

FACULTY OF ENGINEERING
 B.E. 3/4 (Mech.) First Semester (Suppl.) Examination, June/July 2011
 HYDRAULIC MACHINERY AND SYSTEMS

Time : Three Hours]

[Maximum Marks : 75

Note :— Answer ALL questions from Part A. Answer any FIVE questions from Part B.

PART—A (Marks : 25)

1. A water jet of area 0.008 m^2 strikes a fixed flat vertical plate under a head of 100 m. The force exerted on the plate ($C_v = 0.98$) is (kN) :
 (a) 15.1 (b) 25.1 (c) 20.5 (d) 32.8 2
2. A water jet 0.025 m^2 area strikes a hinged plate at its centre with a velocity of 8 m/sec. If the plate swing is 30° , weight of plate is (kN) :
 (a) 2.3 (b) 3.2 (c) 4.8 (d) 6.4 2
3. A single acting reciprocating pump having piston area 0.08 m^2 and 0.5 m stroke runs at 120 rpm. The ($C_d = 0.9$) actual discharge is (m^3/sec) :
 (a) 0.1 (b) 0.08 (c) 0.072 (d) 0.064 3
4. If 84.8 % of work can be saved by fitting an air vessel on a single acting reciprocating pump, then the work saved by fitting an air vessel on a double acting reciprocating pump is :
 (a) 42.4 % (b) 78.4 % (c) 39.2 % (d) 32.9 % 1
5. If the η_{mano} and η_{mech} of a Centrifugal pump are 90 % and 80 % respectively, its η_o is :
 (a) 72 % (b) 64 % (c) 85 % (d) 90 % 3
6. A $1/5^{\text{th}}$ scale model of a Centrifugal pump runs at 1000 rpm under 16 m head. If the prototype pump works under 25 m head, its speed is (rpm) :
 (a) 18 (b) 24 (c) 32 (d) 27 3
7. In a Pelton wheel the vanes deflects the jet through an angle of 120° . The η_{max} is :
 (a) 60 % (b) 75 % (c) 80 % (d) 50 % 3
8. In a Francis turbine the guide blade angle is 45° and the moving vanes are radial at inlet. The flow velocity is constant. Its η_{hyd} is :
 (a) 66.67 % (b) 75 % (c) 85.35 % (d) 50 % 3

9. A turbine develops 7225 kW power under a head of 81 m at 243 rpm. The specific speed of the turbine is :
- (a) 170 (b) 85 (c) 255 (d) 765 3
10. The displacement volume of a Hydraulic accumulator is 0.115 m^3 . If the plunger diameter is 0.35 m its stroke length is (m) :
- (a) 0.1195 (b) 11.95 (c) 1.195 (d) 2.12 2

PART—B (Marks : $5 \times 10 = 50$)

11. A jet of water with a velocity of 60 m/sec strikes a curved vane moving at 30 m/sec. The jet enters an angle of 20° and the angle between relative velocities is 120° . Draw velocity triangles and determine (a) blade angles at inlet and exit (b) work done/N of water, and (c) η_{hyd} .
12. A single acting reciprocating pump has a plunger diameter of 0.375 m and 0.6 m stroke. The delivery pipe is 90 m long and 0.15 m diameter. Find the power saved by fitting an air vessel near the cylinder. The pump runs at 50 rpm and friction factor (f) = 0.008.
13. An impeller of a Centrifugal pump with inner and outer diameters of 0.6 m and 1.2 m runs at 200 rpm and discharges $1.8 \text{ m}^3/\text{sec}$ of water under a head of 6 m. The vane exit angle is 26° and exit flow velocity is 2.5 m/sec. Determine η_{mano} and minimum starting speed of the pump. Neglecting impeller losses, determine the specific speed of the pump.
14. In a Francis turbine the vane velocity at inlet, constant flow velocity and whirl velocity at inlet are 24 m/sec, 3 m/sec and 30 m/sec respectively. Assuming radial discharge and $\eta_{\text{hyd}} = 78\%$, determine head of the turbine, guide vane angle, rotor vane angle at inlet and exit.
15. A Kaplan turbine produces 20600 kW of power under a head of 22 m with $\eta_o = 85\%$. If speed ratio = 1.6 and flow ratio = 0.5 find the diameter of the runner, speed of the runner and specific speed of the turbine. Take the hub diameter = 0.35 times the runner diameter.
16. (a) Describe the working of a Hydraulic Ram with a sketch. 6
 (b) $0.2 \text{ m}^3/\text{sec}$ of water is supplied from a height of 3 m to a Hydraulic Ram which raises $0.002 \text{ m}^3/\text{sec}$ of water to a height of 20 m from the Ram. Determine D' Aubuisson's and Rankine's efficiencies of the Hydraulic Ram. 4
17. Write short notes on :—
- (a) Functions of Air vessels of Reciprocating pumps 3
 (b) Performance curves of Centrifugal pumps 3
 (c) Conditions of similarity of Turbines. 4