

FACULTY OF ENGINEERING

B.E. III/IV (Mech.) I – Semester (Suppl.) Examination, July 2010

HYDRAULIC MACHINES AND SYSTEMS

Time: 3 Hours]

[Max. Marks: 75

Note : 1) Answer all questions from Part – A.

2) Answer any five questions from Part – B.

PART – A

25

1. A 100 mm diameter jet moving at 15 m/s impinges normally on a flat plate moving at 3 m/s in the same direction as that of jet. The force exerted by jet on the plate is  
a) 1130 N      b) 113 N      c) 226 N      d) 2260 N      3
2. A single acting reciprocating pump having a 150 mm bore and a 300 mm stroke raises water from a sump. If the pump runs at 40 rpm and delivers 209.5 litres per minute. The percentage of slip is  
a) 1.118 %      b) 2.228 %      c) 0.559 %      d) 11.118 %      3
3. A centrifugal pump delivers 0.03 cumec of water to a height of 18.25 metres through a 100 mm diameter pipe 90 metres long. If the overall efficiency of pump is 75%. The power required to drive the pump in kW is  
a) 17.65      b) 24.01      c) 48.02      d) 35.30      3
4. If jet ratio of Pelton turbine is 6, the number of buckets of turbine would be  
a) 18      b) 24      c) 36      d) 48      2
5. If the flow ratio of Kaplan turbine is 0.68 for a head of 5.50 metres then velocity of flow of turbine in m/s is  
a) 14.06      b) 7.06      c) 3.53      d) 14.12      2

6. An inward flow reaction turbine running at 500 rpm has an external diameter of 700 mm and a width of 180 mm. If the guide vanes are at  $20^\circ$  to the wheel tangent and absolute velocity of water at inlet is 25 m/s then runner angle in degrees at inlet is
- a) 55                      b) 58                      c) 57                      d) 56                      3
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 head in metres if the other pump to deliver half the discharge.
- a) 5.45                      b) 9.45                      c) 8.45                      d) 10.45                      3
8. A hydraulic turbine working under a head of 180 metres runs at 325 rpm, the discharge of turbine being 0.71 cumec. The overall efficiency of turbine is 84%. Then the type of turbine is
- a) Single jet Pelton wheel                      b) Kaplan  
c) Francis                      d) None of the above                      3
9. Identify an impulse turbine from the following
- a) Pelton wheel                      b) Francis turbine  
c) Kaplan turbine                      d) None of these things                      1
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
- a) 10.08                      b) 1.08                      c) 100.8                      d) 2.16                      2

**PART – B**                      (5×10=50 Marks)

11. A Jet of water moving at 13 m/s impinges on a concave vane set to deflect the jet through  $120^\circ$ . If the vane is moving at 4.5 m/s, find the angle of the jet so that there is no shock at inlet. What is the absolute velocity of water at exit in magnitude and direction and work done per kg of water.



12. Show that (a) the work saved in overcoming friction in the pipe lines by fitting air vessels is 84.8% for a single acting reciprocating pump and 39.2% for a double acting pump, (b) the ratio of the work done against friction when air vessels are fitted to that in the absence of air vessels is  $3/2 \pi^2$  for single acting pump.
13. The impeller of a centrifugal pump is 300 mm outside diameter and 150 mm inside diameter. The impeller vane angles are 30 and 25 at the inner and outer peripheries respectively and the speed is 1450 rpm. The velocity of the flow through the impeller is constant. Find the work done by the impeller per kg of water.
14. The details of Francis turbine are as follows. Speed-450 rpm, Head -120 m, Diameter at inlet-120 cm, Flow area -0.4 sq. m. The angles made by absolute and relative velocities at inlet are  $20^\circ$  and  $60^\circ$  respectively with the tangent velocity. Determine i) the volume flow rate, (ii) the power developed and (iii) the efficiency.
15. The details of Pelton turbine are as follows Power-11750 kW, Head-380 m, Speed-750 rpm, Overall efficiency-86%, Jet diameter not to exceed one sixth the wheel diameter, velocity coefficient-0.985, speed ratio-0.45, Determine i) the wheel diameter, ii) the number of jets required, iii) the diameter of jet, iv) size of buckets, (v) number of buckets.
16. Explain the working principle of Hydraulic accumulator with neat sketch.
17. Write short notes on
  - a) Model testing of centrifugal pumps 5
  - b) Working principle of hydraulic press. 5