

Reg No. \_\_\_\_\_ Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
**THIRD SEMESTER B.TECH DEGREE EXAMINATION, JANUARY 2017**Course Code: **CE203**Course Name: **FLUID MECHANICS – I (CE)**

Max. Marks: 100

Duration: 3 Hours

**PART A***Answer any two Questions.*

1. a) A triangular plate of 1 metre base and 1.5 metre altitude is immersed in water. The plane of the plate is inclined at  $30^\circ$  with free water surface and the base is parallel to and at a depth of 2 metres from water surface. Find the total pressure on the plate and the position of centre of pressure. (10)  
b) Explain the terms circulation and vorticity. (5)
2. a) Show that a cylindrical buoy 1.25m diameter and 3.25m high weighing 11127 N will not float vertically in sea water weighing  $10055 \text{ N/m}^3$ . Find the tension necessary in a vertical chain attached to the centre of the base of the buoy that will just keep the cylinder vertical. (13)  
b) Differentiate between the Eulerian and Lagrangian methods of representing fluid flow. (2)
3. a) The velocity vector in an incompressible flow is given by  $V = (6xt + yz^2)\mathbf{i} + (3t + xy^2)\mathbf{j} + (xy - 2xyz - 6tz)\mathbf{k}$  (i) Verify whether continuity equation is satisfied. (ii) Determine the acceleration and velocity at point A (1,1,1) at  $t=1$ . (12)  
b) Differentiate between simple manometer and differential manometer (3)

**PART B***Answer any two Questions*

4. The diameter of a pipe bend is 30 cm at inlet and 15 cm at outlet and the flow is turned through  $120^\circ$  in a vertical plane. The axis at inlet is horizontal and the centre of the outlet section is 1.5 m below the centre of the inlet section. Total volume of water in the bend is  $0.9 \text{ m}^3$ . Neglecting friction, calculate the magnitude and direction of the force exerted by the bend on the water flowing at 250 litres/s and when the inlet pressure is  $0.15 \text{ N/mm}^2$ . (15)
5. a) What are the forces and assumptions considered in the derivation of Euler's equation of motion? (5)  
b) The flow in a 2 m wide rectangular channel is measured by a rectangular weir 1m long and 0.6 m high. 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)

6. a) A circular tank of diameter 3 m contains water up to a height of 4 m. The tank is provided with an orifice of diameter 0.4 m at the bottom. Find the time taken by water, (i) to fall from 4 m to 2 m and (ii) for completely emptying the tank. Take  $C_d = 0.6$ . (10)
- b) Define energy correction factor and momentum correction factor. (5)

### PART C

#### *Answer any two Questions*

7. a) Derive the Hagen –Poiseuille equation for laminar flow in circular pipes. (10)
- b) A piping system consists of three pipes arranged in series; the lengths of the pipes are 1200 m, 750 m and 600 m and diameters 750 mm, 600 mm and 450 mm respectively. (i) Transform the system to an equivalent 450 mm diameter pipe, and (ii) Determine an equivalent diameter for the pipe, 2550 m long. (10)
8. a) The velocity distribution in the boundary layer is given by  $u/U = 2(y/\delta) - (y/\delta)^2$ ,  $\delta$  being boundary layer thickness. Find (i) the displacement thickness, (ii) the momentum thickness and (iii) the energy thickness. (10)
- b) What are the major and minor losses in a pipeline? (5)
- c) Define momentum thickness and energy thickness. (5)
9. a) What is the difference between friction drag and pressure drag? (5)
- b) Calculate the friction drag on a plate 0.15 m wide and 0.45 m long placed longitudinally in a stream of oil flowing with a free stream velocity of 6 m/s. Also find the thickness of the boundary layer and shear stress at the trailing edge. Specific gravity of oil is 0.925 and its kinematic viscosity is  $0.9 \times 10^{-4} \text{ m}^2/\text{s}$ . (10)
- c) Define Hydraulic Grade Line and Total Energy Line. (5)

\*\*\*

Reg. No. \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
**THIRD SEMESTER B.TECH DEGREE EXAMINATION, JULY 2017**

