

Code No: 115ER

**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 °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 ( $C_8H_{18}$ ) 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 vorex 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 °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  $C_{p_s} = 2.4$  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  $18^\circ$  and the blade angles are  $29^\circ$  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  $35^\circ$  and of discharging tips,  $20^\circ$ . 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  $27^\circ\text{C}$  and 1 bar. The pressure ratio is 4. The maximum temperature of the cycle is  $560^\circ\text{C}$ . 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  $15^\circ\text{C}$  through a pressure ratio of 6. It is then heated to  $727^\circ\text{C}$  in the combustion chamber, and expanded back to 1 bar. Calculate the net work done, 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  $0.17\text{ kg/m}^3$ . 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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