Code No. 6302

FACULTY OF ENGINEERING

B.E. 3/4 (Mech) I-Semester (Main) Examination, November/December, 2009

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. A 75 diameter jet moving at 40 m/s impinges normally on a flat plate which remains at rest. The force exerted by jet on the plate in kN is : 3
   (a) 7.07 (b) 14.14 (c) 707 (d) 1414

2. Condition of separation at the end of delivery stroke is : 2
   (a) $H_{at} + H_d - H_{amax}$ (b) $H_{at} + H_d + H_{amax}$
   (c) $H_{at} - H_d + H_{amax}$ (d) $H_{at} - H_d - H_{amax}$

3. A centrifugal pump delivers water against a net head of and design speed of 1000 rpm. The vanes are carried back at angle of 30° with periphery. The impeller diameter is 300 mm and outlet width is 50 mm. The velocity of flow in m/s of the pump if the manometric efficiency is 95%. 3
   (a) 9.54 (b) 95.4 (c) 19.54 (d) 29.54

4. If 'd' represents the diameter of jet, then width of bucket of Pelton turbine : 2
   (a) 5d (b) 10d (c) 20d (d) 15d

5. If the flow ratio of Kaplan turbine is 2.09 for a head of 5.50 metres then peripheral velocity of turbine in m/s is : 2
   (a) 21.71 (b) 10.35 (c) 217.1 (d) 103.5

6. A reaction turbine works at 450 rpm under a head of 120 metres. Its diameter at inlet is 1200 mm and flow area is 0.4 sq.m. The velocity of flow in m/s is : 3
   (a) 13 (b) 26 (c) 39 (d) 52

Contd...2

7. Two geometrically similar pump are at the same speed of 1000 rpm. One pump has an impeller diameter of 0.30 metre and lifts water at the rate of 20 litres/second against a head of 15 metres. Determine the impeller diameter of other pump in metres to deliver half the discharge. 3

(a) 0.24 (b) 0.48 (c) 0.72 (d) 0.96

8. A hydraulic turbine working under a head of 180 metres runs at 325 rpm, the discharge of turbine being 0.71 cumec. Then specific speed of turbine is : 3

(a) 8.65 (b) 18.65 (c) 186.5 (d) 35.5

9. Identify an axial flow turbine from the following : 1

(a) Pelton wheel (b) Kaplan turbine
(c) Francis turbine (d) Both (a) and (b)

10. An hydraulic intensifier is supplied with water pressure of 1.75 bar. The sliding and fixed rams of the intensifier are 50 mm and 120 mm in diameter respectively. The pressure intensity of water leaving the intensifier in bar is : 3

(a) 10.08 (b) 1.08 (c) 100.8 (d) 2.16

PART - B (5x10=50 Marks)

11. A 15 cm jet is moving at 30 m/s impinges on a series of vanes moving at 15 m/s in the direction of the jet. The jet leaves the vanes at 60° with the direction of motion of the vanes. Calculate :

(a) The force exerted by the jet in the direction of motion of the vanes,
(b) work done by the jet per second.

12. Write notes on :

(a) Methods of priming in centrifugal pumps.
(b) Effect of acceleration and friction on indicator diagram of reciprocating pump.

13. A Francis turbine with an overall efficiency of 75% is required to produce 150 kW. Head-7.62 m. The peripheral velocity $=0.26\sqrt{2}$ gH and the radial velocity at inlet is $0.96\sqrt{2}$ gH. Speed-150 rpm and the hydraulic efficiency of the turbine are 22% of the available energy. Assuming radial discharge determine :

(a) guide blade angle
(b) the wheel vane angle at inlet
(c) diameter of the wheel at inlet and
(d) width of the wheel at inlet

Contd...3

14. The details of Kaplan turbine is as follows Runner diameter-4 m, Boss diameter-2 m, Head-22 m, Power-15000 kW, Overall efficiency −85%, Hydraulic efficiency −90%, at the extreme edge of the runner if the guide blade angle is 40°, find runner vane angles at inlet and outlet at the extreme edge of the runner and find also speed of the turbine. Assume that the discharge is radial at outlet.

15. A double acting pump has a bore of 15 cm and a stroke of 30 cm. The suction pipe is 10 cm in diameter and fitted with an air vessel. Find the ratio of flow into or from air vessel when the crank makes angles of 30°, 90° and 120° with the inner dead centre. Determine the crank angles at which there is no flow into or from the air vessel. Assume N = 60 rpm and piston has simple harmonic motion.

16. A centrifugal pump running at 1450 rpm discharges 110 l/s against head of 23 m. If the diameter of the impeller is 250 mm and its width is 50 mm, find vane angles at the outer periphery. Assume manometric efficiency is 75%.

17. Explain the working principle of hydraulic torque converter.

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