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Total Number of Pages : 02

B.Tech  
PME31102

3<sup>rd</sup> Semester Regular / Back Examination 2018-19  
FLUID MECHANICS & HYDRAULICS MACHINES

BRANCH : MECH

Time : 3 Hours

Max Marks : 100

Q.CODE : E942

Answer Question No.1 (Part-1) which is compulsory, any EIGHT from Part-II and any TWO from Part-III.

The figures in the right hand margin indicate marks.

Part- I

Q1 Short Answer Type Questions (Answer All-10) (2 x 10)

- Differentiate between ideal fluid and real fluid.
- Discuss the effect of temperature on viscosity of liquid and gas.
- Write down the expression for depth of centre of pressure for a vertically immersed plane and surface inclined at angle ' $\theta$ ' with horizontal
- The Reynold's number for flow of oil in a certain pipe is 640. Determine the Darcy-Weisbach factor  $f$  for this flow.
- Define equivalent pipe?
- Write two characteristics of streamlines.
- Define circulation?
- What are the function of guide blades in reaction turbine.
- What do you mean by priming of a centrifugal pump.
- Write the function of air vessel used in reciprocating pump.

Part- II

Q2 Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve) (6 x 8)

- A glass tube of 8 mm internal diameter is immersed in a liquid at 20<sup>o</sup> C. The specific weight of the liquid is 20601N/m<sup>3</sup>. The contact angle is 60<sup>o</sup> and Surface tension is 0.15 N/m. Calculate the capillary rise and also the radius of curvature of the meniscus.
- Density of sea water at the surface was measured as 1040 kg/m<sup>3</sup> at an atmospheric pressure of 1 bar. At certain depth in water, the density was found to be 1055 kg/m<sup>3</sup>. Determine the pressure at that point. The bulk modulus is 2290 MPa.
- Discuss with a neat diagram showing various positions of G, B and M for different stability conditions for floating and submerged body.
- What are the manometers? How the manometers are classified? Describe the U tube manometer.
- Determine the discharge in a pipe of 300 mm diameter which suddenly expands to 500 mm diameter and in which the hydraulic grade line rises by 10 mm in the expansion.
- Obtain expression for Darcy- Weisbach friction factor  $f$  for laminar flow in a pipe.
- What is patio tube? How is it used to measure velocity of flow at any point in a pipe.
- Derive continuity equation for a compressible fluid in Cartesian co-ordinate .
- In a flow, the velocity vector  $V=3xi+4yj-7zk$ . Determine the equation of a streamline passing through (1,2,3).
- Derive an expression for the pressure head due to acceleration of the piston of a reciprocating pump.
- With a sketch, explain the constructional features of a centrifugal pump.
- A Pelton wheel turbine with mean runner diameter of 1.2 m is running at 1000 rpm. The net head on the wheel is 840 m. If the angle of deflection of jet is 165<sup>o</sup> and discharge through the nozzle is 0.12 m<sup>3</sup>/sec. Determine Power available at the nozzle.

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**Part-III**

**Long Answer Type Questions (Answer Any Two out of Four)**

**Q3** A shaft 80 mm in diameter is being pushed through a bearing sleeve 80.2 mm in diameter and 0.3 m long. The clearance, assumed uniform, is flooded with lubricating oil of viscosity 0.1 kg/ms and specific gravity 0.9 **(16)**

- a) If the shaft moves axially at 0.8 m/s, estimate the resistance force exerted by the oil on the shaft
- b) If the shaft is axially fixed and rotated at 1800 rpm, estimate the resisting torque exerted by the oil and the power required to rotate the shaft.

**Q4** The velocity components in a two dimensional incompressible flow are **(16)**  
 $u = y^3/3 + 2x - x^2y$        $v = xy^2 - 2y - x^3/3$

- a) Determine the velocity and acceleration at point (x=1 and y=3)
- b) What is the discharge between streamlines passing through (1,3) and (2,3)
- c) Is the flow irrotational? If so, determine the corresponding velocity potential.
- d) Show that each of the stream, and potential functions satisfy Laplace equation.

**Q5** The following data relate to an inclined venturimeter. **(16)**

Diameter of the pipe line = 400 mm  
Inclination of the pipeline with the horizontal =  $30^\circ$   
Throat diameter = 200 mm  
The distance between the mouth and throat of the meter = 600 mm  
Specific gravity of the oil flowing through the pipeline = 0.7  
Specific gravity of heavy liquid (U-tube) = 13.6  
Reading of the differential manometer = 50 mm  
The coefficient of the venturimeter = 0.98  
Determine the rate of flow in the pipeline.

**Q6** A Francis turbine has a diameter of 1.4 m and rotates at 430 rpm. Water enters the **(16)**

runner without shock with a flow velocity of 9.5 m/s and leaves the runner without whirl with an absolute velocity of 7 m/s. The difference between the sum of the static and potential heads at entrance to the runner and at the exit from the runner is 62 m. The turbine develops 12.25 MW. The flow rate through the turbine is  $12 \text{ m}^3/\text{s}$  for a net head of 115 m.

Find the following:

- a) the absolute velocity of water at entry to the runner and the angle of the inlet guide vanes.
- b) the entry angle of the runner blades and
- c) the loss of head in the runner