MEL 626 : MECHANICAL EQUIPMENT IN POWER PLANTS
MAJOR TEST

Date : 1.12.06 Time : 2 hr M.M.: 70

Q1 is compulsory.

Q1 A) Explain the following terms with their significance/ use (**ANY FIVE**):

a) Pressure compounded Rateau Stage
b) Oxygen blown gasifier
c) NTU of a Heat Exchanger
d) Approach of a cooling tower
e) Net positive suction head
f) Dew point temperature
g) Packing function
h) Dampers

(2 x 5 = 10)

Q1B) Discuss the design philosophy of a surface condenser for removal of Non condensable gases from a surface condenser?

(5)

Select questions from Q2 to Q9 such that the maximum marks from this part is 55.

Q2) A two pass surface condenser is used to condense 20kg/s steam leaving the turbine at 0.1bar, 0.9 dry. Terminal temperature difference is 3^0C. Inlet cooling water temperature is 32^0C. Calculate the mass flow rate of cooling water required. Assuming an overall heat transfer coefficient of 3000 W/m^{2}K, calculate the heat transfer area and length of tubes. Condenser tubes are 20mm ID and 1 mm thick. The water velocity through the tubes can be taken as approximately 2m/s.

(15)

Q3) In a steam power plant there are four closed feedwater heaters and a deaerator in the middle, using extractions at 50 bar from hp turbine, 10bar, 5 bar and 3 bar from ip turbine and 1.5 bar from lp turbine. Steam enters the hp turbine at 175 bar and 550^0C and expanded to 20 bar. It is reheated again to 550^0C, before further expansion in ip and lp turbines to condenser pressure of 0.1bar. Draw the cycle on a T-s diagram.
If the TTD for each heater is zero, calculate the fraction of steam extracted in the first hp heater and the specific work output from the hp turbine.

(15)

Q4) The first stage of a steam turbine is a two row velocity compounded Curtis wheel. The steam velocity at the inlet of moving blades is 500m/s at a nozzle angle of 15^0. The blade velocity is 150m/s. The blade exit angles are 20^0 for the first row of moving blades and 24^0 for the fixed set of blades. Assuming the blade friction factor to be 0.9 and a steam flow rate of 5kg/s, calculate the axial thrust and power output from the first row of moving blades. Comment on the power output from the second stage.

(15)

Q5) A converging diverging propulsion nozzle operating at steady state has a throat area of $0.0625m^2$. Gases (C_{pg}=1.148kJ/kgK, R=0.287kJ/kgK and γ =1.333) enter the nozzle with negligible velocity at a pressure of 4 bar and 990K. Determine the critical conditions, the choked mass flow rate and the exit area, temperature and velocity. Assume isentropic expansion upto a pressure of 1 bar.

(15)

Q6) Differentiate between impulse and reaction turbines? What are their relative advantages and disadvantages?

(10)

Q7) Explain the principle of operation of a fluidized bed gasifier and its advantages.

(10)

Q8) As a maintenance engineer in a power plant, you find a pump cavitating. What is your first reaction and remedial step? What will be your further course of action to overcome this problem?

(10)

Q9) Explain in brief the various methods to control the superheat temperature of steam in a steam generator.

(10)