**CE203: FLUID MECHANICS -I**

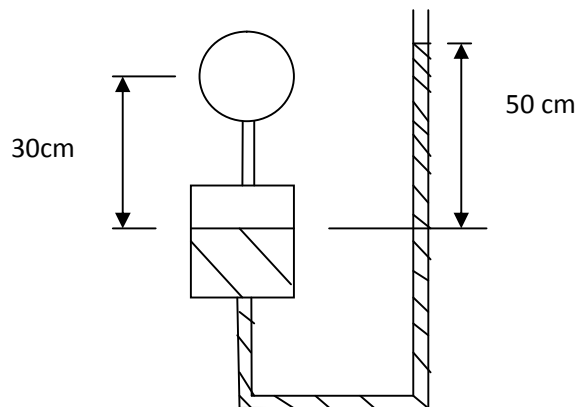
Max. Marks: 100

Duration: 3Hours

**PART A**

*Answer any two full questions.*

1. a. A wooden block of 1m side cube of relative density 0.7 floats in water. Determine the volume of concrete of relative density 2.5 that needs to be placed on it so that the block is just immersed in water. (8)
- b. A single column vertical manometer with a reservoir to is connected to a pipe containing oil of specific gravity 0.9. The area of reservoir is 100 times the area of the manometric tube. The reservoir contains mercury of specific gravity 13.6. The level of mercury in the reservoir is at depth 30cm below the centre of pipe. If the difference of mercury levels in the reservoir and the right limb is 50cm, calculate the pressure in the pipe. (7)



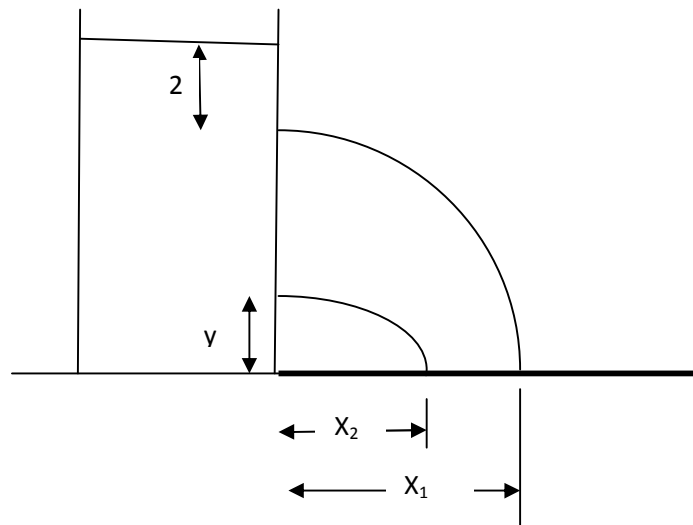
2. a. A circular plate of 0.3m diameter is immersed in water at an inclination  $60^\circ$  to the free surface with its top edge at 1m below the water surface. Find the total pressure and the centre of pressure on the plate. (7)

- b. Show that  $u = 3x + y$  and  $v = 2x - 3y$  are the velocity components of a fluid flow. Also find the circulation around a rectangle  $A(-2, 0)$ ,  $B(2, 0)$ ,  $C(2, 2)$ ,  $D(-2, 2)$  (8)
3. A pipe diameter changes from 0.5m to 1m in a length of 0.785m<sup>3</sup>/s flows from 0.5m diameter section towards 1m diameter section. Determine the convective acceleration at 0.3m from the entrance. If the discharge is increased from 0.785m<sup>3</sup>/s to 1.570m<sup>3</sup>/s in 10 seconds, determine the total acceleration at the exit. (15)

### PART B

*Answer any two full questions.*

4. a. Water under pressure of  $4 \times 10^{-3}$  N/m<sup>2</sup> is flowing through a pipe at the rate of 0.25m<sup>3</sup>/s. If the pipe is bent such that the internal angle between the two limbs of the bend is 135°, find the magnitude and direction of the resultant force on the bend. (10)
- b. What is Cippoletti weir? Show how the effect of end contraction is compensated in a Cippoletti weir. (5)
5. A rectangular tank resting on ground is filled with water for a depth of 10m. There are two orifices on the side of the tank, one at 2m below the water surface and the other at a height of  $y$  from the bottom. The water jets coming out of the two orifices strike on the ground such that  $x_2 = \frac{3x_1}{4}$  as shown in the figure. Find the value of  $y$



