Code: 13A03502 **R13**

B.Tech III Year I Semester (R13) Regular Examinations December 2015

THERMAL ENGINEERING – II

(Mechanical Engineering)

(Use of steam tables are 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 limitations on increasing the mean temperature of heat addition in a Rankine cycle?

(b) What is the difference between an open and a closed feed water heater?

(c) Explain the use of following: (i) Blow off cock. (ii) Fusible plug.

(d) Write the basic functions of a chimney in a natural draught.

(e) Steam at a pressure of 10 bar and 0.9 dry expands through a nozzle to a pressure of 1.4 bar. What is the enthalpy drop during the expansion through the nozzle?

(f) Write any four differences between jet and surface condensers.

(g) Explain the following terms related to an impulse turbine: (i) Stage efficiency. (ii) Axial force on the turbine wheel. (iii) Energy converted to heat by blade friction. (iv) Blade velocity coefficient.

(h) Draw the T-s and h-s diagrams for the following: (i) Rankine cycle. (ii) Brayton cycle. (iii) Turo jet. (iv) Convergent divergent nozzle.

(i) Write the basic difference between propeller jet, turbo jet, and turbo prop.

(j) Write the various methods to improve the performance of a gas turbine power plant.

PART – B

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

UNIT – I

2 A smaller power plant produces 25 kg/s steam at 3 MPa and 600^{o}C, in the boiler. It cools in the condenser with ocean water so that the condenser exit is at 45^{o}C. There is reheat done at 500 kPa upto 400^{o}C, and then expansion takes place in the low-pressure turbine. Find the net power output and the total heat transfer in the boiler.

OR

3 With neat block diagrams, explain clearly the various methods to improve Rankine cycle performance. Draw the T-s and h-s diagrams for each category

UNIT – II

4 (a) What are the unique features of high pressure boilers when compared to lower pressure boilers?

(b) Explain the working of a Lamont boiler with a neat sketch.

OR

5 A 30 m high chimney discharges flue gases at 357^{o}C in to an atmosphere at 27^{o}C. Consider the air-fuel ratio required to burn the coal on the grate is 16. Calculate:

(a) Volume of flue gases passing through the chimney per sec if 1360 kg of coal is burnt per hour over the grate.

(b) The base diameter of the chimney if the velocity of the flue gases at the base of the chimney is given by, $H_1 = K \frac{C^2}{2}$, where the value of K = 1.627.

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UNIT – III

6 A set of 16 nozzles for an impulse turbine receives steam at 16 bar and 300°C. The pressure of steam at exit is 10 bar. If the total discharge is 245 kg/min and efficiency of nozzle is 90%, calculate the cross sectional area at the exit of each nozzle. If the steam has a velocity of 100 m/sec at the entry to the nozzles, calculate the percentage increase in discharge.

OR

7 The observations recorded during the trail on steam condenser are given below:
Condenser vacuum = 685 mm of Hg; Barometer reading = 765 mm of Hg; Mean condenser temperature = 34°C; Hot well temperature is 28°C; Condensate formed per hour = 1750 kg; Circulating cooling water inlet temperature is 18°C; Outlet temperature is 30°C; Quantity of cooling water is 1300 kg/min. Calculate: (i) Vacuum efficiency. (ii) Under-cooling of condensate. (iii) Efficiency of condenser. (iv) Condition of steam as it enters the condenser. (v) Mass of air present per kg of uncondensed steam.

UNIT – IV

8 In a Delaval turbine, the steam issues from the nozzles with a velocity of 850 m/s. The nozzle angle is 20°C. Mean blade velocity 350 m/s. The blades are equiangular. The mass flow rate is 1000 kg/min. Friction factor is 0.8. Determine: (i) Blade angles. (ii) Axial thrust on the bearing. (iii) Power developed. (iv) Blade efficiency. (v) Stage efficiency if nozzle efficiency is 93%.

OR

9 (a) The outlet angle of the blade of a Parson's turbine is 20°C and axial velocity of flow of steam is 0.5 times the mean blade velocity. If the diameter of the ring is 1.25 m and the rotational speed is 3000 rpm. Calculate: (i) Inlet angles of the blades. (ii) Power developed if dry saturated steam at 5 bar passes through the blade whose height may be assumed as 6 cm. Neglect the effect of blade thickness.

(b) Derive the expression for maximum blade efficiency for a Parson' 50-50 reaction turbine.

UNIT – V

10 A large stationary Brayton-cycle gas turbine power plant delivers a power output of 100 MW to an electric generator. The minimum temperature in the cycle is 300 K, and the maximum temperature is 1600 K. The minimum pressure in the cycle is 100 kPa, and the compressor pressure ratio is 14 to 1. Calculate the power output of the turbine. What fraction of the turbine output is required to drive the compressor? What is the thermal efficiency of the cycle?

OR

11 A turbojet engine consumes air at the rate of 60.2 kg/s when flying at a speed of 1000 km/hr. Calculate: (i) Exit velocity of the jet when the enthalpy change for the nozzle is 230 kJ/kg and velocity coefficient is 0.96. (ii) Fuel flow rate in kg/s when air fuel ratio is 70:1. (iii) Thrust specific fuel consumption. (iv) Thermal efficiency of the plant when combustion efficiency is 92% and calorific value of the fuel used is 42000 kJ/kg. (v) Propulsion efficiency.

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