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

Question Paper Code : 97031

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2014.

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)

(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. What is the importance of kinematic viscosity?

2. Define – Incompressible fluid.

3. State the assumptions used in the derivation of the Bernoulli's equation.

4. Differentiate between hydraulic grade line and energy grade line.

5. Brief on Intuitive method. Give some examples.

6. Define – Mach number and state its application.

7. List the losses in centrifugal pump.

8. What is meant by NPSH?

9. State and concise on Euler turbine equation.

10. Define – volumetric efficiency of turbine.

PART B — ($5 \times 16 = 80$ marks)

11. (a) (i) Water flows at the rate of 200 litres per second upwards through a tapered vertical pipe. The diameter at the bottom is 240 mm and at the top 200 mm and the length is 5 m. The pressure at the bottom is 8 bar, and the pressure at the topside is 7.3 bar. Determine the head loss through the pipe. Express it as a function of exit velocity head. (10)

(ii) Determine the viscous drag torque and power absorbed on one surface of a collar bearing of 0.2 m ID and 0.3 m OD with an oil film thickness of 1 mm and a viscosity of 30 centi poise if it rotates at 500 rpm. (6)

Or

(b) (i) The water level in a tank is 20 m above the ground. A hose is connected to the bottom of the tank, and the nozzle at the end of the hose is pointed straight up. The tank is at sea level, and the water surface is open to the atmosphere. In the line leading from the tank to the nozzle is a pump, which increases the pressure of water. If the water jet rises to a height of 27 m from the ground, determine the minimum pressure rise supplied by the pump to the water line. (10)

(ii) A hollow cylinder of 150 mm OD with its weight equal to the buoyant forces is to be kept floating vertically in a liquid with a surface tension of 0.45 N/m^2. The contact angle is 60°. Determine the additional force required due to surface tension. (6)

12. (a) (i) An oil of specific gravity 0.80 and kinematic viscosity 15×10^{-6} m^2/s flows in a smooth pipe of 12 cm diameter at a rate of 150 lit/min. Determine whether the flow is laminar or turbulent. Also, calculate the velocity at the centre line and the velocity at a radius of 4 cm. What is head loss for a length of 10 m? What will be the entry length? Also determine the wall shear. (10)

(ii) Describe the Moody's chart. (6)

Or

(b) Oil at 27°C (ρ = 900 kg/m^3 and μ = 40 centi poise) is flowing steadily in a 1.25-cm-diameter, 40-m-long pipe. During the flow, the pressure at the pipe inlet and exit is measured to be 8.25 bar and 0.97 bar, respectively. Determine the flow rate of oil through the pipe assuming the pipe is

(i) horizontal,

(ii) inclined 20° upward, and

(iii) inclined 20° downward. (16)

13. (a) The power developed by hydraulic machines is found to depend on the head H, flow rate Q, density ρ, speed N, runner diameter D and acceleration due to gravity g. Obtain suitable dimensionless parameters to correlate experimental results. (16)

Or

(b) Obtain a relation using dimensional analysis, for the resistance to uniform motion of a partially submerged body in a viscous compressible fluid. (16)

14. (a) (i) The dimensionless specific speed of a centrifugal pump is 0.06. Static head is 32 m. Flow rate is 50 l/s. The suction and delivery pipes are each of diameter 15 cm. The friction factor is 0.02. Total length is 60 m other losses equal 4 times the velocity head in the pipe. The vanes are forward curved at 120°. The width is one tenth of the diameter. There is a 7% reduction in flow area due to the blade thickness. The manometric efficiency is 80%. Determine the impeller diameter if inlet is radial. (10)

(ii) Explain about the performance characteristics of centrifugal pumps. (6)

Or

(b) (i) A centrifugal pump running at 920 rpm and delivering 0.32 m^3/s of water against a head of 28 m, the flow velocity being 3 m/s. If the manometric efficiency is 80% determine the diameter and width of the impeller. The blade angle at outlet is 25°. (10)

(ii) Discuss the working of Lobe and vane pumps. (6)

15. (a) (i) A Francis turbine developing 16120 kW under a head of 260 m runs at 600 rpm. The runner outside diameter is 1500 mm and the width is 135 mm. The flow rate is 7 m^3/s. The exit velocity at the draft tube outlet is 16 m/s. Assuming zero whirl velocity at exit and neglecting blade thickness determine the overall and hydraulic efficiency and rotor blade angle at inlet. Also find the guide vane outlet angle. (10)

(ii) Discuss about draft tube and its types. (6)

Or

(b) (i) A Kaplan turbine delivers 10 MW under a head of 25 m. The hub and tip diameters are 1.2 m and 3 m. Hydraulic and overall efficiencies are 0.90 and 0.85. If both velocity triangles are right angled triangles, determine the speed, guide blade outlet angle and blade outlet angle. (10)

(ii) Discuss about construction details of Kaplan turbine with a neat sketch. (6)
