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

Question Paper Code : 27113

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2015.

Third Semester

Mechanical Engineering

CE 6451 — FLUID MECHANICS AND MACHINERY

(Common to Aeronautical Engineering, Automobile Engineering, Mechatronics Engineering, Mechanical and Automation Engineering and Production Engineering and also common to Fourth Semester Industrial Engineering, Industrial Engineering and Management and Manufacturing Engineering)

(Regulations 2013)

Time : Three hours Maximum : 100 marks

Any missing data can be suitably assumed

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Calculate the specific weight and specific gravity of 1 litre of a liquid with a density of 713.5 kg/m^3 and which weighs 7N.

2. Explain the variation of viscosity with temperature.

3. Differentiate Hydraulic Gradient Line and Total Energy Line.

4. Define Boundary layer thickness.

5. Define Dimensional homogeneity.

6. Derive the expression for Reynolds's Number.

7. Explain the cavitation problem in Centrifugal pumps.

8. Define slip of the Reciprocating pump.

9. Write short notes on draft tube.

10. Define the volumetric efficiency of the turbine.

PART B — (5 × 16 = 80 marks)

11. (a) With basic assumptions derive the Bernoulli's Equation from the Euler's Equation. (16)

Or

(b) (i) Water is flowing through a pipe of diameter 30 cm and 20 cm at sections 1 and 2 respectively. The rate of flow through pipe is 35 lps. The section 1 is 8m above datum and section 2 is 6m above datum. If the pressure at section 1 is 44.5 N/cm^2 . Find the intensity of pressure at section 2. (8)

(ii) Calculate the dynamic viscosity of oil which is used for lubrication between a square plate of size 0.8m × 0.8m and an inclined plane with angle of inclination 30°. The weight of the square plate is 330 N and it slide down the inclined plane with a uniform velocity of 0.3 m/s. The thickness of the oil film is 1.5 mm. (8)

12. (a) Derive the expression for shear stress and velocity distribution for the flow through circular pipe and using that derive the Hagen Poiseuille formula. (16)

Or

(b) Three pipes of 400 mm, 200 mm and 300 mm diameters have lengths of 400 m, 200 m and 300 m respectively. They are connected in series to make a compound pipe. The ends of the compound pipe are connected with two tanks whose difference of water levels is 16 m. If the coefficient of friction for these pipes is same and equal to 0.005, determine the discharge through the compound pipe neglecting first the minor losses and then including them. (16)

13. (a) Using Buckingham's π theorem, show that the velocity through a circular orifice is given by $v=\sqrt{gH\Phi}\left[\frac{D}{H},\frac{\mu}{\rho vH}\right]$, where H is the head causing flow, D is the diameter of the orifice, μ is the coefficient of viscosity, ρ is the mass density and g is the acceleration due to gravity. (16)

Or

(b) (i) Explain similitude with types of similarities. (8)

(ii) The ratio of lengths of a submarine and its model is 30:1. The speed of the prototype is 10 m/s. The model is to be tested in a wind tunnel. Find the speed of air in wind tunnel. Also determine the ratio of the drag between the model and prototype. Take values of kinematic viscosities of sea water and air as 0.012 stokes and 0.016 stokes respectively. The density of sea water and air is given as 1030 kg/m^3 and 1.24 kg/m^3 respectively. (8)

14. (a) (i) Explain the working principle with the main parts of Centrifugal pump. (8)

(ii) The internal and external diameters of the impeller of a centrifugal pump are 300 mm and 600 mm respectively. The pump is running at 1000 rpm. The vane angles of the impeller at inlet and outlet are 20° and 30° respectively The water enters the impeller radially and velocity of flow is constant. Determine the work done by the impeller per unit weight of water. Sketch the velocity triangle. (8)

Or

(b) (i) Explain the working principle of a Reciprocating pump with a neat sketch. (8)

(ii) A single acting reciprocating pump running at 60 rpm delivers 0.02 m^3/s of water. The diameter of the piston is 250 mm and stroke length 450 mm. Determine (1) theoretical discharge of the pump, (2) coefficient of discharge (3) slip of pump and (4) % slip of the pump. (8)

15. (a) Design a Pelton wheel for a head of 400 m when running at 750 rpm. The pelton wheel develops 12,110 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, $\Phi = 0.45$. (16)

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 200rpm 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. (16)
