Reg No.:_____ Name:_____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

Third Semester B.Tech Degree Regular and Supplementary Examination December 2022 (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 | Differentiate between simple manometer and differential manometer. | (3) |
| 2 | How will you determine the metacentric height of a floating body experimentally? Explain with the help of neat sketch | (3) |
| 3 | What do you understand by the terms: a) Total acceleration, b) Local acceleration and c) Convective acceleration | (3) |
| 4 | Differentiate between the Eulerian and Lagrangian methods of representing fluid flow. | (3) |
| 5 | Derive the expression for Kinetic energy correction factor. | (3) |
| 6 | What is a compound pipe? What will be the head loss and discharge when pipes are connected in series? | (3) |
| 7 | Explain on conveyance of the channel section for uniform flow. | (3) |
| 8 | What is a Cipolletti weir? Give its significance. | (3) |
| 9 | Using a specific energy curve, explain the relationship between specific energy and depth of flow. | (3) |
| 10 | Enlist any six practical applications of hydraulic jump. | (3) |

## PART B

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

### Module 1

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|---|---|---|
| 11a. | Two points A and B are connected with a differential manometer as shown in figure 1. Air pressure at point B is 8.87 N/cm$^2$(abs), find the absolute pressure at A. | (6) |

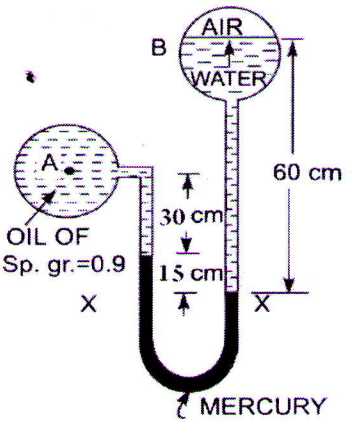


**Fig. 1**

11b. A circular plate 2.5m diameter is immersed in water, its greatest and least depths below the water surface being 3m and 1m respectively. Find a) the total pressure on one face of the plate, and b) the position of centre of pressure. (8)

12 a. Obtain the expressions for total pressure and centre of pressure of a lamina placed in fluid in vertical position (7)

12 b. A rectangular opening 2m wide and 1m deep in the vertical side of a tank is closed by a sluice gate of the same size. The gate can turn about the horizontal centroidal axis. The head of water above the upper edge of the gate is 1.5m. Determine (i) the total pressure on the sluice gate and (ii) the torque on the sluice gate. (7)

**Module 2**

13 A rectangular pontoon 10m long, 7m broad and 2.5 m deep weighs 700 kN. It carries an empty boiler of 5m diameter and 590 kN weight on its upper deck. The centre of gravity of the boiler and the pontoon are at their respective centres along a vertical line. Find the meta centric height. Weight density of sea water is 10.104 kN/m$^3$. (14)

14 a. Determine the third velocity component for the given case such that it satisfy continuity equation. $\mathbf{u = x^2 + y^2 + z^2}$, $\mathbf{v = xy^2 - yz^2 + xy}$ (5)

14 b. Derive the continuity equation in 3D Cartesian coordinates. (9)

**Module 3**

15 A pipe carrying water has a 30cm x15cm venturimeter which is positioned inclined at 30° to the horizontal. The flow is upwards. The converging cone is 45 cm in length and the coefficient of discharge of the meter is 0.98. A (14)

differential U tube manometer with mercury as indicating fluid is connected to the inlet and to the throat and shows a differential column height of 30cm.

i. Calculate the discharge in the pipe.

ii. If the pressure at the inlet section is 50 kPa, determine the pressure at the throat.

iii. Find the head loss in the converging section of the venturi meter.

16 a. A reservoir discharges through a sluice 1.05 m wide and 1.35 m deep. The top of the opening is 0.61 m below the water level in the reservoir and the downstream water level is below the bottom of the opening. Calculate (8)

(i) discharge through the opening if $C_d = 0.61$

(ii) the percentage error if the opening is treated as a small orifice

16 b. A horizontal pipe carrying water suddenly increases its diameter from 15cm to 30cm. Find out the loss of head due to sudden increase in diameter if the discharge through the pipe is 175 litres/s. Also find out the pressure difference between the two sections. (6)

**Module 4**

17 a. Find the discharge through a rectangular channel 5m wide, having depth of 3m and bed slope 1 in 1500. Take N = 0.03, in Kutter's formula. (5)

17 b. A power canal of trapezoidal section has to be excavated through hard clay at least cost. Determine the dimensions of the channel given, discharge equal to $15m^3/s$, bed slope 1: 2500, Manning's n = 0.020. (9)

18 a. Water flows over a triangular right-angled weir first and then over a rectangular weir of 1m width. The coefficient of discharge of triangular and rectangular weirs are 0.6 and 0.7 respectively. If the depth of water over triangular weir is 360mm, find the depth of water over rectangular weir. (5)

18 b. Water flows over a rectangular sharp crested weir 1m long, head over sill of weir being 0.66m. The approach channel is 1.4m wide and depth of flow in the channel is 1.2m. Determine the discharge over weir. Considering velocity of approach and end contractions. Cd = 0.6. (9)

**Module 5**

19 a. A rectangular channel, 7.5m wide has a uniform depth of flow of 2m and has a bed slope of 1 in 3000. If due to weir constructed at the downstream end of the channel, water surface at the section is raised by 0.75 m, determine the (8)

water surface slope with respect to horizontal at this section. Assume Manning's n = 0.02

19 b. Give the step-by-step procedure to determine the length of water surface profile with help of Direct Step Method. (6)

20 a. The discharge through a 3m wide rectangular channel is $12m^3/s$. When the depth of flow is 2m. Calculate (i) Specific Energy (ii) Critical Depth (iii) Minimum Specific energy (iv) Froude Number. Also Comment on the nature of flow, whether sub critical or super critical. (5)

20 b. What is hydraulic jump? With neat sketches explain the different types of hydraulic jump. (9)

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