Code No: R2021032 **R20** SET - 1

II B. Tech I Semester Supplementary Examinations, July - 2023
FLUID MECHANICS & HYDRAULIC MACHINES
(Com to ME, AME)

Time: 3 hours Max. Marks: 70

Answer any **FIVE** Questions each Question from each unit
All Questions carry **Equal** Marks
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UNIT-I

1 a) What is viscosity? Define and explain Newton's law of viscosity. Explain how the fluids are classified. [7M]

b) A solid of 300 mm diameter and 1000 mm length has its base 25 mm thick and specific gravity 6. The remaining part of the cylinder is of specific gravity 0.7. State, if it can float vertically in water. [7M]

OR

2 a) A single column vertical manometer is connected to a pipe containing oil of specific gravity is 0.8. the area of the reservoir is 70 times the area of the manometer tube. The reservoir contains mercury of specific gravity is 13.6. The level of mercury levels in the reservoir is at a height of 250 mm below the centre of the pipe and difference of mercury levels in the reservoir and right limb is 450 mm. Find the pressure in the pipe. [7M]

b) What is metacentric height? Determine the metacentric height by using analytical method. [7M]

UNIT-II

3 a) Explain in detail about the fluid flow is classification. [7M]

b) Derive Darcy-Weisbach equation. Explain its importance. [7M]

OR

4 a) Derive the one-dimensional equation of continuity for a cartesian coordinate system for a non-viscous flow [7M]

b) A pipe of 300 mm long slopes down at 1 in 100 and tapers from 400 mm diameter at higher end to 200 mm at the lower end, carries 100 $litres/$ sec $of\ oil$ ($sp.gravity$ 0.8). If the pressure gauge show at higher end as 70 kN/m^2, Determine : [7M]

(i) Velocities at two ends,
(ii) Pressure at lower end.

Neglect all losses in the pipe.

UNIT-III

5 a) What is boundary layer? Explain the characteristics of a boundary layer over a flat plate. [7M]

b) The discharge Q of a centrifugal pump depends upon the mass density of fluid (ρ), the speed of the pump (N), the diameter of the impeller (D), the manometric head (H_m), and the viscosity of the fluid (μ). Show that [7M]

$$Q = ND^3\emptyset\left(\frac{gH}{N^2D^2}, \frac{\mu}{\rho ND^3}\right)$$

OR
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6 a) The velocity distribution in the boundary layer is given by $\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2$, δ being boundary layer thickness. Calculate the following; [7M]
   (i) Displacement thickness, ii) Moment thickness,
   (ii) Energy equation.

   b) The pressure drop Δp in a pipe of diameter D and length l depends on the density ρ and viscosity μ of fluid flowing, mean velocity v of flow and average height of protuberance t. Show that the pressure drop can be expressed in the form: [7M]

$$= \rho v^2 \emptyset\left(\frac{l}{D}, \frac{\mu}{vD\rho}, \frac{t}{D}\right)$$

UNIT-IV

7 a) Derive the forces exerted on a curved vane when the plate is moving in the direction of jet, for single vane. [7M]

   b) A jet of water moving at 15 m/s impinges on a concave shaped vane to deflect the jet through 100° when stationary. The vane is moving at 6 m/s. Find : [7M]
   (i) The angle of jet so that there is o shock at inlet,
   (ii) The absolute velocity of the jet at exit in magnitude and direction,
   (iii) The work done per second per N of water. Assume that vane is smooth.

OR

8 a) What is a hydraulic turbine? How are hydraulic turbines classified? [7M]

   b) A Pelton wheel having a mean bucket diameter of 1.5 m is running at 1100 r.p.m. The net head of the Pelton wheel is 900 m. If the side clearance angle is 17° and discharge through the nozzle is 0.18 m^3, determine : [7M]
   (i) Power available at the nozzle,
   (ii) Hydraulic efficiency of the turbine.

UNIT-V

9 a) In a hydroelectric generating plant there are four similar turbines of total output 250000 kW. Each turbine is 90% efficient and runs at 120 r.p.m. under a head of 70 m. It is proposed to test the model of the turbine in a flume where discharge is 0.5 m^3/s under a head of 6 m. Determine the size(scale ratio) of the model. Also calculate the model speed and power results expected from the model. [7M]

   b) List the component parts of the centrifugal pump and explain them briefly. Also explain the following efficiencies of a centrifugal pump: [7M]
   (i) Manometric efficiency,
   (ii) Mechanical efficiency,
   (iii) Volumetric efficiency,
   (iv) Overall efficiency.

OR

10 a) What is a hydraulic coupling? Explain in detail the working principle and mention its advantages. [7M]

b) A centrifugal pump running at 1000 r.p.m. is working against a total head of 20.8 m. The external diameter of the impeller is 500 mm and outlet width 70 mm. If the vane angles at outlet is 45° and manometric efficiency is 75% , determine, [7M]

(i) Flow velocity at outlet,
(ii) Absolute velocity of the water leaving the vane,
(iii) Angle made by the absolute velocity at outlet with the direction of motion at outlet,
(iv) Rate of flow through pump.