Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 70284

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2021.

Third/Fourth Semester

Mechanical Engineering

CE 6451 — FLUID MECHANICS AND MACHINERY

(Common to : Aeronautical Engineering/Automobile Engineering/Industrial Engineering/Industrial Engineering and Management/Manufacturing Engineering/Mechanical and Automation Engineering/Mechatronics Engineering/Production Engineering)

(Regulations 2013)

(Also Common to : PTCE 6451 – Fluid Mechanics and Machinery for B.E. (Part-Time) – Mechanical Engineering – Second Semester – (Regulations – 2014))

Time : Three hours　　　　Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. A clean tube of diameter 2.5 mm is immersed in a liquid with a coefficient of surface tension as 0.4 N/m. The angle of contact of the liquid with the glass can be assumed to be 135 degree. The density of liquid is 13600 kg/m^3. What would be the level of the liquid in the tube relative to the free surface of the liquid inside the tube?

2. State Bernoulli's theorem.

3. What are equivalent pipes? Mention the equation used for it.

4. Define Boundary Layer.

5. Brief on Euler number.

6. What is meant by kinematic similarity?

7. Define the manometric efficiency and the mechanical efficiency of a pump.

8. What are operating characteristic curves of centrifugal pump?

9. Write short notes on draft tube.

10. Define the volumetric efficiency of the turbine.

PART B — ($5 \times 13 = 65$ marks)

11. (a) If the velocity distribution of a fluid over a plate is given by $u = ay^2 + by + c$ with the vertex 0.2 m from the plate, where the velocity is 1.2 m/s. Calculate the velocity gradients and shear stresses at a distance of 0 m, 0.1 m and 0.2 m from the plate, if the viscosity of the fluid is 0.85 Ns/m^2.

Or

(b) A pipe 200 m long slopes down at 1 in 100 and tapers from 600 mm diameter at the higher end to 300 mm diameter at the lower end, and carries 100 litres/sec of oil having specific gravity 0.8. If the pressure gauge at the higher end reads 60 kN/m^2, determine the velocities at the two ends and also the pressure at the lower end. Neglect all losses.

12. (a) Prove that the maximum velocity in a circular pipe for viscous flow is equal to two times the average velocity of flow.

Or

(b) Derive an expression for the major loss in pipe flows.

13. (a) A 1:100 model is used for model testing of ship. The model is tested in wind tunnel. The length of ship is 400 m. The velocity of air in the wind tunnel around the model is 25 m/s and the resistance is 55 N. Determine the length of model. Also find the velocity of ship as well as resistance developed. Take density of air and sea water as 1.24 kg/m^3 and 1030 kg/m^3. The kinematic viscosity of air and seawater are 0.018 stokes and 0.012 stokes respectively. (13)

Or

(b) Using Buckingham's π theorem, show that the velocity through a circular orifice is given by $V = \sqrt{2gH}\,\phi\left[\frac{D}{H}, \frac{\mu}{p\upsilon H}\right]$, where H is the head causing flow, D is the diameter of the orifice, μ is coefficient of viscosity, ρ is the mass density and g is the acceleration due to gravity. (13)

14. (a) An axial flow pump running at 620 rpm deliver 1.5 m^3/s against a head of 5.2 m. The speed ratio is 2.5. The flow ratio is 0.5. The overall efficiency is 0.8. Determine the power required and the blade angles at the root and tip and the diffuser blade inlet angle. Inlet whirl is zero.

Or

(b) Discuss about air vessel used with reciprocating pump. A single acting reciprocating pump handles water. The bore and stroke of the unit are 22 cm and 32 cm. The suction pipe diameter is 12 cm and length is 10 m. The delivery pipe diameter is 12 cm and length is 30 m. Take frictional factor as 0.02. The speed of operations 32 rpm. Determine the friction power with and without air vessels.

15. (a) Design a Pelton wheel for a head of 400 m when running at 750 rpm. The pelton wheel develops l2,110 kW shaft power. The ratio of Jet diameter to the wheel diameter is 1/6. The overall efficiency, $\eta_0 = 0.86$, Coefficient of velocity $C_V = 0.985$ and Speed ratio, $\Phi = 0.45$. (13)

Or

(b) A Francis turbine with an overall efficiency of 70% is required to produce147.15 kW. It is working under a head of 8m. the peripheral velocity$=0.30\sqrt{2gH}$ and the radial velocity of the flow at inlet is $0.96\sqrt{2gH}$. The wheel runs at 200 rpm and the hydraulic losses in the turbine are 20% of the available energy. Assume radial discharge, determine (i) guide blade angle, (ii) wheel vane angle at inlet, (iii) diameter of wheel at inlet and (iv) width of wheel at inlet. Draw the suitable velocity triangle. (13)

PART C — (1 × 15 = 15 marks)

16. (a) A liquid has a specific gravity of 0.72. Find its density, specific weight and its weight per litre of the liquid. If the above liquid is used as the lubrication, between the shaft and the sleeve of length 100 mm. Determine the power lost in the bearing, where the diameter of the shaft is 0.5 m and the thickness of the liquid film between the shaft and the sleeve is 1 mm. Take the viscosity of fluid as 0.5 N-s/m^2 and the speed of the shaft rotates at 200 rpm. (15)

Or

(b) For a high head storage capacity dam of net head 800 m, it has been decided to design and install a Pelton wheel for generating power of 13,250 kW running at a speed of 600 RPM, if the coefficient of jet is 0.97 Speed Ratio = 0.46 and the Ratio of jet diameter is 1/15 of the wheel diameter calculate (i) Numbers of jets, (ii) Diameter of jets, (iii) Diameter of Pelton wheel, (iv) No of buckets and (v) Discharge of one jet. (15)