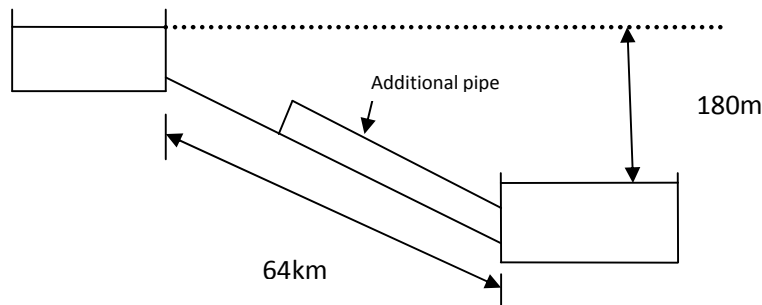
(15)

6. a. A submerged weir 2m long has height of water on the upstream 0.15m and downstream 0.075m above the top of the weir. Find the discharge over the weir, if the coefficients of discharge for free and drowned portions are 0.58 and 0.8 respectively. (8)
- b. Oil of specific gravity 0.75 flows through a 15cm diameter pipe under a pressure of  $98.1\text{kN/m}^2$ . If the datum is 3m below the centre of the pipe and the total energy per unit weight with respect to datum is 20m, calculate the discharge (7)

### PART C

*Answer any two full questions.*

7. Derive the Hagen – Poiseuille equation for laminar flow through a pipe. (20)
8. Two reservoirs with a difference in water levels of 180m are connected by a 64km long pipe of 600mm diameter and darcy's friction factor  $f = 0.015$ . Determine the discharge through the pipe. In order to increase this discharge by 50% another additional pipe of the same diameter is laid from the first pipe and connected to the reservoir. Determine the length of the additional pipe. (20)



9. a. A rectangular flat plate of length  $a$  and width  $b$  is towed length-wise through water with velocity  $U_a$  and subsequently width-wise with velocity  $U_b$ . The boundary layer is laminar and the plate experiences equal drag in both cases. Determine the ratio of velocities  $U_a$  and  $U_b$  in terms of dimensions of the plate. (10)
- b. Water is delivered by a 15cm diameter pipe at 60 litres per second. Calculate the pressure difference between two points 300m apart on the same horizontal line. (Take friction factor = 0.022) (10)

\*\*\*

Reg No.: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
**THIRD SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2017**

**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) Two pipelines, one carrying oil of relative density 0.9 and other carrying water are connected to a manometer as shown in Figure 1. By what amount, the pressure in water pipeline should be increased so that mercury levels in both the limbs of the manometer become equal? (8)

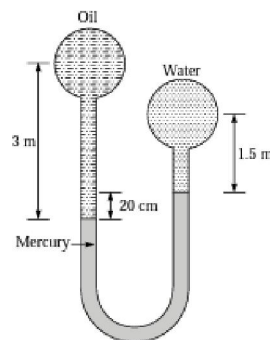


Figure 1.

- b) Obtain an expression for centre of pressure of a lamina paced in inclined position. (7)
- 2 a) Derive continuity equation in three dimensional Cartesian coordinates. (7)
- b) A rectangular barge 16 m x 5 m has a depth of immersion of 1.6 m when floating horizontally. The centre of gravity of the barge is 1.9 m above the bottom. Determine the angle of tilt if a 50 kN weight is moved across the deck by 3.5 m. (8)
- 3 a) In a 2-dimensional steady incompressible flow, the velocity components  $u, v$  are given by  $u = 2x - x^2y + \frac{y^3}{3}$ ,  $v = xy^2 - 2y - \frac{x^3}{3}$ . Determine the acceleration at P(1,3). (6)
- b) A door in a tank retaining water is in the form of a quadrant of a cylinder of 1.5 m radius and 1.8 m wide as shown in Figure 2. Calculate the resultant force on the gate. (9)

