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Code No: 125ER

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year I Semester Examinations, September - 2021
THERMAL ENGINEERING - II
(Common to ME, AME)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks

1.a) Draw the schematic diagram for an ideal Rankine cycle. Draw p-v, T-s and h-s diagrams for this cycle.

b) Superheated steam at a pressure of 10 bar and 400 ^{0}C is supplied to a steam turbine. Adiabatic expansion takes place to release point at 0.9 bar and it exhausts into a condenser at 0.3 bar. Neglecting clearance, for a steam flow rate of 1.5 kg/s, determine the quality of steam at the end of expansion, power developed, specific steam consumption and cycle efficiency. [8+7]

2. In a reheat cycle steam enters the H.P turbine at 100 bar and 500 ^{0}C. The expansion is continued to a pressure of 8.5 bar with isentropic efficiency of 80%. There is a pressure drop of 1.5 bar in the reheater and then steam enters the L.P turbine at 7 bar and 500 ^{0}C in which expansion is continued to a back pressure of 0.04 bar with isentropic efficiency of 85%. Determine a) thermal efficiency b) specific steam consumption. [7+8]

3.a) What is the significance of draught in steam boilers? Discuss the importance.

b) Describe with a neat line sketch of a Benson boiler mentioning its distinguishing features. [7+8]

4. Steam enters a group of nozzles of a steam turbine at 12 bar and 220 ^{0}C and leaves at 1.2 bar. The steam turbine develops 220 kW with a specific steam consumption of 13.5 kg/kWh. If the diameter of nozzles at throat is 7 mm, calculate the number of nozzles required. [15]

5.a) Deduce an expression for work done per stage of a simple reaction turbine.

b) A single row impulse turbine develops 132.4 kW at a blade speed of 175m/sec, using 2kg of steam per sec. Steam leaves the nozzle at 400m/sec. Velocity coefficient of the blades is 0.9. Steam leaves the turbine blades axially. Determine nozzle angle, blade angles at entry and exit. Assume no shock. [8+7]

6.a) Explain about the open cycle and closed cycle turbines with neat sketches and also draw P-V and T-S diagrams.

b) In a gas turbine plant, air is drawn at 1 bar, 15 ^{0}C and the pressure ratio is 6. The expansion takes place in two turbines. The efficiency of compressor is 0.82, high pressure turbine is 0.85 and low pressure turbine is 0.84. The maximum cycle temperature is 625 ^{0}C. Calculate i) Pressure and temperature of gases entering the low pressure turbine. ii) Net power developed iii) Work ratio iv) Thermal efficiency. Work output of high pressure turbine is equal to compressor work. [7+8]

7. In an air standard regenerative gas turbine cycle the pressure ratio is 5. Air enters the compressor at 1 bar, 300 K and leaves at 490 K. The maximum temperature in the cycle is 1000 K. Calculate the cycle efficiency, given that the efficiency of regenerator and the adiabatic efficiency of the turbine are each 80%. Assume for air, the ratio of specific heats is 1.4. Also show the cycle on T-S diagram. [15]

8.a) A jet propulsion system has to create a thrust of 100 tonnes to move the system at a velocity of 700 km/hr. If the gas flow rate through the system is restricted to a maximum of 30 kg/s. find the exit gas velocity and propulsive efficiency.

b) Explain the advantages and disadvantages of bipropellants used in rocket engines over monopropellants. [8+7]

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