

Reg No.: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
THIRD SEMESTER B.TECH DEGREE EXAMINATION, APRIL 2018

Course Code: CE203

Course Name: FLUID MECHANICS – I (CE)

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) Calculate the pressure due to a column of 0.4 m of (i) water, (ii) an oil of specific gravity 0.9 and (iii) mercury of sp. gr. 13.6. Take density of water as 1000kg/m ³ . | (5) |
| | c) A circular plate 5 m diameter is immersed in water in such a way that its greatest and least depth below the free surface are 4 m and 1.5 m respectively. Determine the total pressure on one face of the plate and position of centre of pressure. | (5) |
| 2 | a) Derive continuity equation in three-dimensions. | (7) |
| | b) A fluid flow is given by $V = xy^2\mathbf{i} - 2yz^2\mathbf{j} - \left(zy^2 - \frac{2z^3}{3}\right)\mathbf{k}$. Prove that it is a possible case of steady incompressible fluid flow. Calculate the velocity and acceleration at the point (1,2,3). | (8) |
| 3 | a) Differentiate between piezometer and pressure gauges. | (2) |
| | b) In a 2D incompressible fluid flow, the fluid velocity components are given by $\mathbf{U} = x - 4\mathbf{y}$ and $\mathbf{V} = -\mathbf{y} - 4\mathbf{x}$. Show that velocity potential exists and determine its form. Find also the stream function. | (13) |

PART B

Answer any two full questions, each carries 15 marks

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|---|--|------|
| 4 | a) State Bernoulli's theorem for a steady flow of an incompressible fluid. Derive an expression for Bernoulli's theorem from the first principle and state the assumptions made for such a derivation. | (10) |
| | b) Describe with the help of sketch, the operation and use of Pitot-static tube. | (5) |
| 5 | a) Define the following: | (5) |
| | i) Coefficient of discharge ii) Coefficient of velocity | |
| | iii) Coefficient of contraction iv) Vena-contracta | |
| | b) A rectangular orifice of 1.5 m wide and 1.2 m deep is fitted in one side of a large tank. The water level on one side of the orifice is 2 m above the top edge of the orifice, while on the other side of the orifice, the water level is 0.4 m below the top edge. Calculate the discharge through the orifice if $C_d = 0.62$. | (10) |
| 6 | a) Find the discharge of water flowing through a pipe 20cm diameter placed in an inclined position, where a Venturi meter is inserted, having a throat diameter of 10 cm. the difference of pressure between the main and throat is measured by a liquid of sp. gr. 0.4 in an inverted U-tube, which gives a reading of 30 cm. The loss of head between the main and throat is 0.2 times the kinetic head of pipe. | (10) |
| | b) What is a Cipolletti weir? Derive an expression for discharge through it. | (5) |

PART C

Answer any two full questions, each carries 20 marks

- 7 a) A fluid of viscosity 0.7Ns/m^2 and specific gravity 1.3 is flowing through a circular pipe of diameter 200mm. The maximum shear stress at the pipe wall is given as 196.2 N/m^2 . Find: (10)
- i) Pressure gradient
 - ii) Average velocity
 - iii) Reynold's number of the flow.
- b) Derive an expression for the loss of head due to friction in pipes. (10)
- 8 a) Define the following: (10)
- i) Laminar boundary layer
 - ii) Turbulent boundary layer
 - iii) Laminar sub layer
- b) What is meant by boundary layer separation? What is the effect of pressure gradient on boundary layer separation. (10)
- 9 a) A horizontal pipe-line 50 m long is connected to a water tank at one end and discharges freely into the atmosphere at the other end. For the first 30 m of its length from the tank, the pipe is 200 mm diameter and its diameter is suddenly enlarged to 400 mm. The height of water level in the tank is 10 m above the centre of the pipe. Considering all minor losses, determine the rate of flow. Take $f = 0.01$ for both sections. Also draw the hydraulic gradient line and total energy line. (10)
- b) Water is flowing over a thin smooth plate of length 4 m and width 2m at a velocity of 1 m/s^2 . If the boundary layer flow changes from laminar to turbulent at a Reynold number 5×10^5 . Find: (10)
- 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 $9.81 \times 10^{-4}\text{ Ns/m}^2$.
