Hall Ticket No | | | | | | | | | | | Question Paper Code: AME013

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Four Year B.Tech V Semester End Examinations(Regular) - November, 2019

Regulation: IARE – R16

THERMAL ENGINEERING

Time: 3 Hours **(ME)** **Max Marks: 70**

Answer ONE Question from each Unit
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

UNIT – I

1. (a) Explain the regenerative cycle with layout and TS diagram. Also list its advantages and disadvantages. **[7M]**

   (b) The steam turbine is fed with the steam having an enthalpy of 3100 kJ/kg. It moves out of the turbine with an enthalpy of 2100 kJ/kg. Feed heating is done at 3.2 bar with steam enthalpy of 2500 kJ/kg. The condensate from the condenser with an enthalpy of 125 kJ/kg enters into the feed heater. The quantity of the bled steam 11200 kg/h. Find the power developed by the turbine. Assume that the water leaving the feed heater is saturated liquid at 3.2 bar and heater is direct mixing type. Neglect the pump work. **[7M]**

2. (a) Deduce an expression for the efficiency of the ideal Rankine cycle. **[7M]**

   (b) In a steam power cycle, the steam supply is at 15 bar and dry and saturated.The condenser pressure is 0.4 bar. Calculate the Carnot and Rankine efficiencies of the cycle. Neglect pump work. **[7M]**

UNIT – II

3. (a) Define nozzle efficiency. Deduce condition for the maximum discharge in steam nozzles. **[7M]**

   (b) Determine the mass flow rate of steam through a nozzle having isentropic flow through it. Steam enters nozzle at 10 bar, 50^0C and leaves at 6 bar. Cross-section area at exit of nozzle is 20 cm^2 . Velocity of steam entering nozzle may be considered negligible. Show the process on h-s diagram also. **[7M]**

4. (a) Explain the concept of Meta stable state while representing Wilson line on h-s diagram. **[7M]**

   (b) "The water level indicator is a mounting". Justify the statement. **[7M]**

UNIT – III

5. (a) Classify the steam turbines. Differentiate impulse and reaction turbines. **[7M]**

   (b) A De-laval turbine type impulse turbine is to develop 150 KW with a probable consumption of 7.5 kg of steam per KWH with initial pressure being 12 bar and the exhaust pressure being 0.15 bar. Taking the diameter of the throat of each nozzle as 6 mm, find the number of nozzles required. Assuming 10 % of total drop is lost in diverging part of the nozzle, find the diameter at the exit of the nozzle. **[7M]**

6. (a) Define steam condenser and state its objectives. Discuss different types of condenser briefly. **[7M]**

   (b) In a reaction turbine, the blade tips are inclined at 35^0 and 20^0 in the direction of motion. The guide blades are of the same shape as the moving blades, but reversed in direction. At a certain place, steam has a pressure of 1.7 bar and dryness 0.935. If the speed of the turbine is 250 r.p.m and the steam passes through the blades without shock, find the mass of the flow and the power developed in the ring of the moving blade. **[7M]**

UNIT – IV

7. (a) Discuss with neat sketch about the inter-cooling effect on gas turbine plant. **[7M]**

   (b) A gas turbine plant has air being supplied at 1 bar, 27^0C to compressor for getting compressed upto 5 bar with isentropic efficiency of 85%. Compressed air is heated upto 1000 K in combustion chamber where also occurs a pressure drop of 0.2 bar. Subsequently expansion occurs to 1 bar in turbine. Determine isentropic efficiency of turbine, if thermal efficiency of plant is 20%. **[7M]**

8. (a) What are the requirements of Gas turbine combustion chambers? Describe how it is achieved in terms of their combustion chamber arrangements. **[7M]**

   (b) A gas turbine unit has a pressure ratio of 6 :1 and maximum cycle temperature of 610^0C. The isentropic efficiencies of the compressor and turbine are 0.80 and 0.82 respectively. Calculate the power output in kilowatts of an electric generator geared to the turbine when the air enters the compressor at 15^0C at the rate of 16 kg/s. Take $C_p = 1.005$ kJ/kg K and $\gamma = 1.4$ for the compression process, and take $C_p = 1.11$ kJ/kg K and $\gamma = 1.333$ for the expansion process. **[7M]**

UNIT – V

9. (a) Explain the construction and working of Turbo jet engine. **[7M]**

   (b) The effective exit jet velocity of a rocket is 3000 m/sec, the forward flight velocity is 1500 m/sec and the propellant consumption is 70 kg per sec. Calculate : i) Thrust ii) Thrust power iii) Specific impulse iv) Specific propellant consumption v) Propulsive efficiency of the rocket. **[7M]**

10. (a) Explain with neat sketch about solid propellant rocket engines. **[7M]**

    (b) A turbo jet engine consumes air at the rate of 60.2 kg/s when flying at a speed of 1000km/h. Calculate fuel flow rate in kg/s if the air-fuel ratio is 70:1. **[7M]**