07 Marks)**

b. Design a Pelton wheel turbine required to develop 1500kN power under a head of 160m running at 400rpm. The overall efficiency may be taken as 85%. Take $C_v = 0.98$, $C_u = 0.46$ and jet ratio = 12. **(09 Marks)**

OR

10 a. What is priming? Explain different methods. **(04 Marks)**

b. Explain pumps in series and parallel with neat sketches. **(06 Marks)**

c. A centrifugal pump delivers water against a head of 14.5m and a design speed of 1000rpm. The vanes are curved back to an angle of 30° with the periphery. The impeller diameter is 300mm and outlet width is 50mm. Determine the discharge of the pump, if $\eta_{man} = 95\%$. **(06 Marks)**

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