Code: 13A03501 **R13**

B.Tech III Year I Semester (R13) Supplementary Examinations June 2017

HYDRAULIC MACHINERY

(Mechanical Engineering)

Time: 3 hours Max. Marks: 70

PART – A

(Compulsory Question)

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1 Answer the following: (10 X 02 = 20 Marks)

(a) (i) Run-off river plants. (ii) Storage plants. (iii) Pumped storage plants.

(b) Differentiate between mass curve and demand curve.

(c) A flat vane mounted on a wheel is rotating with a velocity of u due to impact of jet of velocity V. State the relationship between u and V for maximum efficiency.

(d) A jet of water with velocity, V and jet area, a strikes a flat plate normal to it. Determine the force of impingement, when the plate is permitted to move along the direction of jet at a velocity, u.

(e) Differentiate between impulse and reaction turbines.

(f) State any two functions of draft tube.

(g) Two turbines A and B of similar type will generate same power. But turbine B has less specific speed compared to turbine A. Suggest which turbine is most suitable and why?

(h) Enumerate ill effects of cavitation and water hammer in turbine operation.

(i) Differentiate between rotodynamic pumps and positive displacement pumps based on their working principle.

(j) What is negative slip in reciprocating pump? State the condition under which it exists.

PART – B

(Answer all five units, 5 X 10 = 50 Marks)

UNIT – I

2 Draw a neat sketch of hydropower plant and label various components of it? Also state functions of each component.

OR

3 The monthly runoff volume in million m^3 for a period of 24 months (two water years) recorded at stream gauging site are 3, 6, 16, 30, 18, 15, 10, 8, 6, 4, 3, 1, 2, 5, 17, 28, 20, 15, 12, 7, 5, 4, 3, and 2. Determine the size of the reservoir proposed at the gauging site if it is to maintain an assured supply of 8.33 million m^3 per month. The water year may be taken as June to May.

UNIT – II

4 A 0.075 m diameter jet having a velocity of 30 m/s strikes a flat plate, the normal of which is inclined at 45° to the axis of the jet. Find the normal pressure on the plate: (i) When the plate is stationery. (ii) When the plate is moving with a velocity of 15 m/s in the direction of the jet and away from the jet. Also determine the power and efficiency of the jet when the plate is moving.

OR

5 A jet of water 75 mm in diameter having velocity of 20 m/s strikes a series of the flat plates arranged around the periphery of a wheel such that each plate appears successively before the jet. If the plates are moving at a velocity of 5 m/s, compute the force exerted by the jet on the plate, the work done per second on the plate and the efficiency of the jet.

Contd. in page 2

UNIT – III

6 Classify the turbines based on: (i) Direction of flow of water in the runner. (ii) Head and quantity of water required. (iii) Specific speed. (iv) The basis of disposition. Also mention one example under each case.

OR

7 Design a Francis turbine runner with the following data:

Net head, H = 68 m
Speed, N = 750 rpm
Output power, P = 335.7 kW
Hydraulic efficiency, η_h = 94%
Overall efficiency, ,η_o = 85%
Flow ratio, ψ = 0.15
Breadth ratio, n = 0.1
Inner diameter of runner = 0.5 x Outer diameter

Assume 6% of circumferential area of the runner to be occupied by the thickness of the vanes. Velocity of flow remains constant throughout and flow is radial at exit.

UNIT – IV

8 A turbine develops 8,000 kW when running at 100 rpm. The head on the turbine is 30 m. If the head is reduced to 18 m, determine the speed and power developed by the turbine

OR

9 A conical draft-tube having diameter at the top as 2.0 m and pressure head at 7 m of water (vacuum), discharges water at the outlet with a velocity of 1.2 m/s at the rate of 25 m^3/s. If atmospheric pressure head is 10.3 m of water and losses between the inlet and outlet of the draft-tube is negligible, find the length of draft-tube immersed in water. Total length of tube is 5 m.

UNIT – V

10 Draw a neat sketch of centrifugal pump and mention various components of it. Also state functions of each component.

OR

11 A single acting reciprocating pump has a plunger of 80 mm diameter and a stroke of length 150 mm. It takes its supply of water from a sump 3 m below the pump through a pipe 4.5 m long and 30 mm diameter. It delivers water to a tank 12 m above the pump through a pipe 25 mm diameter and 15 m long. If separation occurs at 78.48 kN/m^2 below the atmospheric pressure, find the maximum speed at which the pump may be operated without separation, assume the plunger to have simple harmonic motion.

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