Code No: 115ER **R13**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B.Tech III Year I Semester Examinations, February/March - 2016

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) What is adiabatic flame temperature of fuel. [2]
b) Explain super saturated flow of steam in steam nozzles. [3]
c) Write the equation for blade efficiency (or) diagram efficiency derivation for impulse turbine. [2]
d) What are the different types of combustion chambers in gas turbines? [3]
e) Explain thrust augmentation used in jet and rocket propulsion. [2]
f) Explain different methods to improve the efficiency of Rankine cycle. [3]
g) Compare and contrast the boiler Mountings and Accessories. [2]
h) Draw line diagram and explain the working of Evaporative Condenser. [3]
i) Explain the deviation of actual Brayton cycle to the theoretical one. [2]
j) Why propeller engines are not recommended now a days in air craft's? [3]

PART-B

(50 Marks)

2.a) Explain the effect of operating variables on Rankine cycle performance.
b) A steam power plant operates on ideal Rankine cycle. The steam enters the turbine at 3 MPa, 350 ^{0}C and is condensed in the condenser at 75 kPa, calculate thermal efficiency, back work ratio and work ratio of this cycle. [5+5]

OR

3.a) How to calculate the minimum air required and excess air calculation in the complete combustion of gaseous fuel.
b) Calculate the air fuel ratio on both mass and molar basis for the complete combustion of octane ($C_8 H_{18}$) with theoretical amount of air and 150% theoretical air. [5+5]

4.a) What is meant by super critical boiler and explain one such boiler.
b) Explain the working principle of a volex boiler with a neat sketch and indicate all mountings and accessories on it. [5+5]

OR

5.a) Derive the equation for critical pressure ratio of nozzle for different conditions.
b) In a convergent-divergent nozzle, the steam enters at 15 bar and 300 ^{0}C and leaves at 2 bar. The inlet velocity to the nozzle is 150 m/s. Find the required throat and exit areas for a mass flow rate of 1 kg/s. Assume nozzle efficiency to be 90% and Cp_s = 2.4 kJ/kg K. [5+5]

6.a) Draw the line diagram and velocity triangles and explain the working details of impulse turbine.

b) Steam leaves the nozzle of a single stage impulse turbine at 850 m/s. The nozzle angle is 18^0 and the blade angles are 29^0 at the inlet and outlet. The friction coefficient is 0.9. Calculate blade velocity and steam mass flow rate in kg/hr to develop 300 W power. [5+5]

OR

7.a) Derive the condition for maximum efficiency and blade height of reaction turbine.

b) In a Parson reaction turbine, the angles of receiving tips are 35^0 and of discharging tips, 20^0. The blade speed is 100 m/s. Calculate the tangential force, power developed, diagram efficiency and axial thrust of the turbine, if its steam consumption is 1 kg/min. [5+5]

8.a) Explain the deviation of actual gas turbine cycle from ideal Brayton cycle.

b) A gas turbine takes in air at 27 ^{0}C and 1 bar. The pressure ratio is 4. The maximum temperature of the cycle is 560 ^{0}C. The efficiency of the compressor and turbine is 0.83 and 0.85 respectively. Find the overall efficiency, if the regenerator effectiveness is 0.75. [5+5]

OR

9.a) Prove that the isothermal work input to a compressor is always minimum.

b) In a gas turbine power plant, operating on Joule's cycle, air is compressed from 1 bar and 15 ^{0}C through a pressure ratio of 6. It is then heated to 727^0 C in the combustion chamber and expanded back to 1 bar. Calculate the net workdone, cycle efficiency and work ratio. Isentropic efficiency of turbine is 90% and of compressor is 85%. [5+5]

10.a) Showing the basic components, explain the working of turbojet engine.

b) A turbojet is flying with a speed of 850 KMPH at an altitude, where air density is 0.17 kg/m^3. The propulsive and overall efficiencies are 55% and 17% respectively. If the drag on air craft is 6000 N, calculate the exit velocity of jet, diameter of jet and propulsive power. [5+5]

OR

11.a) What are the desirable properties of a liquid propellant for a rocket engine?

b) For a rocket engine, jet velocity is 1600 m/s, flight to jet speed ratio is 0.7. Oxidizer flow rate is 4 kg/s. Fuel flow rate is 1 kg/s. Heat of reaction per kg of exhaust gas is 2500 kJ/kg. Calculate the Thrust, specific impulse, propulsive efficiency, thermal and overall efficiency of rocket engine. [5+5]

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