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**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

B.Tech Degree S3 (S,FE) / S1 (PT) (S,FE) Examination June 2024 (2015 Scheme)



**Course Code: CE203**

**Course Name: FLUID MECHANICS - I**

Max. Marks: 100

Duration: 3 Hours

**PART A**

*Answer any two full questions, each carries 15 marks.*

Marks

- 1 a) Define metacentre and Metacentric height (5)
- b) A circular opening 2.5m diameter in a vertical side of a tank is closed by a disc of 2.5 m diameter which can rotate about horizontal diameter. Find the i) force on the disc ii) torque required to maintain the disc in equilibrium in vertical position when the head of water above the horizontal diameter is 3.5m (10)
- 2 a) A rectangular wooden block 2m long ,1m wide and 1m deep floats in water. Find the weight of the body and its metacentric height if the depth of immersion is 0.75m. The specific gravity of the wooden block is 0.6.State whether the body is stable or not. (10)
- b) Show that the streamlines and equipotential lines form a net of mutually perpendicular lines (5)
- 3 a) The velocity vector in a fluid flow is given  $V= 4x^3i-10x^2yj+2tk$ .Find the velocity and acceleration of a fluid particle at (2,1,3) at time  $t=1$  (8)
- b) Obtain an expression for centre of pressure of a lamina paced in inclined position. (7)

**PART B**

*Answer any two full questions, each carries 15 marks.*

- 4 a) A 20cmx10cm venturimeter is inserted in a vertical pipe carrying oil of specific gravity 0.8, the flow of oil in upward direction. The difference of level between the throat and inlet section is 50 cm. The oil mercury differential manometer gives a reading of 30 cm of mercury. Find the discharge of oil. Neglect losses (10)
- b) Explain how a pitot tube can be used to find out velocity at any point in a pipeline (5)
- 5 a) What is a Cipolletti weir? Derive an expression for discharge through it. (5)
- b) Find the maximum discharge over a broad crested weir 5m long if the head of weir on upstream side is 0.96m and coefficient of discharge is 0.62. Neglect velocity of approach. (5)
- c) An orifice of diameter 100mm is fitted at the bottom of a boiler drum of length 5m (5)

and of diameter 2m. The drum is horizontal and half full of water. Find the time required to empty the boiler.  $C_d=0.6$

- 6 a) Explain the experimental method of determination of orifice coefficients. (5)  
b) Derive Euler's equation of motion and then obtain Bernoulli's equation by integrating it along a streamline. What are the assumptions made in deriving the equation? (10)

**PART C**

*Answer any two full questions, each carries 20 marks.*

- 7 a) A compound piping system consists of 1800 m of 50cm, 1200 m of 40 cm and 600 m of 30 cm diameter pipes of the same material connected in series. What is the equivalent length of a 40 cm pipe of the same material? What is the equivalent size of the pipe 3600 m long? (10)  
b) Derive the Darcy-Weisbach equation for head loss in pipes due to friction. (10)
- 8 a) Define the terms displacement thickness, energy thickness and momentum thickness. (6)  
b) What is meant by boundary layer separation? (4)  
c) Discuss the development of boundary layer over a flat plate. (10)
- 9 a) Two pipes each 250 m long are available for connecting in a reservoir from which a flow of  $0.08\text{m}^3/\text{s}$  is required. The pipe diameters are 10cm and 20 cm respectively. Compare the head loss through the system if the pipes constitute series and parallel arrangement. Neglect minor energy losses due to pipe transitions and fittings. Assume  $f=0.01$  (10)  
b) Water is flowing over a thin smooth plate of length 4 m and width 2m at a velocity of 1 m/s . If the boundary layer flow changes from laminar to turbulent at a Reynold number  $5 \times 10^5$  . Find: i) Distance from leading edge up to which boundary layer is laminar. ii) Thickness of boundary layer at the transition point iii) the drag force on one side of the plate. Assume viscosity of water as  $9.81 \times 10^{-4} \text{Ns/m}^2$  . (10)

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