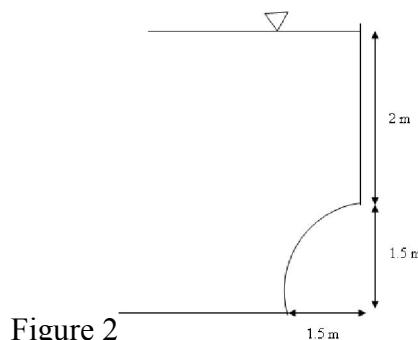


Figure 2

**PART B**

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

- 4 a) Water is flowing through an inclined venturimeter in the upward direction. The inlet and throat diameters of the venturimeter are 200 mm and 100 mm respectively. The pressure at inlet is  $19.62 \text{ N/cm}^2$  (gauge) and at throat is  $3.92 \text{ N/cm}^2$  (vacuum). The length between inlet and throat of the venturimeter is 500 mm and is inclined at  $60^\circ$  with horizontal. Find the discharge through the venturimeter. Take  $C_d=0.98$ . (9)
- b) Differentiate kinetic energy correction factor and momentum correction factor. (6)
- 5 a) A tank has an upper cylindrical portion of 2.5 m diameter and 3 m high with hemispherical base. Find the time required to empty it through an orifice of 8 cm diameter at the bottom, if the tank is initially full of water. Take  $C_d=0.6$ . (10)
- b) Explain the experimental method of determination of orifice coefficients. (5)
- 6 a) Water flows first over a 1 m wide trapezoidal weir at a depth of 0.2 m with a water surface width of 1.5 m and then through a right angled triangular weir installed in a channel. Find the depth of water over the triangular weir if the coefficient of discharge of trapezoidal and triangular weir are 0.62 and 0.6 respectively. (8)
- b) Obtain the condition for maximum discharge over a broad crested weir. Also state its discharge equation. (7)

**PART C**

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

- 7 a) Derive Hagen-Poiseuille equation for laminar flow through circular pipes. (10)
- b) Two parallel plates kept 100 mm apart have laminar flow of oil between them with a maximum velocity of 1.5 m/s. Calculate (i) velocity at 2 cm from the plate (ii) pressure difference between two points 20 m apart, if the viscosity of oil is 24.53 Poise. (10)
- 8 a) Differentiate hydraulic gradient line and total energy line. (5)
- b) A 250 mm diameter, 3 km long straight pipe runs between two reservoirs of surface elevation 135 m and 60 m. A 1.5 km long 300 mm diameter pipe is laid parallel to the 250 mm diameter pipe from its mid-point to the lower reservoir. Neglecting all minor losses and assuming a friction factor of 0.02 for both pipe, find the increase in discharge caused by addition of 300 mm diameter pipe. (15)
- 9 a) State the characteristics of boundary layer growth over a flat plate. (5)
- b) Explain the methods for controlling boundary layer separation. (5)
- c) A smooth flat plate 2 m wide and 2.5 m long is towed in oil of relative density 0.8 at a velocity of 1.5 m/sec along its length. Find the boundary layer thickness at the trailing edge of the plate and power required for towing the plate. Take kinematic viscosity of oil as 1 stokes. (10)

\*\*\*\*\*

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 <sup>3</sup> .  | (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*

- |   |  |      |
|---|--|------|
| 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  $0.7\text{Ns/m}^2$  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  $196.2\text{ N/m}^2$ . 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  $1\text{ m/s}^2$ . If the boundary layer flow changes from laminar to turbulent at a Reynold number  $5 \times 10^5$ . 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  $9.81 \times 10^{-4}\text{ Ns/m}^2$ .

\*\*\*\*

Reg No.: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
THIRD SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 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 the terms gauge pressure, vacuum pressure and absolute pressure. Indicate their relative positions on a chart.  | (5)   |
|   | b) A cubical tank has sides of 1.5 m. It contains water in the lower 0.6 m depth. The upper remaining portion is filled with oil of relative density 0.9. Calculate for one vertical side of the tank (i) the pressure force and (ii) position of the centre of pressure. | (10)  |
| 2 | a) A solid cylinder of diameter 30 cm and height 15 cm is to float in in water with its axis vertical in sea water (specific gravity 1.03). If the relative density of the cylinder material is 0.9, examine the stability of cylinder.                                   | (9)   |
|   | b) Derive the continuity equation for one dimensional flow.   | (6)   |
| 3 | a) Differentiate between forced vortex flow and free vortex flow  | (4)   |
|   | b) A 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)   |
|   | c) Distinguish between:<br>(i) rotational flow and irrotational flow.<br>(ii) streamline and path-line.   | (4)   |

