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

Question Paper Code : 77070

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 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)

(Regulation 2013)

Time : Three hours Maximum : 100 marks

Any missing data can be suitably assumed.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Calculate the mass density and specific volume of one litre of a liquid which weighs 7 N.

2. What is the use of control volume?

3. Write the expression for calculating the loss due to sudden expansion of the pipe.

4. Give the classification of boundary layer flow based on the Reynolds number.

5. Write the dimension of surface tension and vapour pressure in MLT system.

6. What are the similitudes that should exist between the model and its prototype?

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

8. What are operating characteristic curves of centrifugal pump?

9. Distinguish between an impulse turbine and a reaction turbine.

10. Define specific speed and unit speed of a turbine.

PART B — (5 × 16 = 80 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) Oil flows through a pipe 150 mm in diameter and 650 mm in length with a velocity of 0.5 m/s. If the kinematic viscosity of oil is 18.7×10^{-4} m^2/s, find the power lost in overcoming friction. Take the specific gravity of oil as 0.9.

Or

(b) A pipe line of 0.6 m diameter is 1.5 km long. To increase the discharge, another line of the same diameter is introduced parallel to the first in the second half of the length. Neglecting minor losses, find the increase in discharge if Darcy's friction factor is 0.04. The head at inlet is 300 mm.

13. (a) Using Buckingham π method of dimensional analysis obtain an expression for the drag force R on a partially submerged body moving with a relative velocity V in a fluid; the other variables being the linear dimension L, height of surface roughness K, fluid density ρ and the gravitational acceleration g.

Or

(b) The efficiency η of a fan depends on the density ρ, the dynamic viscosity μ of the fluid, the angular velocity ω, diameter D of the rotor and the discharge Q. Express η in terms of dimensionless parameters. Use Rayleigh's method.

14. (a) A centrifugal pump has an impeller 500 mm in diameter running at 400 rpm. The discharge at the inlet is entirely radial. The velocity of the flow at outlet is 1 m/s. The vanes are curved backwards at outlet at 30° to the wheel tangent. If the discharge of the pump is 0.14 m^3/s, calculate the impeller power and the torque on the shaft.

Or

(b) Explain with a neat sketch the working of a single-acting reciprocating pump. Also obtain the expression for weight of water delivered by the pump per second.

15. (a) Draw inlet and outlet velocity triangles for a Pelton turbine and indicate the direction of various velocity components. Also obtain an expression for the work done per second by water on the runner of the Pelton wheel.

Or

(b) The hub diameter of a Kaplan turbine working under a head of 12 m, is 0.35 times the diameter of the runner. The turbine is running at 100 rpm. If the vane angle of the extreme edge of the runner at outlet is 15° and flow ratio is 0.6, find the diameter of the runner, diameter of the boss and the discharge through the runner. The velocity at the whirl at outlet is given as zero.
