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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S3 (R,S) / S3 (WP) (R,S) / S1 (PT) (S,FE) Examination November 2024 (2019 Scheme)

Course Code: CET203

Course Name: Fluid Mechanics and Hydraulics

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions. Each question carries 3 marks Marks

1 Define pressure. State how the pressure varies in a fluid at rest. (3)

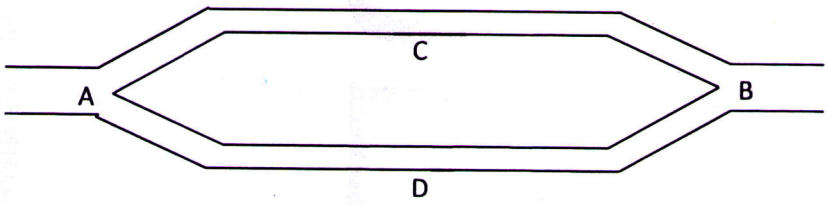
2 Explain how you would find the resultant pressure on a curved surface immersed in a liquid (3)

3 Define the terms buoyancy and centre of buoyancy. (3)

4 Distinguish between steady and unsteady flow. (3)

5 What is Euler's equation of motion? How will you obtain Bernoulli's equation from it? (3)

6 (3)



What is the relation between the head loss between A and B across the path ACB and ADB ?

7 Explain velocity distribution in open channels. (3)

8 Find the discharge of water flowing over a rectangular notch of 2m length when the constant head over the notch is 300mm. Take C_d=0.6. (3)

9 What is specific energy of a flowing fluid? (3)

10 Explain the term hydraulic jump. (3)

PART B

Answer any one full question from each module. Each question carries 14 marks

Module 1

11 (a) What is a manometer? How are they classified? (5)

(b) The right limb of a simple U tube manometer containing mercury is open (9)

to the atmosphere while the left limb is connected to a pipe in which a fluid of specific gravity 0.9 is flowing. The centre of the pipe is 12cm below the level of mercury in the right limb. Find the pressure of fluid in the pipe if the difference of mercury level in the two limbs is 20cm.

12 (a) Derive an expression for the force exerted on a submerged inclined plane surface by the static fluid and locate the position of centre of pressure. (5)

(b) A circular plate 2.5m diameter is immersed in water, its greatest and least depth below the free surface being 3m and 1m respectively. Find the total pressure on one face of the plate and the position of the centre of pressure. (9)

Module 2

13 (a) Explain the terms metacentre and metacentric height. (4)

(b) A solid cylinder of diameter 4m has a height of 4m. Find the metacentric height of the cylinder if the specific gravity of the material of cylinder = 0.6 and it is floating in water with its axis vertical. State whether the equilibrium is stable or unstable. (10)

14 Two velocity components are given in the following cases. Find the third component such that they satisfy the continuity equation. (14)

a. $u = x^3+y^2+2z^2$; $v = -x^2y-yz-xy$

b. $u = \log(y^2+z^2)$; $v=\log(x^2+z^2)$

c. $u = \frac{-2xyz}{(x^2+y^2)^2}$; $w = \frac{y}{x^2+y^2}$

Module 3

15 a. What is a venturimeter? Derive an expression for the discharge through a venturimeter. (6)

b. A horizontal venturimeter with inlet and throat diameters 30cm and 15cm respectively is used to measure the rate of flow of water. The reading of differential manometer connected to the inlet and throat is 20cm of mercury. Determine the rate of flow. Take C_d= 0.98. (8)

16 The difference in water surface levels in two tanks which are connected by three pipes in series of lengths 300m, 170m and 210m and of diameters 300mm,200mm and 400mm respectively is 12m. Determine the rate of flow of water if coefficient of friction are 0.005, 0.0052, and 0.0048 respectively considering (i) minor losses also (ii) neglecting minor losses. (14)

Module 4

17 a. Derive an expression for the discharge through a channel by Chezy's formula. (7)

b. A trapezoidal channel has side slopes of 1 horizontal to 2 vertical and the slope of the bed is 1 in 1500. The area of the section is 40 m^2. Find the dimensions of the section if it is most economical. Determine the discharge of the most economical section if C = 50. (7)

18 a. What is cipolletti weir ? Estimate the side slope of the cipolletti weir. (7)

b. A sharp crested rectangular weir of 1m height extends across a rectangular channel of 3m width. If the head of water over the weir is 0.45m, calculate the discharge. Consider velocity of approach and assume C_d= 0.623. (7)

Module 5

19 a. Explain the classification of water surface profiles occurring in the channels. (5)

b. A rectangular channel 10m wide carries a discharge of 30m^3/s. It is laid at a slope of 0.0001. If at a section in this channel the depth is 1.6m, how far (upstream or downstream) from the section will the depth be 2m? Take Manning's n as 0.015. (9)

20 a. Derive expressions for sequent depths and energy loss for hydraulic jump in horizontal rectangular channels. (9)

b. In a rectangular channel there occurs a jump corresponding to Fr_1=2.5. Determine the critical depth and head loss in terms of the initial depth y_1. (5)

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