**PART B**

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

- |   |   |      |
|---|---|------|
| 4 | a) A bend in pipeline conveying water gradually reduces from 0.6 m to 0.3 m diameter and deflects the flow through $60^\circ$ in the anticlockwise direction. At the larger end the gauge pressure is $171.675 \text{ kN/m}^2$ . Determine the magnitude and direction of the force exerted on the bend when the flow is 876 litres/s. The pipe is lying on a horizontal plane. Neglect the losses in the bend. | (12) |
|   | b) Define kinetic energy correction factor.   | (3)  |
| 5 | a) A 40 metres long weir is divided into 12 equal bays by vertical posts, each 0.6 m wide. Taking $C_d = 0.623$ , calculate the discharge over the weir if the head over the crest is 1.20 m and velocity of approach is 2 m/s.   | (7)  |
|   | b) A reservoir discharges through a sluice 0.915 m wide and 1.22 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<br>(i) discharge through the opening if $C_d=0.6$<br>(ii) the percentage error if the opening is treated as a small orifice   | (8)  |

- 6 a) A venturimeter 30 cm x 10 cm is provided in a vertical pipeline to measure the flow of oil of relative density 0.85. The difference in elevations of the throat section and entrance section is 40 cm, the direction of flow of oil being vertically upwards. The oil-mercury differential U tube manometer shows a gauge deflection of 20 cm. Calculate the discharge of oil and the pressure difference between the entrance section and throat section. Take the coefficient of discharge as 0.97 and specific gravity of mercury as 13.6. (10)
- b) Define coefficient of velocity, coefficient of contraction and coefficient of discharge. Find out the relation among the three. (5)

### PART C

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

- 7 a) Derive the Hagen –Poiseuille equation for laminar flow in circular pipes. (10)
- b) A horizontal pipe carrying water suddenly increases its diameter from 10 cm to 20cm. Find out the loss of head due to sudden increase in diameter if the discharge through the pipe is 150 litres/s. Also find out the pressure difference between the two sections. (6)
- c) Define Hydraulic Grade Line and Total Energy Line. (4)
- 8 a) The velocity distribution in the boundary layer is given by:  $\frac{v}{V} = \frac{3}{2}\eta - \frac{1}{2}\eta^3$  (10)  
where  $v$  is the velocity at a distance  $y$  from the plate,  $\eta = \frac{y}{\delta}$  and  $v = V$  at  $y = \delta$ ,  $\delta$  being the boundary layer thickness. Find the displacement thickness and the momentum thickness in terms of  $\delta$
- b) Differentiate between friction drag and pressure drag (4)
- c) What are the factors affecting the boundary layer thickness along a flat plate? (6)
- 9 a) A 0.3 m diameter pipe 2340 m long is connected with a reservoir whose surface is 72 m above the discharging end of the pipe. If for the last 1170 m, a second pipe of the same diameter is laid beside the first and connected to it, what would be the increase in discharge? Neglect minor losses. Take  $f=0.02$ . (10)
- b) Oil of specific gravity 0.85 and viscosity 2.5 Poise is flowing through a 30cm diameter pipe kept horizontally. The length of pipe is 2.5 km and the head loss is 20 m. If the flow is laminar, estimate (i) shear stress at the pipe wall (ii) shear stress at a radial distance of 10 cm from the pipe axis and (iii) the friction factor  $f$ . (10)

\*\*\*\*

Reg No.: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
**THIRD SEMESTER B.TECH DEGREE EXAMINATION(S), May 2019**

