



B.E/B.Tech. (Full Time) DEGREE END SEMESTER EXAMINATION, APRIL/MAY 2011

COMMON TO MINING, INDUSTRIAL AND MANUFACTURING ENGINEERING

FOURTH SEMESTER

CE 9211 - FLUID MECHANICS AND MACHINERY

(REGULATION 2008)

Time: 3 hours

Max. Marks: 100

Answer ALL questions

Part – A (10 x 2 = 20 Marks)

1. Define Newtonian and non-Newtonian fluids.
2. State the effect of temperature on fluids.
3. Differentiate between flow through pipes in series and parallel.
4. Write Darcy Weisbach equation in flow through pipes.
5. Distinguish between Rayleigh's method and Buckingham's method.
6. State the necessity of non-dimensional numbers.
7. What do mean by draft tube in turbine.
8. A centrifugal pump with an impeller diameter of 75 mm delivers $4.12 \text{ m}^3/\text{s}$ of water at a head of 20.82 m at 21000 rpm. Compute the Specific speed.
9. Why negative slip will occur in reciprocating pump, express it in terms of suction and delivery stroke?
10. Write the classification of Rotary Pumps.

Part - B (5 x 16 = 80 Marks)

11. (i) Explain the working principles of any two rotary pumps (6)
(ii) The Diameter and stroke length of a single acting reciprocating pump are 12 cm and 20 cm respectively. The lengths of suction and delivery pipes are 8 m and 25 m respectively and their diameters are 7.5 cm. If the pump is running at 40 rpm and suction and delivery heads are 4 m and 14 m respectively, find the pressure head in the cylinder (i) at the beginning of the suction and delivery stroke and (ii) in the middle of suction and delivery stroke. (10)
12. a(i) Determine the viscosity of fluid between the shaft and sleeve, where the diameter of the shaft is 0.3 m and thickness of oil film is 0.03 mm. The force acting on the shaft is 25 N. Take the width of the sleeve as 0.75 m and velocity of oil as 1.6 m/s. (6)
(ii) A 0.4 m x 0.3 m, 90° bend carries $0.5 \text{ m}^3/\text{s}$ oil of specific gravity 0.85 with a pressure of 118 kN/m^2 and 103.46 kN/m^2 at inlet and outlet to the bend respectively. The volume of the bend is 0.1 m^3 . Find the magnitude and direction of the force on the bend. Neglect friction and assume both inlet and outlet sections to be at same horizontal plane. Also assume that water enters the bend at 45° to horizontal. (10)

(OR)

b(i) A U tube differential manometer connects two pressure pipes A and B. Pipe A contains carbon tetrachloride having a specific gravity of 1.594 under a pressure of 1.2 kgf/cm^2 and pipe B contains oil of specific gravity of 0.8 under a pressure of

1.2 kgf/cm². The pipe A lies 2.5 m above pipe B. Find the difference of pressure measured by mercury as fluid filling U – tube. (6)

(ii) Derive an expression for three dimensional continuity equation. (10)

13. a(i) Write the different types of boundary layer thickness. (6)

(ii) Derive an expression for steady laminar flow in a circular pipe and prove that the $U_{max}/V_{mean} = 2$. Also state the velocity and shear stress distribution with diagram. (10)

(OR)

b(i) A pipe line carrying water has a diameter of 0.5 m and is 2.0 km long. To increase the delivery another pipeline of the same diameter is introduced parallel to the first pipe in the second half of this length. Find the increase in discharge in the total head loss in both the cases is 15 m. assume $f = 0.02$ for all the pipes. (6)

(ii) Derive Euler's equation of motion along a stream line and obtain Bernoulli's equation by its integration. (10)

14. a(i) Explain the method of selecting repeating variables. (6)

(ii) A simply supported beam of diameter D , length L , and modulus of elasticity E is subjected to a fluid cross flow of velocity V , density ρ , and viscosity μ . Its center deflection is assumed to be a function of all these variables. Write this proposed function in dimensionless form and derive the relation using Buckingham pi theorem. (10)

(OR)

b(i) Write the different types of model laws. (6)

(ii) A ship 250 m long moves in sea-water, whose density is 1030 kg/m³. A 1:125 model of this ship is to be tested in wind tunnel. The velocity of air in the wind tunnel around the model is 20 m/s and the resistance of the model is 50 N. Determine the velocity of ship in sea-water and also the resistance of the ship in sea-water. The density of air is given as 1.24 kg/m³. Take kinematic viscosity of sea-water and air as 0.012 stokes and 0.018 stokes respectively. (10)

15. a(i) Sketch the flow diagram of inward and outward radial flow reaction turbine. (6)

(ii) A Kaplan turbine runner is to be designed to develop 10,000 BHP. The net available head is 5.50 m. Assume that the speed ratio is 2.09 and flow ratio is 0.68 and the overall efficiency is 60%. The diameter of the boss is 1/3 of the diameter of the runner. Find the diameter of the runner, its speed and its specific speed. (10)

(OR)

(b) (i) Explain with a neat sketch, why dissimilar pumps should not be arranged in series or in parallel. (6)

(ii) A three stage centrifugal pump has impeller of 40 cm in diameter and 2.5 cm wide at outlet. The vanes are curved back at the outlet at 30° and reduce the circumferential area by 15%. The manometric efficiency is 85% and overall efficiency is 75%. Determine the head generated by the pump when running at 12000 rpm and discharging 0.06 m³/s. Also find shaft horse power (10)