Code No: 115ER **R13**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech III Year I Semester Examinations, November/December - 2016

THERMAL ENGINEERING – II

(Common to AME, ME)

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 Rankine cycle on p-V and T-S diagrams. [2]
b) What is meant by Reheating and its advantages? [3]
c) Write the significance of accessories of a boiler. [2]
d) Draw different nozzle cross sections and explain them. [3]
e) Draw velocity triangle at exit for impulse turbine. [2]
f) Explain the working principle of Ejector condenser. [3]
g) What is the purpose of regeneration in the gas turbine? [2]
h) Explain the purpose of compressor in gas turbine plant. [3]
i) Write equation for Thrust power and propulsive power. [2]
j) Explain liquid propellant rocket engine. [3]

PART - B

(50 Marks)

2.a) Draw combined cycle diagram and explain briefly.
b) In a steam turbine installation running on ideal Rankine cycle steam leaves the boiler at 10 MPa and 700^{0}C and leaves turbine at 0.005 MPa. For the 50 MW output of the plant and cooling water entering and leaving condenser at 15^{0}C and respectively determine.
i) The mass flow rate of steam in kg/s
ii) The mass flow rate of condenser cooling water in kg/s
iii) The thermal efficiency of cycle
iv) The ration of heat supplied and rejected (in boiler and condenser respectively).
Neglet K.E. and P.E. changes. [5+5]

OR

3.a) Explain the significance of adiabatic flame temperature.
b) Draw the line diagram and explain the flue gas analysis using Orsat apparatus. [5+5]

4.a) Compare and contrast the boiler mountings and accessories.
b) Draw the line diagram and explain the working of a Benson boiler and mention its limits. [5+5]

OR

5.a) Derive the equation for critical pressure ratio in nozzles.

b) An impulse turbine of 1MW has steam entering at 20 bar 300^0C and steam consumption of 8 kg per kW hour. Steam leaves at 0.2 bar and 10% of total heat drop is lost in overcoming friction in deveining portion of nozzle. If throat diameter of each nozzle is 1 cm then determine (i) the number of nozzle required (ii) exit diameter of each nozzle. Solve using mollier diameter. [5+5]

6.a) Draw the line diagram and explain pressure compounded impulse turbine.

b) A single stage of simple impulse turbine produce 120 kW at blade speed of 150 m/s when steam mass flow rate is 3 kg/s. Steam enters moving blade at 350 m/s and leaves the stage axially. Considering velocity coefficient of 0.9 and smooth entry without shock into blades, determine the nozzle angle and blade angles. Solve using velocity diagram. [5+5]

OR

7.a) Draw the line diagram and explain the working of evaporative condenser.

b) In a reaction turbine 6 kg/s steam is admitted at 15 bar dry saturated in the first stage. Turbine has eight pairs on mean diameter of 50 cm and run at 3000 rpm with mean blade speed to steam velocity ratio of 0.8. There occurs tip leakage of steam at all rows amounting to 10% of total and efficiency of working steam is 85%. Considering blade outlet angles for both fixed and moving blades to be 20^0, determine the following analytically.

i) The output from turbine in hp

ii) The pressure of steam leaving turbine,

iii) The mean blade height. [5+5]

8.a) Briefly derive the equation for Brayton cycle efficiency.

b) In a Brayton cycle gas turbine power plant the minimum and maximum temperature of the cycle are 300 K and 1200 K. the compression is carried out in two stages of equal pressure ratio with intercooling of the working to the minimum temperature of the cycle after the first stage of compression. The entire expansion is carried out in one stage only. The isentropic efficiency of both compressors is 0.85 and that of the turbine is 0.9. Determine the overall pressure ratio that would give the maximum net work per kg working fluid. Take γ= 1.4. [5+5]

OR

9.a) Draw the line diagram and explain the Reheat gas turbine cycle.

b) A gas turbine plant has air being supplied at 1 bar, 270 C to compressor for getting compressed up to 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% .

Neglect the air property variation throughout cycle. Take γ=1.4 [5+5]

10.a) Explain the working of Turbojet engine with the help of pressure, velocity, temperature variations.

b) A jet propulsion engine has compressor with pressure ratio 4 and compressed air enters into combustion chamber where combustion occurs so as to yield temperature of 500^0C at turbine inlet. Actual temperature at inlet to combustion chamber is 10% more than that of isentropic compressor temperature rise. Exhaust from turbine is expanded up to atmospheric pressure of 1 bar. The ambient temperature is 285 K. Determine (i) power required to derive compressor ,(ii) air fuel ratio if calorific value of fuel is 43100 kJ/ kg, (iii) static thrust developed per kg of air per second. [5+5]

OR

11.a) Derive the equation for propulsive efficiency of rocket propulsion.

b) Compare and contrast liquid and solid propellant rocket engines in detail. [5+5]

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