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2005 JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY

III B.TECH I SEMESTER SUPPLEMENTARY EXAMINATIONS
THERMAL ENGINEERING - II
(MECHANICAL ENGINEERING)

NOVEMBER 2005

TIME: 3 HOURS
MAX MARKS: 80

Answer any FIVE Questions
All Questions carry equal marks

1. In a boiler, the following observations were made:
Pressure of steam = 10 bar
Steam condensed = 540 kg/hr
Fuel used = 65 kg/hr
Moisture in fuel = 2% by Mass
Mase of dry flue gases = 9kg/kg of fuel
LCV of fuel = 32,000 KJ/kg
Temperature of the flue gases = 325 0C
Temperature of boiler house = 28 0C
Feed water temperature = 50 0C
Mean specific heat of flue gases = 1 KJ/kg K
Dryness factor of steam = 0.95
Prepare a heat balance sheet for the boiler. [16]

2. (a) Explain various types of nozzles.

(b) Dry saturated steam enters a steam nozzle at pressure of 12 Bar and is discharged at a pressure of 1.5 Bar and dryness fraction 0.95. What will be the final velocity of steam? Neglect initial velocity. If 12% of heat drop is lost in friction. find the percentage reduction in the final velocity. [6+10]

3. (a) What are the requirements of a good surface condenser?

(b) What are the merits and demerits of a surface condenser over jet condenser? [6+10]

4. (a) Define the following as related to steam turbines.

i. Speed ratio

ii. blade velocity coefficient

iii. Diagram efficiency

iv. stage efficiency

(b) Derive the expression for maximum blade efficiency in a single stage impulse turbine. [8+8]

5. (a) what is the Parson's Reaction turbine?

(b) A 50% reaction turbine (with symmetrical velocity triangles) running at 400 rpm has the exit angle of the blades as 20o and the velocity of steam relative to the blades at the exit is 1.35 times the mean blade speed. The steam flow rate is 8.33 kg/s and at a particular stage the specific volume is 1.381 m3/kg.Calculate for this stage:

i. The suitable blade height, assuming the rotor mean diameter as 12 times the blade height, and

ii. The diagram work. [6+10]

6. (a) The following data is refers to a closed cycle gas turbine plant Atmospheric Air temperature 270C Maximum temperature of the cycle 8230C Pressure at compressor inlet 1 bar Pressure ratio 4 Compressor efficiency 80% Turbine efficiency 85% Heating value of fuel 41,800 kJ/Kg Turbine efficiency 80% Heater loss 10% of Heating value Find.

i. Work ratio

ii. Turbine work

iii. Compressor work

iv. Heat supplied Assume the working substance is Air ,regard as simple gas with Cp = 1 KJ/Kg 0K and = 1.4

(b) What is “regeneration ” in gas turbines. [12+4]

7. (a) Explain the working difference between propeller jet, turbo-jet and turbo prop.

(b) A turbo-jet unit flying at a speed of 729 Km/hr at an altitude where air temperature and pressure are 22 K and 0.877 bar. The maximum temperature of the plant is limited to 8600o C. Find the specific thrust produced if the exhaust gases from the turbine are expanded to atmospheric pressure in a convergent nozzle. Using the following data: The pressure ratio of the compressor is 4:1 Efficiency of ram compression is 0.90 c = 0.80, t =0.85, n =0.93 Transmission efficiency is 0.98 Neglecting the pressure losses and mass of the fuel find the specific thrust produced by the unit. [6+10]

8. (a) Describe nuclear rocket engine with a neat sketch.

(b) What are the other kinds of rocket propulsion? Mention some of them. [8+8]