6E3053

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B.Tech VI Sem. (Main/Back) Exam., April-May, 2012
Mechanical Engg.
6ME5 Hydraulic Machines & Hydrelectric
Power Plant

Time : 3 Hours   **Maximum Marks : 80**
                                          Min. Passing Marks : 24

Instructions to Candidates:

> *Attempt any **five questions**, selecting one question from **each unit**.*
> *All Question carry **equal** marks. Schematic diagrams must be shown*
> *wherever necessary. Any data you feel missing suitably be assumed*
> *and stated clearly.*
>
> *Units of quantities used/ calculated must be stated clerly.*

Use of following supporting material is permitted during examination. (Mentioned in form No. 205)

1. _____**Nil**_____   2. _____**Nil**_____

Unit - I

1. (a)   The power developed by a turbine is a function of density e of the
         fluid, the speed N of the turbine, the diameter D of turbine, and the
         pressure intensity p under which it operates. Show that

$$P = e \, N^3 D^5 f\left[\frac{N^2 D^2}{g \, H}\right]$$

Hence obtain an expression for the specific speed of such a turbine.
                                                                    8

   (b)   The nozzle of a pelton wheal is 38 mm in diameter , the head at the
         nozzle is 152 meters, Cv = 0.97, wheel diameter = 380mm, relative
         velocity at discharge = 0.85 times the relative velocity at inlet, discharge edge of blading is at 15^0 to the plane of motion of the blading.
         Calculate unit power and unit speed if the blade speed is 0.46 of the
         jet speed.
                                                                    8

Or

1 (a) A jet has direct impact on series of flat vanes mounted over the periphery of a large wheel. Determine the force of impact and the work done per second? 8

   (b) A jet of water moving with a velocity of 30 m/s impinges on a series of vanes moving at15m/s. The jet makes an angle of 30° to the direction of motion of vanes at entry and leaves the vanes at 120°. Draw the inlet and outlet velocity diagram and find (1) vane angles at inlet and outlet.(ii) work done per sec Newton of water and (iii) The efficiency. 8

Unit - II

2 (a) Explain the construction and working of pelton wheel with help of neat sketch. 8

   (b) The head at the base of nozzle of a pelton wheel is 650 cm. The outlet vane angle of the bucket is 15° the relative velocity at outlet is reduced by 15% due to friction along the vanes. If the discharge at outlet is without whirl, find the ratio of the bucket speed to the jet speed. If the jet diameter is 100 mm while the wheal diameter is 1.2 m, find the speed of the turbine in rpm, the force exerted by the jet on the wheel, the power developed and the hydraulic efficiency. Take q = 0.97 8

Or

2 (a) Explain the principle of Governing of impulse turbine with a neat sketch. 8

   (b) Show that for the maximum efficiency the bucket speed of a pelton wheal should be equal to one half the jet speed. 8

Unit - III

3 (a) Draw a schematic diagram of a Kaplan turbine and explain briefly its construction and working. 8

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(b)   The particulars of a reaction turbine are given below: Type of turbine
        : Inward flow turbine,   External diameter = 625 mm, Internal diam-
        eter = 405 mm, width at inlet = 55mm, Inlet vaneangle = 95°, out-
        let vane angle = 14°,Head on turbine = 56 m, Hydraulic efficiency =
        88%, overall efficiency = 81%, Velocity of flow though the runner is
        constant. Discharge at outlet is entirely radial. Determine (i) The guide
        vane angle, (ii) The speed of turbine (iii) The shaft power.   8

                                        Or

3.   (a)   In a vertical Francis turbine the runner speed is 380 rpm and avail-
        able head across the turbine is 49m. The inlet to the runner is 1.8 m
        above the tail race level and the area and diameter of the runner at
        inlet are 0.234 m² and 0.90 m respectively. The guide and the runner
        vane angles atinlet are 15° and 70° raspectively. The water enters a
        draft tube without whirl at 1.575 m above. the tail race level and the
        draft tube diameter is 0.55 m. At the outlet the draft tube is 0.70 m in
        diameter. If the frictional losses in the runner amount to 2.70 m and
        that in draft tube is 1.5 mand overall efficiency is 0.90x hydraulic ef-
        -ficiency, find (i) Shaft power (ii) hydraulic efficiency(iii) pressure head
        at inlet to the runner (iv) pressure head at entry to'draft tube.   8

(b)   What do you mean by characteristic curves of a turbine? What are
        main and operating characteristic curves of a turbine?   8

Unit - IV

4.   (a)   Obtain expression for the pressure head due to friction on the suction
        and delivery pipe for a reciprocating pump.   8

(b)   A simple acting reciprocating pump has a plunger of diameter 150mm
        and a stroke 300mm. The length of the suction and delivery pipes are
        5 m and 20m respectively, and their diameter is 75mm. The suction
        and delivery heads are 3.5m and 8m respectively. Find the heads in
        the cylinder at the beginning , middle and end of the suction and de-
        livery strokes. Take f = 0.0075 and speed of the pump =30 rpm.
        Also find the power required to drive the pump. Assume atmospheric
        pressure head = 10.30 meter of water.   8

Or

4. Explain any two of following :

    (a)   Hydraulic Intensifier

    (b)   Hydraulic Press

    (c)   Hydraulic coupling   8

Unit - V

5.   (a)   Explain following:

        (i)   Hydrograph

        (ii)   Hydrological cycle

        (iii) Fliw duration curve

        (iv) Run off   4x2=8

   (b)   Explain Surge Tank with sketch   8

Or

5.   (a)   Write a note on Hydro Power development in Rajasthan.   8

   (b)   Write note on Selection of turbine.   8