Code No. 2345 / N

FACULTY OF ENGINEERING

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

Subject : Hydraulic Machinery and Systems

Time : 3 hours **Max. Marks : 75**

Note: 1. Answer all questions from Part-A. Answer any FIVE questions from Part-B.
2. Draw neat sketches wherever necessary. Any missing data may be assumed suitably and indicate the same clearly.

PART – A (25 Marks)

1. A jet of water of 100mm diameter impinges normally on a fixed plate with a velocity of 30 m/s. The force exerted on the plate is (3)
   a) 7.07 kN b) 7.70 kN c) 7.71 kN d) 7.17 kN

2. According to Euler momentum in equation for the flow of jet through a moving blade, the work done per kg is given by (with usual notations) (3)
   a) $U(V_{w1} \pm V_{w2})$ b) $\frac{1}{g}(V_{w1} + V_{w2})U$
   c) $V_{r1}(V_{w1} + V_{w2})$ d) None of the above

3. A single acting reciprocating pump running at 100 rpm delivers 12 ℓit/sec of water. The diameter and stroke of the cylinder are 20 cm and 30cm respectively. The percentage of slip is (3)
   a) 23.7% b) 23.6% c) 23.8% d) 23.4%

4. The pressure head due to acceleration either in suction or delivery pipe is given by (with usual notations) (2)
   a) $\frac{L}{g} \cdot \frac{a}{A} \cdot \omega^2 r \sin\theta$ b) $\frac{L}{g} \cdot \frac{A}{a} \cdot \omega^2 \cdot r \sin\theta$
   c) $\frac{L}{g} \cdot \frac{A}{a} \cdot \omega^2 \cdot r \cos\theta$ d) $\frac{L}{g} \cdot \frac{a}{A} \cdot \omega^2 \cdot r \cos\theta$

5. A pump delivers 100 ℓit/s at a head of 25m when running at 1450 rpm. A homologous pump delivers 100 ℓit/s at 12.5m will have a specific speed of (3)
   a) 10 b) 41 c) 20 d) 82

6. The cavitation factor is defined as (with usual notations) 2
   a) $\frac{NPSH}{\sqrt{H_m}}$ b) $\frac{H_m}{NPSH}$ c) $\frac{NPSH}{H_m}$ d) $\frac{\sqrt{H_m}}{NPSH}$

7. The type of turbine used is, if the head is 150 meters to develop 1500 kW, while running at 300 rpm is (3)
   a) Pelton wheel b) Francis turbine
   c) Kaplan turbine d) None of the above

8. The discharge through Kaplan turbine is given by (with usual notations) : (3)

   a) $Q = \frac{\pi}{4}\left(D_0^2 . D_b^2\right) \cdot V_f$ b) $Q = \frac{\pi}{4} d^2 \sqrt{2gH}$

   c) $Q = \pi DB.V_f$ d) $Q = \frac{4}{\pi}\left(D_b^2 - D_0^2\right)$

9. The power developed by a hydraulic cylinder equals the product of its (2)

   a) Force and velocity b) Length and time
   c) Discharge and area d) None of the above

10. The hydraulic power developed by pumps is converted back into mechanical energy by (1)

    a) hydraulic actuators b) external pump
    c) compressor d) all of the above

PART – B (50 Marks)

11. A jet of water coming out of a nozzle of 25 cm^2 with a velocity of 35 m/s strikes to a flat plate inclined at 30^0 to the axis of the jet. Find the force exerted on the plate normal to the axis of the plate. Also the ratio of discharge gets divided after striking the plate.

12. Explain how separation occurs in reciprocating pump either during suction or during delivery. Discuss preventive measures adopted for reduction in separation.

13. A centrifugal pump of 1.5 metre diameter runs at 210 r.p.m. and pumps 180 litres of water per second. The angle which the vane makes, at exit, with the tangent to the impeller is 25^0. Assuming radial entry and velocity of flow throughout as 2.5 m/s, determine the power required to drive the pump. If manometric efficiency of the pump is 65%, find the average lift of the pump.

14. A double acting reciprocating pump runs at 90 r.p,m. the diameter and stroke are 100mm and 250mm respectively. The suction pipe is 250mm diameter and 6m long. Calculate the maximum permissible suction lift assuming no air vessel is fitted and separation occurs at 2m of water absolute.

15. Design a Francis turbine to develop 400 kW under a head of 90m while running at a speed of 750 rpm. Assume any data suitably.

16. What are the characteristic curves of a hydraulic turbine? How are they useful to practical engineer?

17. Describe the working and construction details of single acting and double acting actuator.

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