**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) A cylinder contains a fluid at a gauge pressure of  $350 \text{ kN/m}^2$ . Express the pressure in terms of head of (a) water, (b) mercury. What would be the absolute pressure in the cylinder if the atmospheric pressure is  $101.3 \text{ kN/m}^2$ ? (5)
- b) An annular ring cut in a sheet metal has 1.5 m outer diameter and 1.0 m inner diameter. It is inserted vertically in a liquid of relative density 0.90 with its centre 1.75 m below the surface. Calculate the total force on one side of this ring and the location of the centre of pressure. (10)
- 2 a) A ship 60 m long and 10 m wide displaces 15000 kN of water. A weight of 200 kN is displaced across the deck through a distance of 5 m and the ship is tilted through  $4.5^\circ$ . The moment of inertia of the ship about the fore - and - aft axis is 80 % of the circumscribing rectangle. The centre of buoyancy is 2 m below the water surface. Determine the metacentric height and the position of the centre of gravity of the ship. Take specific gravity of water as 1.03. (10)
- b) Show that the streamlines and equipotential lines form a net of mutually perpendicular lines. (5)
- 3 a) Differentiate between the Eulerian and Lagrangian methods of representing fluid flow. (3)
- b) The stream function for a flow field is represented by  $\Psi = 2xy$ . Show that the flow exists and is irrotational. (7)
- c) Distinguish between: (5)
- (i) Steady flow and Unsteady flow.
- (ii) Uniform flow and Non uniform flow.

**PART B**

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

- 4 a) 215 l of gasoline (specific gravity 0.82) flow per second upwards in an inclined (12)

venturimeter fitted to a 300 mm diameter pipe. The venturimeter is inclined at  $60^\circ$  to the vertical and its 150 mm diameter throat is 1.2 m from the entrance along its length. Pressure gauges inserted at the entrance and throat show pressures of  $0.141 \text{ N/mm}^2$  and  $0.077 \text{ N/mm}^2$  respectively. Calculate discharge coefficient of the venturimeter. If instead of pressure gauges, the entrance and throat of the venturimeter are connected to the two limbs of a U-tube mercury manometer, determine its reading in mm of differential mercury column

- b) Explain how a pitot tube can be used to find out velocity at any point in a pipeline. (3)
- 5 a) Explain the methods of experimental determination of orifice coefficients (6)
- b) The flow in a 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. (9)
- 6 a) 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? (8)
- b) What is an orifice? How are the orifices classified? (5)
- c) What is a Cipolletti weir? (2)

### PART C

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

- 7 a) Derive Dupuit's equation for pipes in series. (5)
- b) Oil of viscosity 0.97 poise and relative density 0.9 is flowing in a horizontal circular pipe of diameter 100 mm and of length 10 m. If 100 kg of oil is collected at the outlet of the pipe in 30 s, calculate the difference in pressure at the two ends of the pipe. Also, verify that the flow is laminar. (10)
- c) Name the minor and major losses during the flow of liquid through a pipeline. (5)
- 8 a) The velocity distribution in the boundary layer is given by:  $\frac{v}{V} = \frac{y}{\delta}$ , where  $v$  is the velocity at a distance  $y$  from the plate and  $v = V$  at  $y = \delta$ ,  $\delta$  being the boundary layer thickness. Find (i) the displacement thickness, (ii) the momentum thickness and (iii) the energy thickness. (14)
- b) Derive the Darcy-Weisbach equation for head loss in pipes due to friction. (6)
- 9 a) A city water supply main is 1000 m long and delivers a flow of 100 l/s between (10)

two reservoirs with a head difference of 15 m. It is proposed to increase the flow by 30 % by adding another pipe from the upstream reservoir in parallel and joining to the main pipe at a suitable location. Assume all pipes are of same diameter and same friction factor ( $f=0.02$ ). Determine length of the additional pipe.

- b) Discuss the development of boundary layer over a flat plate. (5)
- c) Discuss the phenomenon of separation of boundary layer over curved surface. (5)

\*\*\*\*

Reg No.: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
**THIRD SEMESTER B.TECH DEGREE EXAMINATION(R&S), DECEMBER 2019**

