Reg No.:_____ Name:_____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

Third Semester B.Tech Degree Examination December 2021 (2019 scheme)

**Course Code: CET203**

**Course Name: Fluid Mechanics and Hydraulics**

Max. Marks: 100 Duration: 3 Hours

**Assume any missing data suitably.**

**PART A**

***Answer all questions. Each question carries 3 marks*** Marks

| | | |
|---|---|---|
| 1 | Differentiate between: i) simple manometer and differential manometer ii) absolute pressure and gauge pressure | (3) |
| 2 | An isosceles triangular plate of base 3 m and altitude 3 m is immersed vertically in an oil of specific gravity 0.8. The base of the plate coincides with the free surface of oil. Determine the total pressure on the plate. | (3) |
| 3 | Find the specific weight of a metallic body which floats at the interface of mercury and water such that 35% of its volume is submerged in mercury and remaining in water. | (3) |
| 4 | Define the terms i) Total acceleration ii) local acceleration and iii) convective acceleration. | (3) |
| 5 | Explain kinetic energy correction factor. | (3) |
| 6 | Define: i) Coefficient of discharge ii) Coefficient of velocity and iii) Coefficient of contraction | (3) |
| 7 | Differentiate between suppressed weir and contracted weir. | (3) |
| 8 | Differentiate between: i) Gradually varied flow and rapidly varied flow ii) Subcritical flow and supercritical flow. | (3) |
| 9 | The discharge through a rectangular channel 3.6 m wide is 9 $m^3/s$. Find the depth of water at a section where specific energy is minimum. | (3) |
| 10 | What are the practical applications of a 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 | A simple U-tube manometer containing mercury is used to find the negative | (4) |

pressure in a pipe containing water. The right limb is open to the atmosphere. Find the vacuum pressure in the pipe, if the difference of mercury level in the two limbs is 100 mm and height of water in the left limb from the centre of the pipe is found to be 40 mm below.

b A tank contains water in the lower 0.8 m depth. An immiscible liquid of relative density 0.85 is filled on the top of water up to a height of 1.2 m. If the tank is 2 m wide calculate (i) the pressure force on one side of the tank and (ii) position of the centre of pressure (10)

12a Find the absolute pressure at a depth of 5 m below the surface of a liquid of relative density 0.85. The barometer reading on the surface is 750 mm of mercury (4)

b A 1m wide and 1.5 m deep rectangular plane surface lies in water in such a way (10)

that its plane makes an angle of 30° with the free water surface. Determine the total pressure and position of centre of pressure when the1m wide upper edge is 0.75 m below the free water surface.

**Module 2**

13a Explain with figures the stability of floating bodies. (6)

b A wooden block in the form of a rectangular prism floats with its shortest axis vertical. The block is 40 cm long, 20 cm wide and 15 cm deep with a depth of immersion of 12 cm. Determine the metacentric height and analyse the stability of the block. (8)

14a Derive the continuity equation for a three-dimensional flow in Cartesian coordinates. (7)

b An unsteady velocity field is given by $u = t^2 + 3y$ and $v = 4t + 5x$. Calculate the acceleration at the point (5,3) at time t = 2 units. (7)

**Module 3**

15a Define Hydraulic Gradient Line and Total Energy Line (3)

b A venturimeter 20 cm x 10 cm is provided in a vertical pipeline to measure the flow of oil of relative density 0.9. The difference in elevations of the throat section and entrance section is 30 cm, the direction of flow of oil being vertically upwards. The oil-mercury differential U tube manometer shows a gauge deflection of 10 cm. Calculate the discharge of oil and the pressure (11)

difference between the entrance section and throat section. Take the coefficient of discharge as 0.98 and specific gravity of mercury as 13.6.

16a A horizontal pipe with 6 cm diameter suddenly enlarges to 9 cm diameter at a section. The pressure just upstream of the expansion is 25 kN/$m^2$. Calculate the pressure just after expansion if the discharge of water in the pipe is 0.0075 $m^3$/s. (9)

b A rectangular orifice 0.6 m wide and 0.8 m deep is discharging water from a vessel. The top edge of the orifice is 0.4 m below the water surface in the vessel. Find the discharge through the orifice if coefficient of discharge is 0.62. (5)

**Module 4**

17a The flow in a 2.2 m wide rectangular channel is measured by a rectangular weir with crest length 1 m and height 0.6 m. Find the discharge in the channel when the head over the weir is 0.3 m. Take $C_d$ as 0.62. Consider end contractions and velocity of approach. (10)

b Define the terms hydraulic depth and hydraulic radius. (4)

18a Explain the characteristics of velocity distribution in open channels. (4)

b A trapezoidal channel discharging water at the rate of 10 $m^3$/s is to be designed for most economical section. Find the bottom width of the channel and depth of water. The side slope is $60^0$. Take bed slope as 1 in 750 and Chezy's constant as 66. (10)

**Module 5**

19a Derive the dynamic equation of gradually varied flow in a channel, stating the assumptions involved (8)

b A rectangular channel 8 m wide carries a discharge of 15 $m^3$/s. If the depth of flow is 1.2 m determine i) specific energy of water flowing through the channel ii) critical depth and critical velocity and iii) Froude number. (6)

20a Explain the specific energy diagram. (6)

b In a hydraulic jump occurring in a horizontal rectangular channel, the initial and sequent depths are 0.2 m and 1.2 m respectively. Estimate the discharge per unit width and the energy loss. (8)

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