

Course: B. Tech in Mechanical Engineering

Sem: III

Subject Name: Fluid Mechanics

Subject Code: BTMEC303

Max Marks:60

Date: 05-12-2018

Duration: 3 Hr.

Instructions to the Students:

1. Solve ANY FIVE questions out of the following.
2. The level question/expected answer as per OBE or the Course Outcome (CO) on which the question is based is mentioned in () in front of the question.
3. Use of non-programmable scientific calculators is allowed.
4. Assume suitable data wherever necessary and mention it clearly.

	(Level/CO)	Marks
Q. 1 Solve Any <u>Two</u> of the following.		
A) State and derive Pascal's law.	(Remember)	(6)
B) A cubical block weighing 4.5 N and having a 40 cm edge is allowed to slide down an inclined plane surface making an angle of 30° with the horizontal on which there is a uniform layer of oil 0.005 cm thick. If the expected steady state velocity of the block is 12.5 cm/s, determine viscosity of the oil. Also express the kinematic viscosity in stokes if the oil has mass density of 800 kg/m^3 .	(Apply)	(6)
C) List some occurrences which can be attributed to the physics of surface tension. Set-up a relationship between surface tension and pressure intensity (in excess of outside pressure) for a liquid droplet.	(Analysis)	(6)
Q.2 Solve the following questions.		
A) A rectangular plate 3 m x 5 m is immersed vertically in water such that the 3 m side is parallel to the water surface. Determine the hydrostatic force and centre of pressure if the top surface is i) flush with the water surface ii) 2 m below the water surface.	(Apply)	(6)
B) A solid cylinder of diameter 4.0m has a height of 3m .Find the meta-centric height of the cylinder when it is floating in water with its axis vertical. The specific gravity of the cylinder = 0.6. Comment on the stability of cylinder	(Understand)	(6)
Q. 3 Solve the following questions.		
A) Derive the differential form of continuity equation in Cartesian coordinate system.	(Understand)	(6)
B) A stream function is given as $\psi = 2xy$. Determine i) whether the flow is possible ii) whether the flow is rotational or irrotational	(Analysis)	(6)

Q.4 Solve the following questions.

- A) State Bernoulli's theorem. Derive Euler's equation of motion and from it derive Bernoulli's equation. (Understand) (6)
- B) A horizontal venturimeter with inlet and throat diameters 30 cm and 15 cm respectively is used to measure the flow of water. The reading of differential manometer connected to the inlet and the throat is 20 cm mercury. Determine the rate of flow. Take $C_d=0.98$ (Apply) (6)

Q.5 Solve the following questions.

- A) Derive an expression for the velocity distribution for viscous flow through a circular pipe. (Understand) (6)
- B) Determine the difference in the elevations between the water surfaces in the two tanks which are connected by a horizontal pipe of diameter 300 mm and length 400 m. The rate of flow of water through the pipe is 300 litres/s. Consider all losses and take the value of $f = 0.008$ (Analysis) (6)

Q.6 Solve Any Two of the following questions.

- A) In a compressor, the frictional torque T in the impeller depends on diameter D , rotational speed N , fluid density ρ and viscosity μ . Using Buckingham's π theorem, obtain an expression for torque. (Apply) (6)
- B) The velocity distribution in the boundary layer is given by $\frac{u}{U} = \left(\frac{y}{\delta}\right)^{\frac{1}{7}}$. Calculate the displacement thickness and momentum thickness. (Apply) (6)
- C) What do you understand by the terms drag, lift and coefficient of drag? (Recall) (6)

*** End ***