ANNA UNIVERSITY, CHENNAI
END SEMESTER EXAMINATION, NOVEMBER 2012
III SEMESTER B.E. (MECHANICAL ENGG.)
CE 9211 FLUID MECHANICS AND MACHINERY

TIME : 3 HOURS **MARKS:100**

Assume any other data if found necessary

PART A (10x2=20 marks)

1. Define capillarity and write the expression for capillary fall.

2. Distinguish between unsteady flow and non-uniform flow.

3. Draw the hydraulic gradient and energy gradient line and highlight them.

4. State the advantage of estimating the size of equivalent pipe.

5. Highlight the limitation in using Rayleigh's method.

6. What is meant by kinematic similarity?

7. Define specific speed of a turbine.

8. State the condition for best efficiency of a centrifugal pump at inlet.

9. Write the relation to calculate discharge in the reciprocating pump if the diameter of the piston rod is not neglected.

10. State any two important advantages of rotary pumps.

PART B (5x16=80 marks)

11. (a) Describe the working principle of a double acting reciprocating pump. Explain how exactly an ideal indicator diagram could be depicted. (8)

    (b) A single acting reciprocating pump has a cylinder 200 mm in diameter and a stroke of 400 mm. The delivery pipe is 75 mm in diameter and 40 m long. Taking f = 0.01 find the power saved by fitting a large air vessel to the delivery pipe. The pump runs at 60 rpm. The air vessel is fitted 2 m away from the cylinder. (8)

12. (a)(i) Distinguish between specific mass and specific gravity. A vertical cylindrical tank of diameter 10 m and depth 5 m contains water at 20°C to the brim. If the water is heated at 50°C, how much water will spill over the edge of the tank. Specific weights of water at 20°C and 50°C are 9.8 kN/m^3 and 9.69 kN/m^3 respectively. (8)

(ii) The velocity distribution over a plate is given by $u = 2/3y - y^2$ in which u is the velocity in m/s at a distance of y m above the plate. Determine the shear stress at y = 0, 0.1 and 0.2 m. Take the value of μ as 6 poise. (8)

OR

(b) Derive the Euler's equation of motion and deduce it to Bernoulli's equation along with its assumptions. (16)

13. (a)(i) A pipe 200 mm in diameter, 20 km long conveys oil of density 900 kg/m^3 and viscosity 0.08 Ns/m^2 at 10 litres/second. Find the loss of head and power required to maintain the flow. (7)

(ii) Derive an expression for the loss of head due to friction in a pipeline. Calculate the loss of head due to friction in a pipe 300 m long and 150 mm diameter when the discharge is 2.73 m^3/minute and the coefficient of friction is 0.01. (9)

OR

(b)(i) Explain boundary layer and highlight the meaning of nominal thickness. Also give the definition of displacement thickness along with its expression. (8)

(ii) Determine the rate of flow of water through a pipe of diameter 20 cm and length 50 m when one end of the pipe is connected to a tank and other end of the pipe is open to the atmosphere. The pipe is horizontal and the height of water in the tank is 4 m above the centre of the pipe. Consider all minor losses and take f = 0.009. Use'4f'instead of 'f' in the Darcy Weisbach's equation. (8)

14. (a) The force 'F' on the propeller of an aircraft is known to depend upon the forward speed of aircraft 'U', the density of air 'ρ', the viscosity of air 'μ', diameter of the propeller 'D', and the speed of rotation of the propeller 'N'. Obtain the functional relationship by Buckingham pi theorem. (16)

OR

(b)(i) Distinguish between distorted and undistorted model. Comment of dimensional homogeneity. (7)

(ii) It is desired to estimate the drag force on a 10 m long wing with a frontal projected area of 20 cm x 10 m subjected to 20 m/s wind by undertaking a model study in the laboratory. What should be the sizes of the aerofoils tested with the methods (i) in an air stream at 40 m/s in a wind tunnel? and (ii) in a water stream at 10 m/s. (9)

15. (a) A Pelton wheel is working under a gross head of 400 m. The water is supplied through penstock of diameter 1 m and length 4 km from reservoir to the Pelton wheel.

The coefficient of friction for the penstock is given as 0.008. The jet of water of diameter 150 mm strikes the buckets of the wheel and gets deflected through an angle of 165°. The relative velocity of water at outlet is reduced by 15% due to friction between inside surface of the bucket and water. If the velocity of the buckets is 0.45 times the jet velocity at inlet and mechanical efficiency as 85%, determine (i) power given to the runner (ii) shaft power (iii) hydraulic efficiency and overall efficiency. Show the inlet and outlet velocity triangles. (16)

OR

(b)(i) The internal and external diameters of an outward flow reaction turbine are 2 m and 2.75 m respectively. The head on the turbine is 150 m. The turbine is running at 250 rpm and the rate of flow of water through the turbine is 5 m^3/s. The width of the runner is constant at inlet and outlet and is equal to 250 mm. Neglecting thickness of the vanes and taking the discharge as radial at outlet, determine the vane angles at inlet and outlet and velocity of flow at inlet and outlet. (8)

(ii) A centrifugal pump is running at 1000 rpm. The outlet vane angle of the impeller is 30° and velocity of flow at outlet is 3 m/s. The pump is working against a total head of 30 m and the discharge through the pump is 0.3 m^3/s. If the manometric efficiency of the pump is 75%, calculate the diameter of the impeller and the width of the impeller at outlet. (8)