Code No: 125ER **R15**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year I Semester Examinations, November/December - 2018
THERMAL ENGINEERING – II
(Common to ME, AME)

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

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

PART - A

(25 Marks)

1.a) Draw the P-V diagram and T-s diagram of Reheat cycle. [2]
b) Write the significance of adiabatic flame temperature. [3]
c) Write the significance of mountings of a boiler. [2]
d) Explain the working principle of a nozzle. [3]
e) Draw velocity diagram at inlet for impulse turbine. [2]
f) Explain the working principle of draft in the condenser. [3]
g) What is the purpose of inter cooling in gas turbine. [2]
h) Draw two combustion chambers of gas turbine plant. [3]
i) Write equations for propulsive efficiency and thermal efficiency of jet propulsion engine. [2]
j) Explain solid propellant rocket engine. [3]

PART - B

(50 Marks)

2.a) What is meant by the concept of mean temperature of heat addition in Rankine cycle?
b) A steam power plant running on Rankine cycle has steam entering HP turbine at 20 MPa , 500^0C and leaving LP turbine at 90% dryness. Considering condenser pressure of 0.005 MPa and reheating occurring upto the temperature of 500^0C determine,
i) The pressure at which steam leaves HP turbine
ii) The thermal efficiency. [5+5]

OR

3.a) Write the steps involved in the determination of air requirement for complete combustion.
b) Using orsat analysis, explain the flue gas analysis. [5+5]

4.a) Classify the boilers based on the temperature and pressure limits.
b) Draw the line diagram of volex boiler and mention its pressure limits. [5+5]

OR

5.a) Derive the equation for maximum discharge in nozzles.
b) In a nozzle steam expands from 12 bar and 300^0C to 6 bar with flow rate of 5 kg/s. Determine throat and exit area if exit velocity is 500 m/s and velocity at inlet to nozzle is negligible. Also find coefficient of velocity at exit. Coefficient of velocity is the ratio of actual velocity of fluid at nozzle exit to the velocity at exit considering isentropic flow through nozzle. [5+5]

6.a) Draw the free hand sketch and explain velocity compounded impulse turbine.

b) In a single stage impulse turbine the isentropic enthalpy drop of 200 kJ/kg occurs in the nozzle having efficiency of 96% and nozzle angle of 15^0. The blade velocity co efficiency is 0.96 and ratio of blade speed to steam velocity is 0.5. The steam mass flow rate 20 kg/s and velocity of steam entering is 50 m/s. determine

i) The blade angles at inlet and outlet if the steam enters blades smoothly and leaves axially.

ii) The blade efficiency

iii) The power developed in Kw

iv) The axial thrust.

Solve using velocity diagram. [5+5]

OR

7.a) What is the principle of Ejector condenser and explain the working with line diagram of the same.

b) A Parson's reaction turbine has mean diameter of blades as 1.6 m and rotor moving at 1500 rpm. The inlet and outlet angles are 80^0 and 20^0 respectively. Turbine receives steam at 12 bars, 200^0C and has isentropic heat drop of 26 kJ/kg. 5% of steam supplied is lost through leakage. Determine the following considering horse power developed in stage to be 600 hp.

i) The stage efficiency

ii) The blade height. [5+5]

8.a) Draw line diagram and explain Regenerative gas turbine cycle.

b) A gas turbine unit receives air at 2 bar, 300 k and compresses it adiabatically to 6.2 bar. The compressor efficiency is 88%. The fuel has a heating value of 44186 kJ/kg and fuel- air ratio is 0.017 kg fuel/kg of air. The turbine internal efficiency is 90%. Calculate the work of turbine and compressor per kg of air compressed and thermal efficiency. For products of combustion C_p=1.147 kJ/kg K, γ=1.33. [5+5]

OR

9.a) Explain the need and significance of inter cooling in gas turbines.

b) In a gas turbine installation air is supplied at 1 bar, 27^0C into compressor having compressor ratio of 8. The air leaving combustion chamber is heating upto 1100 K and expanded upto 1 bar. A heat exchanger having effectiveness of 0.8 is fitted at exit of turbine for heating the air before its inlet into combustion chamber. Assuming polytrophic efficiency of the compressor and turbine as 0.85 and 0.90 determine cycle efficiency, work ratio and specific work output of plant. Take Cp=1.0032 kJ/kg. K for air. [5+5]

10.a) Derive the equation for propulsive power of jet propulsion engine.

b) A jet propulsion engine moves with speed of 200 m/s at an altitude where total pressure and total temperature at inlet to compressor are 0.5 bar and 272 K. Isentropic efficiency of compressor and turbine are 0.84 and 0.82 respectively. Total pressure and temperature and temperature of gases at inlet to turbine are 3 bar and 1000 k and static back pressure of propulsion nozzle is 0.4 bar and nozzle efficiency based on total pressure drop is 92%. Determine (i) power required to run compressor per kg of air, (ii) the air –fuel ratio, (iii) the total pressure of gas leaving turbine , (iv) thrust per flow rate, (v) Plot the processes on h-s diagram. Take $C_{p\ gas}$ =1.13 kJ/kg. K, γ_{gas} = 1.33, $C_{p\ air}$ =1.005 kJ/kg. K, γ_{gas}=1.4 and Calorific value 41.84 MJ/kg of fuel. [5+5]

OR

11.a) Draw line diagram and explain the working of liquid propellant rocket engine.

b) Compare and contrast turbojet engine with Rocket propulsion engine in all aspects. [5+5]

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