TED (10) – 3044 S4 ME Reg. No. .....

(REVISION —2010) Signature .....

FOURTH SEMESTER DIPLOMA EXAMINATION IN MECHANICAL ENGINEERING — MARCH, 2015

HYDRAULIC MACHINES

[*Time* : 3 hours

(Maximum marks : 100)

Marks

PART—A

(Maximum marks : 10)

I Answer the following questions in one or two sentences. Each question carries 2 marks.

1. What is meant by jet propulsion ?
2. What are the classifications of water turbines based on its operating principles ?
3. List the functions of draft tube.
4. What is cavitation ?
5. Define slip of a pump. (5x2=10)

PART—B

(Maximum marks : 30)

II Answer *any five* of the following questions. Each question carries 6 marks.

1. Derive an expression for work done on flat vertical plate moving in the direction of jet.
2. Draw the velocity triangles and mark the velocities and angles of a jet tangentially impinging at on tip of an unsymmetrical moving curved plate.
3. Briefly explain the main parts of a Pelton turbine.
4. Differentiate impulse and reaction turbines.
5. Describe the working of a Kaplan turbine.
6. Explain various heads of a centrifugal pump and the importance.
7. Explain the construction and operation of a hydraulic ram.

(5x6=30)

Marks

PART—C

(Maximum marks : 60)

(Answer *one* full question from each unit. Each full question carries 15 marks.)

UNIT – I

III (a) A square plate weighing 115N and the uniform thickness and 300mm edge is hung so that a horizontal jet 20mm diameter and having a velocity of 15m/s impinges on the plate. The centre line of the jet is 150mm below the upper edge of the plate and when the plate is vertical, the jet strikes the plate normally and at its centre. Find what force is the force exerted by the jet. If the plate is allowed to swing freely, find the inclination to vertical which the plate will assume under the action of jet. 7

(b) A jet of water of diameter 150mm strikes a flat plate normally with a velocity of 12 m/s. The plate is moving with a velocity of 6 m/s in the direction of the jet. Find :

(i) The force exerted by the jet on the plate.

(ii) Work done by the jet on the plate per second.

(iii) Power of the jet.

(iv) Efficiency. 8

OR

IV (a) A jet of water of diameter 50mm strikes a fixed plate in such a way that the angle between the plate and the jet is 30°. The force exerted in the the direction of jet is 1471.5N. Determine the rate of flow of water. 7

(b) A jet of water having a velocity of 15m/s, strikes a series of curved vane which is moving with a velocity of 5m/s in the same direction as that of the jet at inlet. The vane is so shaped that the jet is deflected through 135°. The diameter of jet is 100mm. Assuming the vane to be smooth :

(i) Find the force exerted by the jet on the vane in the direction of motion.

(ii) Power exerted on the vane. 8

UNIT – II

V (a) Describe the working principle of an impulse turbine. 7

(b) A double jet Pelton wheel operates under a 40m head and develops 735kW brake power when running at 450 rpm. Make calculations for the flow rate and the diameter of the nozzle jet. Assume overall efficiency is 0.85% and co-efficient of velocity is 0.98. 8

OR

Marks

VI (a) Sketch the governing mechanism of a Pelton wheel. 7

(b) A Pelton wheel is to be designed for a head of 60m when running at 200 rpm. The pelton wheel develops 95.6475kW shaft power. The velocity of the buckets is 0.45 times the velocity of the jet, overall efficiency is 0.85 and coefficient of velocity is 0.98. Find :

(i) diameter of wheel

(ii) diameter of jet. 8

UNIT – III

VII (a) An inward flow reaction turbine has external and internal diameters as 1m and 0.5m respectively. The velocity of flow through the runner is equal to 1.5m/s. Determine :

(i) Discharge through the runner

(ii) Width of the turbine at outlet if the width of the turbine at inlet = 200mm. 7

(b) A francis turbine works at 450 rpm under ahead of 120m. Its diameter at inlet is 120cm and flow area as $0.4m^2$. The angles made by the absolute and relative velocities at inlet are 20° and 60° respectively with the tangential velocity. Determine : (i) the volume of flow rate, (ii) hydraulic power developed, (iii) the efficiency. Assume whirl at outlet to be zero. 8

OR

VIII (a) The external and internal diameters of an inward flow reaction turbine are 60cm and 30cm respectively. The breadth at inlet being 15cm. The flow velocity through the runner is constant at 1.5m/s. Make calculations for the rate of flow passing through the turbine and the breadth if turbine wheel at outlet. 7

(b) A Kaplan turbine runner is to be designed to develop 7357.5kw shaft power. The net available head is 5.5m. Assume that the speed ratio is 2.09 and flow ratio is 0.68 and the overall efficiency is 60%. If the diameter of the runner is 6.79m, find the discharge, speed and specific speed. 8

Marks

UNIT – IV

IX (a) A double acting reciprocating pump, running at 40 rpm, is discharging 1.0m³ of water per minute. The pump has a stroke of 400mm. The diameter of the piston is 200mm. The delivery and suction head are 20m and 5m respectively. Find the slip of the pump and power required to drive the pump. 7

(b) Explain the high head multistage centrifugal pump with sketch. 8

OR

X (a) Compare centrifugal and reciprocating pump. 7

(b) A three throw pump has cylinder of 25cm diameter and stroke of 50cm each. The pump is required to deliver 100 liters per second at a head of 100m. Friction losses are estimated to be 1m in suction pipe and 19m in delivery pipe. Velocity of water in the delivery pipe is 1m/s, overall pump efficiency is 85% and the slip is 3%. Determine the speed of pump and the power required to run it. 8
