

Name:  
Enrolment No:



**UNIVERSITY OF PETROLEUM AND ENERGY STUDIES**  
**End Semester Examination, December 2018**

**Course: Fundamental of Fluid Mechanics (MECH2010)**

**Semester: III**

**Programme: B.Tech-PSE**

**Time: 03 hrs.**

**Max. Marks: 100**

**Instructions:**

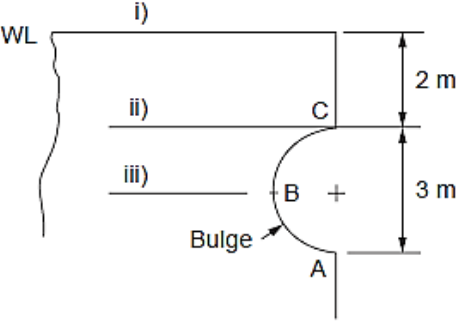
- i. There are three sections viz. Section A, Section B and Section C. Section A carries 20 marks, Section B carries 40 marks and Section C carries 40 marks*
- ii. Attempt all the questions in Section A, and section C*
- iii. Attempt any four in section B*
- iv. Make appropriate assumptions wherever required*

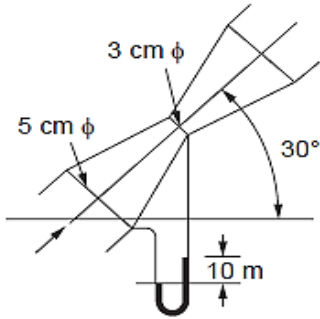
**SECTION A (20 Marks)**

S. No.		Marks	CO
Q 1	Diesel injection nozzle sprays fuel with an average diameter of 0.0254 mm. The surface tension is 0.0365 N/m. Determine the pressure difference between the inside and outside of the nozzle. Also determine the pressure difference if the droplet size is reduced to 10 $\mu\text{m}$ .	5	CO1
Q.2	Determine the stream function for a uniform x directional flow towards the origin from the positive x direction at 5m/s and a source of strength 12 m	5	CO2
Q.3	A tank 0.4 m $\times$ 0.2 m size and of height 0.4 m is filled with water up to a depth of 0.2 m. The mass of the container is 10 kg. The container slides without friction downwards on a surface making 30° with the horizontal. Determine the angle the free surface makes with the horizontal. If the tank is moved up with the same acceleration, determine the slope of the free surface.	5	CO1
Q.4	Three pipes of 400 mm, 350 mm and 300 mm diameter are connected in series between two reservoirs with a difference in level of 12 m. The friction factors are 0.024, 0.021 and 0.019 respectively. The lengths are 200 m, 300 m and 250 m respectively. Determine the flow rate neglecting minor losses.	5	CO3

**Section B (40 Marks)**

Q.5	A hemispherical bulge of 3m diameter inwards is as shown in Figure. Determine for the given dimensions, the magnitude and direction of the resultant force on the wall of the bulge (i) when water is full (ii) water level comes to the top of the bulge and (iii) water level up to the centre of the bulge.	10	CO1
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Q.6	<p>Determine the metacentric height of a ship for rolling (Y - Y-axis) and pitching (X - X-axis) whose plan view is in the form of an ellipse with major axis of 40 m and minor axis of 15 m. The weight of the ship is 9000 kN and the centre of buoyancy is 2 m below the water level and the centre of gravity is 0.5 m below the water level. Assume density of seawater as 1025 kg/m<sup>3</sup>.</p>	10	CO1
Q.7	<p>The drag force acting on a spherical particle of diameter D falling slowly through a viscous fluid at velocity u is found to be influenced by the diameter D, velocity of fall u, and the viscosity <math>\mu</math>. Using the method of dimensional analysis obtain a relationship between the variables.</p>	10	CO2
Q.8	<p>An oil of specific gravity 0.82 and kinematic viscosity <math>16 \times 10^{-6}</math> m<sup>2</sup>/s flows in a smooth pipe of 8 cm diameter at a rate of 2 l/s. Determine whether the flow is laminar or turbulent. Also, calculate the velocity at the centre line and the velocity at a radius of 2.5 cm. What is head loss for a length of 10 m? What will be the entry length? Also, determine the wall shear.</p>	10	CO4
<b>Section C (40 Marks)</b>			
Q.9	<p>Assuming the velocity distribution in the boundary layer as <math>\frac{u}{u_\infty} = \sin\left(\frac{y}{2}\right)</math> (in the range <math>0 \leq y \leq \delta</math> and <math>\frac{u}{u_\infty} = 1</math> beyond <math>\delta</math>) determine the thickness of the boundary layer, using integral momentum method</p>	20	CO4
Q.10	<p>A venturimeter as shown in Figure is used measure flow of petrol with a specific gravity of 0.8. The manometer reads 10 cm of mercury of specific gravity 13.6. Determine the flow rate.</p>	20	CO2



**OR**

Explain how the validity of a given potential function  $\phi$  is established. Validate the potential function given as (i)  $\phi = y^2 - x^2$  (ii)  $\phi = xy$

**CO2**