**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) The pressure difference between two points A and B in a pipe conveying oil of specific gravity 0.9 is measured by an inverted U-tube and the column connected to B stands 1.2 m higher than that of A. A pressure gauge attached at A reads  $9.81 \times 10^5 \text{ N/m}^2$ , determine the pressure in the pipe at B. (5)
- b) A hollow equilateral triangular plate of side 4 m on the outside and 2m in the hollow portion is immersed in water with its plane vertical, with its vertex downwards and base upwards, base being parallel to the free surface at a depth of 1m below the free surface. Determine the hydrostatic pressure force on one side of the plate and the depth of centre of pressure. (7)
- c) Define the following terms: (i) Streamline (ii) Path line (iii) Streak line. (3)
- 2 a) A solid cylinder of diameter 3m has a height of 2 m. Find the metacentric height of the cylinder when it is floating in water with its axis vertical. The specific gravity of the cylinder is 0.6. State whether the body is stable or not. (7)
- b) What is a pressure distribution diagram? What are the applications of such diagram? (4)
- c) Calculate the velocity at the point (3, 3) for the velocity potential (4)
- $$\phi = \frac{(y^2 - x^2)}{2} + xy + 6$$
- 3 a) Derive the continuity equation for a three dimensional flow in Cartesian co-ordinates (6)
- b) For the velocity potential function  $\phi = \frac{3(y^2 - x^2)}{2}$ , determine the corresponding stream function. Also estimate the discharge per unit depth in the Z direction passing between the streamlines through the points (1, 3) and (3, 3). (6)
- c) Explain Circulation and Vorticity (3)

**PART B**

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

- 4 a) An orifice meter with orifice diameter 15 cm is inserted in a pipe of 30 cm diameter. The pressure gauges fitted upstream and downstream of the orifice meter give readings of  $14.715 \times 10^4 \text{ N/m}^2$  and  $9.81 \times 10^4 \text{ N/m}^2$  respectively. Find the rate of flow of water through the pipe. Take  $C_d = 0.6$  (7)
- b) State and prove Bernoulli's equation, mentioning the assumptions underlying it. (6)
- c) What is kinetic energy correction factor? (2)
- 5 a) A bend in horizontal pipeline conveying water gradually reduces from 0.6 m to 0.3 m diameter and deflects the flow through angle of  $60^\circ$ . At the larger end the gauge pressure is  $171.65 \text{ kN/m}^2$ . Determine the magnitude and direction of the force exerted on the bend, (i) when there is no flow, (ii) when the flow is 876 l/s. (10)
- b) What is a Cipoletti weir. Show how the effect of end contraction is compensated in a Cippoletti weir (5)
- 6 a) A tank is in the form of a hemisphere of 3m diameter and having a cylindrical upper part of 3 m diameter and 5 m height. Find the time required to empty it through an orifice of 50 mm diameter at its bottom if the tank is initially full of water. Take  $C_d = 0.62$ . (8)
- b) Water flows over a rectangular weir 2 m wide at a depth of 200 mm and afterwards passes through a triangular right angled weir. Taking  $C_d$  for the rectangular and triangular weir as 0.61 and 0.58 respectively, find the depth over the triangular weir. (7)

**PART C**

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

- 7 a) Derive the Hagen-Poiseuille equation for laminar flow in circular pipes. (10)
- b) Determine the rate of flow of water through a pipe of diameter 20 cm and length 50 m when one end of the pipe is connected to a tank and other end of the pipe is open to the atmosphere. The pipe is horizontal and the height of water in the tank is 4 m above the centre of the pipe. Consider all losses and take  $f = 0.036$  (10)
- 8 a) Define Hydraulic Gradient Line and Total Energy Line (5)
- b) A plate of 600 mm length and 400 mm wide is immersed in a fluid of specific (10)

gravity 0.9 and kinematic viscosity  $10^{-4} \text{ m}^2/\text{s}$ . The fluid is moving with a velocity of 6 m/s. Determine (i) boundary layer thickness and (ii) shear stress at the end of the plate. Also find the drag force on one side of the plate

- c) Explain the phenomenon of boundary layer separation (5)
- 9 a) Explain “Moody’s Chart”. What is its use in pipe flow? (4)
- b) Two parallel plates kept 0.1 m apart have laminar flow of oil between them with a maximum velocity of 1.5 m/s. Calculate the discharge per unit width, the shear stress at the plates, the difference in pressure between two points 20 m apart, the velocity gradient at the plates and velocity at 0.02 m from the plate. Take viscosity of oil to be  $2.453 \text{ Ns/m}^2$ . (10)
- c) Explain with neat sketches the growth of boundary layer over a flat plate (6)

