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FOURTH SEMESTER B.TECH. (ENGINEERING) (14 SCHEME) DEGREE EXAMINATION, APRIL 2016

ME 14 405—FLUID MACHINERY

Time : Three Hours Maximum : 100 Marks

Part A

Answer any **eight** *questions.*

1. Describe free vortex flow.
2. Derive an expression for the force exerted by a jet of water on stationary curved plate when jet strikes the plate at the centre.
3. Differentiate between impulse and reaction turbines.
4. Discuss the different types of draft tubes with neat sketches.
5. Calculate the diameter and speed of the runner of a Kaplan turbine developing 6000 kW under an effective head of 5 m. Overall efficiency of the turbine is 90%. The diameter of the boss is 0.4 times the external diameter of the runner. The turbine speed ratio is 1 and flow ratio 0.6.
6. Explain briefly the following efficiencies of a centrifugal pump :—
   (i) Manometric efficiency.
   (ii) Volumetric efficiency.
   (iii) Overall efficiency.
7. It is required to pump water out of deep well under a total head of 90 m. A number of identical pumps of design speed 1000 r.p.m. and specific speed 30 with a rated capacity of 0.15 m^3/s are available. How many pumps are required and how should they be connected whether in series or parallel ?
8. Prove that work done by a reciprocating pump is proportional to the area of indicator diagram.
9. A single-acting reciprocating pump operating at 120 r.p.m. has a piston diameter of 200 mm and stroke of 300 mm. The suction and delivery heads are 4 m and 20 m respectively, if the efficiency of both suction and delivery strokes is 75%, determine the power required by the pump.
10. Describe with a neat sketch, the working of a hydraulic ram.

(8 × 5 = 40 marks)

Part B

Answer **all** *the questions.*

11. (a) A 75 mm diameter jet having a velocity of 30 m/s strikes a flat plate, the normal of which is inclined at 45° to the axis of the jet. Find the normal pressure on the plate :

(i) when the plate is stationary ;

(ii) when the plate is moving with a velocity of 15 m/s and away from the jet. Also determine the power and efficiency of the jet when the plate is moving.

Or

(b) The pressure difference Δp in a pipe of diameter D and length 1 due to turbulent flow depends on the velocity V, viscosity μ density ρ and roughness k. Using Buckingham's Π-theorem, obtain an expression for Δp.

12. (a) A single jet Pelton wheel runs at 300 r.p.m. under a head of 510 m. The jet diameter is 200 mm, its deflection inside the bucket is 165° and its relative velocity is reduced by 15% due to friction. Determine :

(i) Water power ;

(ii) Resultant force on the bucket, and

(iii) Overall efficiency

Take Cv = 0.985 and speed ratio = 0.46.

Or

(b) An inward flow reaction turbine has an external diameter of 1 m and its breadth at inlet is 250 mm. If the velocity of flow at inlet is 2 m/s, find weight of water passing through the turbine per second. Assume 10 percent of the area of flow is blocked by blade thickness. If the speed of the runner is 210 r.p.m. and guide blades make an angle of 10° to the wheel tangent, draw the inlet velocity triangle and find :

(i) The runner vane angle at inlet ;

(ii) The velocity of wheel at inlet ;

(iii) The absolute velocity of water leaving the guide vanes, and

(iv) The relative velocity of water entering the runner blade.

13. (a) A centrifugal pump runs at 1000 r.p.m. with their vane angles at inlet and outlet as 20° and 35° respectively. The internal and external diameters are 25 cm and 50 cm respectively. Find the work done per unit weight (N) of water assuming velocity of flow as constant. Water enters radially through the pump.

Or

(b) Define specific speed of a centrifugal pump. Derive an expression for the same.

14. (a) The diameter and stroke length of a single-acting reciprocating pump are 50 mm and 100 mm respectively. It takes the supply of water from a sump 4 m below the pump through a pipe 6 m long and 30 mm in diameter. It delivers water to a tank 15 m above the pump through a pipe 40 mm in diameter and 20 m long. If separation occurs at 70 kN/m^2 below the atmospheric pressure, find the maximum speed at which pump may be operated without separation. Assume that the piston has a simple harmonic motion.

Or

(b) Discuss with neat sketch the construction and working of a gear pump. Also explain its performance characteristics.

(4 × 15 = 60 marks)