

## FACULTY OF ENGINEERING

B.E. 3/4 (Mech.) I – Semester (Old) Examination, Nov. / Dec. 2012

Subject : Hydraulic Machinery and Systems

Time : 3 hours

Max. Marks : 75

Note: Answer all questions from Part-A. Answer any FIVE questions from Part-B.

## PART – A (25 Marks)

1. The force exerted by a jet of water on a stationary vertical plate in the direction of jet is given by (2)
  - a)  $F_x = \rho AV^2 \sin^2\theta$
  - b)  $F_x = \rho AV^2[1+\cos\theta]$
  - c)  $F_x = \rho AV^2$
  - d) none of the above
2. The magnitude of the force exerted by a jet of cross sectional area  $2000 \text{ mm}^2$  and of velocity  $25 \text{ m/s}$  on a fixed smooth curved vane which deflects the jet by  $120^\circ$  is given by (3)
  - a) 21.65
  - b) 20.70
  - c) 21.56
  - d) 23.72
3. A hydraulic turbine has a discharge of  $3 \text{ m}^3/\text{s}$  when operating under a head of  $15 \text{ m}$  and a speed of  $500 \text{ rpm}$ . If it is to operate under  $12 \text{ m}$  of head, the rotational speed will be, (2)
  - a)  $600 \text{ rpm}$
  - b)  $559 \text{ rpm}$
  - c)  $447 \text{ rpm}$
  - d)  $400 \text{ rpm}$
4. A pump is required to deliver  $150 \text{ Lit./s}$  at a head of  $45 \text{ m}$  when running at  $1750 \text{ rpm}$ . The specific speed of the pump is (2)
  - a) 17.4
  - b) 39
  - c) 89
  - d) 1233
5. The maximum permissible suction lift for centrifugal pump in practice (at sea level and  $30^\circ$ ) is (2)
  - a)  $12 \text{ m}$
  - b)  $10 \text{ m}$
  - c)  $6 \text{ m}$
  - d)  $3 \text{ m}$
6. The moment of momentum of water in a turbine is reduced by  $15915 \text{ N-m}$  in a turbine rotating at  $600 \text{ rpm}$ . The power developed in kW is (2)
  - a) 1000
  - b) 1500
  - c) 2000
  - d) 5000
7. In a Kaplan turbine working under a head of  $35 \text{ m}$ , the speed ratio is 2.0. If the outer diameter of the runner is  $2.0 \text{ m}$  and the hub diameter is  $0.6 \text{ m}$ , the rotational speed, in rpm is (3)
  - a) 500
  - b) 125
  - c) 150
  - d) 250
8. Mechanical advantage of a hydraulic press is (3)
  - a) always greater than one
  - b) always less than one
  - c) always equal to one
  - d) not certain about this
9. In a hydraulic intensifier, the water enters at a pressure of  $5 \text{ bar}$  and comes out at  $50 \text{ bar}$ . The internal diameter of the sliding cylinder is  $20 \text{ cm}$ . The diameter of the fixed ram is (3)
  - a)  $6.2 \text{ cm}$
  - b)  $6.3 \text{ cm}$
  - c)  $6.1 \text{ cm}$
  - d)  $6.4 \text{ cm}$

10. The discharge through Francis turbine is given by (3)

a)  $Q = \frac{\pi}{4} d^2 \sqrt{2gH}$

b)  $Q = \pi(D - nt)BV_f$

c)  $Q = \frac{\pi}{4} (D_o^2 - D_b^2) V_f$

d) none of the above

**PART – B** (5 x 10 = 50 Marks)

11. A jet of water coming out of 6 cm diameter nozzle with a velocity of 25m/s strikes to a symmetrical blade at the centre. After striking, the jet is deflected through  $120^\circ$  at the outlet of the blade. Find the force exerted on blade.

12. A double jet Pelton wheel getting water from a head of 400m develops 6MW brake power at 400 rpm. Find out the diameter of the jet and mean diameter of the rotor.

Take  $C_v = 0.98$  and  $\phi = \frac{U}{V_1} = 0.45$  and  $\eta_0 = 0.9$ .

13. A centrifugal pump of 40 cm outer diameter is running at 1440 rpm. The exit vane angle is  $35^\circ$ . The radial velocity of flow is constant and equal to 2m/s. Find the work done by the impeller if the flow is 100 lit/sec and exit relative velocity of water.

14. What precautions are to be taken while starting and closing the centrifugal pump? Also, explain the characteristic curves of centrifugal pumps.

15. A single acting reciprocating pump has a 20 cm cylinder with a stroke of 40 cm. The suction pipe is 10 cm diameter and 5m long. If the speed of the pump is 30 rpm. Determine the maximum suction lift if separation occurs at 2.5m water (abs). Assume atmospheric pressure = 10.0m of water (abs).

16. Draw a neat sketch of a hydraulic jack used in automobiles and explain its working.

17. A hydraulic press, operated by a lever has 3cm diameter plunger and leverage is 10. Find the diameter of ram required to raise the load of 15 MN when the force applied is 20 kN at the free end of lever. Assume the losses are 20%.

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