\*\*\*\*

Reg No.: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

Third semester B.Tech examinations (S) September 2020

**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) A U-tube differential gauge is attached to the two sections A and B in a horizontal pipe in which oil of specific gravity 0.8 is flowing. The deflection of the mercury in the gauge is 60 cm, the level nearer to A being the lower one. Calculate the difference in pressure between sections A and B. (6)
- b) Explain convective and local acceleration. (4)
- c) What is a flow net? What are its uses? (5)
- 2 a) How is the metacentric height of a body determined experimentally? (5)
- b) A solid cylinder of diameter 5 m has a height of 5 m. Find the metacentric height of the cylinder if the specific gravity of the material of the cylinder is 0.7 and it is floating in water with its axis vertical. State whether the equilibrium is stable or unstable. (10)
- 3 a) The velocity vector in a fluid flow is given  $V = 4x^3 i - 10x^2y j + 2t k$ . Find the velocity and acceleration of a fluid particle at (2, 1, 3) at time  $t = 1$ . (10)
- b) Describe velocity potential function and stream function. (5)

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

- 4 a) A pipe line carrying oil of specific gravity 0.8, changes in diameter from 300 mm at a position A to 500 mm diameter at a position B, which is 5m at a higher level. If the pressure at A and B are  $19.62 \text{ N/cm}^2$  and  $14.91 \text{ N/cm}^2$  respectively and the discharge is 150 litres/sec, determine the loss of head and direction of flow. (6)
- b) A bend in a pipeline conveying water gradually reduces from 0.6 m to 0.3 m diameter and deflects the flow through an angle of  $60^\circ$ . At the larger end the gauge pressure is  $171.675 \text{ kN/m}^2$ . Determine the magnitude and direction of the force exerted on the bend when the flow is 876 litres/s. (9)
- 5 a) A venturimeter is used for measuring the flow of petrol in a pipeline inclined at (9)

35° to the horizontal. The specific gravity of petrol is 0.81 and throat area ratio is 4. If the difference in mercury levels in the gauge is 50 mm, calculate the flow in litres/hour if the pipe diameter is 0.3 m. Take coefficient of discharge of venturimeter as 0.975.

- b) Explain Cipolletti weir and proportional weir. (6)
- 6 a) A weir of length 48 m is divided into 10 equal bays by vertical posts of width 0.5 m. Calculate the discharge over the weir by using Francis formula if the head over the crest of the weir is 1.4 m and the velocity of approach is 2.5 m/s. (7)
- b) An orifice in the side of a large tank is rectangular in shape 1.2 m wide and 0.7 m deep. The water level on one side of the orifice is 1.2 m above the top edge and the water level on the other side of the orifice is 0.25 m below the top edge. Compute the discharge if  $C_d=0.62$ . (7)

### PART C

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

- 7 a) Differentiate between hydraulic gradient line and total energy line. (4)
- b) Derive the expression for loss of head for laminar flow between fixed parallel plates. Also show that the maximum velocity is 1.5 times the average velocity. (12)
- c) Explain Blasius' boundary layer equations for laminar and turbulent boundary layer. (4)
- 8 a) What is meant by boundary layer separation? What are the methods for controlling boundary layer separation? (6)
- b) Find the displacement thickness and momentum thickness for the velocity distribution in the boundary layer given by  $\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2$  (8)
- c) Explain Pressure drag, friction drag, and profile drag. (6)
- 9 a) An oil of viscosity  $0.1 \text{Ns/m}^2$  and relative density 0.9 is pumped through a 32 mm diameter pipe. If the pressure drop per meter length of the pipe is  $20 \text{kN/m}^2$ , find (i) the mass flow rate (ii) maximum shear stress (iii) type of flow and power required per metre length of the pipe to maintain the flow (12)
- b) A flat plate  $2 \text{m} \times 2 \text{m}$  moves at  $40 \text{km/hour}$  in stationary air of density  $1.25 \text{kg/m}^3$ . If the coefficients of drag and lift are 0.2 and 0.8 respectively find the (i) lift force (ii) drag force (iii) resultant force and (iv) power required to keep the plate in motion (8)