Total No. of Printed Pages:3

SUBJECT CODE NO: H-407
FACULTY OF SCIENCE AND TECHNOLOGY
B.E. (Mechanical)
Turbo Machines
(REVISED)

[Time: Three Hours]   [Max.Marks:80]

Please check whether you have got the right question paper.

N.B
1. Solve <u>three</u> questions <u>from each section</u>.
2. Figures to the right indicate full marks.

Section A

Q.1   a) Define a turbo machine with a neat sketch explain different parts of turbo machine.   06

        b) Distinguish between a turbo machine & positive displacement machine.   07

Q.2   a) Show that a curve radial vane the work done per second is given by   06
            $\varrho a v^2 [\, v w_1 u_1 \pm v w_2 u_2]$, the notation carry usual meaning.

        b) A 8.5 cm diameter jet having a velocity of 33 m/s strikes a flat plate, the normal of which   07
            is inclined at 45° to the axis of the jet. Find the normal pressure on the plate, when.
            i)   The plate is stationary
            ii)   When the plate is moving with a velocity of 18 m/s & away from the jet.
            iii)   Also determine the power & efficiency of the jet when the plate is moving.

Q.3   a) A jet of water of diameter 75mm moving with a velocity of 30 m/s, strikes a curved fixed   06
            plate tangentially at one end at an angle of 30° to the horizontal. The jet leaves the plate at
            an angle of 20° to the horizontal. Find the force exerted by the jet on the plate in the
            horizontal & vertical direction. Also calculate resultant force per unit weight of water.

        b) A jet of water of 30mm diameter strikes a hinged square plate at its Centre with a velocity   07
            of 23m/s. The plate is deflected through an angle of 20°. Find the weight of plate. If the
            plate is not allowed to swing, what will be the force required at the lower edge of the plate
            to keep the plate in vertical position. If the height of the plate is 30cm.

Q.4   a) Describe briefly the function of various main component of Kaplan turbine with neat   06
            sketch.

        b) What is the purpose of draft tube? Describe with neat sketches different types of draft   07
            tube. Also write efficiency equation of draft tube.

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Q.5 The three – jet pelton turbine is required to generate 10,000 KW under a net head of 420m. The   14
blade angle at outlet is 15° and the reduction in the relative velocity while passing over the blade
is 5%. If the overall efficiency of the wheel is 80%, coefficient of velocity is 0.98 & speed ratio
is 0.46 then find:
        i)   The diameter of jet
        ii)   The total flow in m^3/s
        iii)   The force exerted by a jet on the buckets.
        iv)   If the jet ratio is not to be less than 10, find the speed of the wheel for a
              frequency of 50 Hertz / sec & the corresponding wheel diameter.

Section B

Q.6   a) Define Manometric efficiency, and obtain an expression for the minimum starting speed   06
        of a centrifugal pump.

     b) A centrifugal pump having outer diameter equal to three times the inner diameter and   07
        running at 1200 rpm. Works against a total head of 75m. The velocity of flow through the
        impeller is constant & equal to 3.2 m/s. The vanes are set back at an angle of 30°at outlet.
        If the outlet diameter of the impeller is 600mm & width at outlet is 50mm. determine:
            i)   Vane angle at inlet
            ii)   Manometric efficiency
            iii)   Least speed to start the pump
            iv)   Pressure rise in the impeller of a centrifugal pump.

Q.7   a) Why governing of steam turbine necessary? Describe with neat sketch the throttle   07
        governing of steam turbine.

     b) Draw a schematic diagram of a gas turbine plant employed with reheating. Also represent   06
        cycle on P-V & T –S diagram & mentioned the assumptions made.

Q.8   A single row impulse turbine develops 132.4 KW at a blade speed of 175 m/s using 2kg of steam   13
per sec. steam leaves the nozzle at 400 m/s. steam leaves the turbine blade axially. Velocity
coefficient of blade is 0.90.
        Find
        i)   Maximum blade efficiency
        ii)   Tangential force on blade
        iii)   Energy converted to heat by blade friction.
        iv)   Developed axial thrust.

Q.9   In a gas turbine the compressor takes in air at a temperature of 15℃ & compresses it to four   14
times the initial pressure with an isentropic efficiency of 82%. The air is then passed through a
heat exchanger heated by the turbine exhaust before reaching the combustion chamber. In the heat
exchanger 78% of the available heat is given to the air. The maximum temp after constant
pressure combustion is 600℃ & efficiency of the turbine 70%. Neglecting all losses.

     Find:
     i)   Work developed by system
     ii)   Thermal efficiency
     iii)   Work ratio.
$$r = 1.4 \ , CPa = CPg = 1 \ KJ/Kg \ .K$$

Q.10   Write short notes on <u>any three</u> of followings.   13

     i)   Stirling cycle
     ii)   Net Positive Suction Head (NPSH)
     iii)   Energy losses in steam turbine
     iv)   Velocity compounding of steam turbine
     v)   Closed cycle gas turbine