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Code No: 125ER

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech III Year I Semester Examinations, November/December - 2017

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) State the essential differences between Carnot and Rankine cycles. [2]

b) Define the terms lean mixture, rich mixture and stochiometric mixture. [3]

c) What is the function of fusible plug? [2]

d) Differentiate the super heater and economizer. [3]

e) Define isentropic efficiency of a compressor. Explain with the help of T-s diagram. [2]

f) Compare the merits and demerits of surface condenser over jet condenser. [3]

g) What is meant by positive displacement and non positive displacement compressor? [2]

h) Atmospheric air at 1.0 bar and 27 ^{0}C enters a compressor with a velocity of 100 m/s. Determine (i) the stagnation temperature and ii) the stagnation pressure. [3]

i) Define the terms thrust power and propulsion efficiency. [2]

j) What is meant by thrust augmentation? When is it necessary? [3]

PART - B

(50 Marks)

2.a) A power generating plant uses steam as working fluid and operates at boiler pressure of 50 bar, dry saturated and condenser pressure of 0.5 bar. Calculate for these limits i) the cycle efficiency and ii) the work ratio and iii) specific steam consumption for Carnot cycle and Rankine cycle.

b) Enumerate the characteristics of good fuel. What is meant by dry and wet analysis of the products of combustion? [7+3]

OR

3.a) Show that the thermal efficiency of a regenerative cycle is always greater than that of a simple Rankine cycle regardless of where steam is tapped off.

b) Discuss the effects of following parameters in a Rankine cycle.
i) steam pressure at inlet to turbine and ii) steam temperature at inlet to turbine. [7+3]

4.a) Sketch and describe the operation of Babcock and Wilcox boiler.

b) Why boiler accessories are installed. Explain the operation of economiser with the help of simple diagram. [5+5]

OR

5.a) A convergent-divergent nozzle is required to discharge 2 kg of steam per second. The nozzle is supplied with steam of 10 bar and 200 ^{0}C and discharge takes place against a back pressure of 0.34 bar. Estimate the throat and exit areas. Assume isentropic flow and take the index n = 1.3. If the nozzle efficiency is assumed to be 85%, determine the exit area.

b) Derive the value of critical velocity in terms of sonic velocity at inlet conditions and index of expansion. [6+4]

6.a) Why compounding is necessary in the steam turbines? What are the types and explain any one type of compounding with neat sketch.

b) Sketch the velocity diagram of a single stage impulse turbine and determine the expression for the force, work done, diagram efficiency and axial thrust. [5+5]

OR

7.a) Sketch and describe the operation of down flow surface condenser.

b) Explain the working of single stage reaction turbine. Sketch pressure and velocity variations along the axis of the turbine. Show the expansion on *h-s* chart. [5+5]

8.a) Write notes on the requirements of gas turbine combustion chamber.

b) Derive an expression for the efficiency as a function of temperature ratio and pressure ratio of the cycle for an ideal gas turbine cycle with reheat and heat exchange. [5+5]

OR

9. The following details refer to a gas turbine power plant with a single stage compressor and two stage gas turbine. The compressor is driven by the H.P. stage of the two-stage turbine and compresses 5 kg of air per second from 1 bar to 5 bar with an isentropic efficiency of 85%. The H.P. stage turbine has an isentropic efficiency of 87% and its inlet temperature is 675 ^{0}C. The L.P. stage turbine, which is mechanically independent, has an isentropic efficiency of 82%. The expansion pressure ratios of the two turbines are not equal and there is no reheating between the stages. The exhaust gases from the L.P. stage pass to a heat exchanger which transfers 70% of the heat available in cooling the exhaust to raise the compressor temperature at delivery. Assuming the working fluid to be air throughout, of constant specific heat, and neglecting pressure losses, estimate the intermediate pressure and temperature between the two turbine stages, the power output of the L.P. stage and the overall plant efficiency. Assume inlet pressure of 1 bar and temperature of 15 ^{0}C. [10]

10.a) With a neat sketch and T-s diagram, explain the working of a turboprop engine.

b) What is meant by thrust? Derive the thrust equation for a general propulsion system. [4+6]

OR

11.a) The effective jet exit velocity from a jet engine is 2700 m/s. The forward flight velocity is 1350 m/s and the air flow rate is 78.6 kg/s. Calculate: i) thrust ii) thrust power and iii) propulsive efficiency.

b) Explain clearly the various factors affecting the performance of a propulsion device. [5+5]

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