Applied Thermodynamics

(ME-207/209, May. 2007)

Time: 3 Hours Max. Marks: 60

Note: Question No. 1 is compulsory. Attempt any four questions from section B and two questions from section C.

Section-A

1. (a) What is a pure substance?
   (b) What is sensible heat, explain.
   (c) What is the optimum pressure of modern high-pressure boiler?
   (d) Name the two fluids of binary cycle.
   (e) Why compounding of turbines are essential?
   (f) What is degree of under-cooling?
   (g) What is reheat factor?
   (h) What is degree of reaction?
   (i) Write three uses of compressed air.
   (j) What is function of condensing plant?

Section-B

2. Using steady flow energy equation of nozzle derives the relation of critical pressure ratio for maximum discharge.
3. Steam with absolute velocity of 300 m/s is supplied through a nozzle to a single impulse turbine. The nozzle angle is 25º, the diameter of rotor is 1 m and has speed 2000 r.p.m. Find blade angles for zero axial thrust. If the blade velocity coefficient is 0.9 and steam flow rate is 10 kg/s. Calculate power.
4. Differentiate between impulse and reaction turbine.
5. Derive the maximum diagram efficiency of a reaction turbine.
6. What is a fusible plug and state where it is located in a boiler?

Section-C

7. (a) A 2-stage compressor is used to compress from 1.0 bar to 16 bar. The compression is as per the law $pv^{1.25}$. The temperature of air at inlet of compressor is 300K. Neglecting the clearance and assuming perfect inter-cooling. Find out the indicated power in KW to deliver $5m^3$/min air measured at inlet conditions and find intermediate pressure also.
   (b) Explain the effects of air leakage in a condenser.
8. With the help of neat sketch, explain the working of Babcock and Wilcox boiler and its essential features.
9. In a single heater regenerative cycle the steam enters the turbine at 30 bar, 400ºC and exhaust pressure is 0.1 bar. The feed water heater is a direct contact type which operates at 4 bar. Find
   (a) Efficiency (b) Steam rate of the cycle.