CODE NO: NR 310303 NR

2006 JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY

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

NOVEMBER 2006

TIME - 3 HOUR
MARK – 80

Answer any FIVE Questions
All Questions carry equal marks

1. (a) Explain how the heat balance in done for a Boiler.

(b) With a neat sketch, explain the regenerative type of Air preheater. [8+8]

2. A convergent divergent nozzle is required to pass 1.8 kg of steam per second. At inlet the steam pressure and actual temperature are 7 bar and 2000C respectively and the speed is 75 m/s. Expansion is stable throughout to the exit pressure of 1.1bar. There is no loss by friction in the converging section of the section, but loss by friction between throat and outlet is equivalent to 71 kJ/kg of steam. Calculate

(a) the required area of throat in mm2,

(b) the required area of outlet in mm2and

(c) the overall efficiency of the nozzle, based on the heat drop between the actual inlet pressure and temperature and the outlet pressure. [4+6+6]

3. (a) Draw the neat diagram of evaporative condenser and discuss its working principles ?
(b) Define and derive the equations for the terms:

i. vacuum efficiency and

ii. condenser efficiency [8+8]

4. In a single row impulse turbine the nozzle angle is 300 and the blade speed is 215 m/sec. The steam speed is 550 m/sec. The blade friction coefficient is 0.85. assuming axial exit and a flow rate of 700 kg/hr, determine

(a) the blade angles ,

(b) the absolute velocity of steam at exit and

(c) the power output of the turbine. [4+4+8]

5. In a stage of impulse reaction turbine provided with single row wheel, the mean diameter of the blades is 1metre.it turns at 3000r.p.m.the steam issues from the nozzle at a velocity of

350m/sec and the nozzle angle is 200. The rotor blades are equiangular. The blade friction factor is 0.86.determine the power developed if the axial thrust on the end bearing of a rotor is 118N. *[16]*

6. (a) Is it always useful to have a regenerator in gas turbine power cycle ? why?.

(b) Air enters the compressor of a gas turbine plant operating on Brayton cycle at 101.325kPa, 270C . the pressure ratio in the cycle is 6. Calculate the maximum temperature of the cycle and the efficiency of the cycle. Assume W T= 5/2 Wc ; = 1.4 Where WT = Turbine work WC = Compressor work

(c) Define "work ratio" ? *[8+4+4]*

7. The speed of a jet propulsion unit is 210 m/s relative to still air. The total pressure and total temperature at the intake to an uncooled compressor are 0.7 bar and -1.110C. The total temperature and total pressure of the gases entering the turbine are 7600 C and 3.15 bar. The isentropic efficiencies of the compressor and turbine based on total head values are 85% and 80% respectively. The static backpressure on the propulsion nozzle is 0.56 bar and the efficiency of the nozzle based on the total pressure drop, available is 90%. Neglect other losses and mass increase due to fuel consumed and calculate:

(a) The power required to drive the compressor per kg of air per second,

(b) The air-fuel ratio of the fuel has a heating value of 42000 KJ/kg.

(c) The total pressure of the gases leaving the turbine.

(d) The thrust per kg of air per second.

Take Cp =1.005 KJ/kg-K and = 1.4 for air and Cp =1.147 KJ/kg-K and = 1.33 for gases. *[16]*

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

(b) What are the other kinds of rocket propulsion? Mention some of them