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Code: 13A03502 **R13**

B.Tech III Year I Semester (R13) Supplementary Examinations June 2016

THERMAL ENGINEERING – II

(Mechanical Engineering)

(Use of steam tables is permitted in the examination hall)

Time: 3 hours Max. Marks: 70

PART – A

(Compulsory Question)

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

(a) What are the difficulties experienced in carrying out Carnot cycle in steam power plants?

(b) Explain why a condenser is placed in a Rankine cycle.

(c) Explain the difference between a fire tube and water tube boiler. State which type of boiler is used for power generation.

(d) What is the role of a steam accumulator in a steam generator and where is it placed?

(e) Explain the terms “over expanding” and under expanding” applied to a fluid flow through a nozzle.

(f) What do you mean by vacuum efficiency of a condenser? On what factors does this efficiency depend?

(g) Explain the essential differences in the functioning of moving blades in impulse and reaction turbines.

(h) Explain the terms blade speed ratio and blade velocity coefficient in a steam turbine.

(i) Enumerate at least four advantages of gas turbine in relation to steam turbine.

(j) Enumerate the requirements of an ideal rocket propellant.

PART – B

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

UNIT - I

2 Steam is the working fluid in an ideal Rankine cycle. Saturated vapour enters the turbine at 10 MPa and saturated liquid exits the condenser at a pressure of 0.010 MPa. The net power output of the cycle is 110 MW. Determine the following for the cycle.

(a) The thermal efficiency.

(b) The back work ratio.

(c) Steam mass flow rate in kg/hr.

(d) Rate of heat added to the working fluid in the boiler.

(e) Heat removed from the working fluid in the condenser.

OR

3 Steam used in a reheat cycle for the working of steam engine. The steam leaves the boiler and enters the turbine at 3 MPa and 350℃. After expansion in the turbine to 500 kPa, the steam is reheated to 500℃ and then expanded in the low pressure turbine to 20 kPa. Determine the efficiency of the reheat cycle.

UNIT - II

4 Describe the working of a Lancashire boiler with the aid of a neat sketch. Show the path of flue gasses to stack and the relative position of economizer and super heater.

OR

5 From the data given below, estimate the power of a motor required to drive an induced draught fan: Draught to be maintained = 50 mm of water, mean temperature of flue gasses = 475 K; temperature of boiler house = 310 K; efficiency of fan = 75%; air supplied = 15 kg/kg of coal; and coal consumption = 1600 kg/hr.

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UNIT - III

6 From the fundamentals deduce expressions for mass discharge and critical pressure ratio for maximum discharge in the case of flow through nozzles.

OR

7 A surface condenser is to be introduced to handle 14000 kg of steam per hour. The steam enters the condenser at 0.07 bar, 0.81 dry and the condensate leaves the condenser at the corresponding saturation temperature. Determine the rise in cooling water temperature, if the cooling water flow rate is 8.30 x 10^5 kg/hr. It is assumed that the pressure is same throughout the condenser.

UNIT - IV

8 A single state impulse turbine rotor has a diameter of 1.1 m and running at 3200 rpm. The nozzle angle is 22°. The blade speed ratio is 0.45. The ratio of the blade velocity at outside to the relative velocity at inlet is 0.95. The outlet angle of the blade is 10° smaller than the inlet angle. The steam flow rate is 2 kg/sec. Draw the velocity diagram and estimate:

(a) Velocity of whirl.

(b) Axial thrust on the bearings.

(c) Blade angles.

(d) Power developed.

OR

9 In a reaction turbine, the tips are inclined at 40° and 25° to the direction of motion. The guide blades are of the same shape as the moving blades, but reverse in direction. At some point in the turbine, the drum diameter is 1.2 m and blades are 100 mm high. At this place, the steam has a pressure of 2 bar and dryness fraction 0.9. If the speed of this machine is 300 rpm and the steam passes through the blades without shock, find the mass flow rate of steam and power developed in the ring of moving blades.

UNIT - V

10 A gas turbine has an overall pressure ratio of 6 and a maximum cycle temperature of 600℃. The turbine drives the compressor and an electric generator, the mechanical efficiency of the drive being 90% the ambient temperature 17℃ and air enters the compressor at the rate of 12 kg/s. The isentropic efficiencies of compressor and turbine are 85% and 91% respectively. Neglecting changes in kinetic energy, mass flow rate of fuel and all pressure losses, calculate:

(a) The power output.

(b) The cycle efficiency.

(c) Work ratio. Assume $\gamma = 1.35$ for both expansion and compression and C_p = 1.005 kj/kg K.

OR

11 Explain the working of a turbojet with a schematic diagram indicating various components and with the help of pressure and velocity curves. Also explain the advantages of a turbojet engine over the multi cylinder piston engine.

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