

## ***B.Tech. Degree IV Semester Examination, April 2009***

### **ME 403 THERMAL ENGINEERING II** (1999 Scheme)

Time: 3 Hours

Maximum Marks: 100

- I a) Explain the term “quality of steam”. Differentiate between wet, dry saturated and super heated steam. (8)
- b) A steam power plant works between 40 bar and 0.05 bar. If the steam supplied is dry saturated and the cycle of operation is Rankine, find:  
     i) Cycle efficiency  
     ii) Specific steam consumption.  
 Show the Cycle on T – S Plane. (12)
- OR**
- II a) What are the effects of friction on the flow through a steam nozzle? Explain with the help of h – s diagram. (8)
- b) Estimate the mass flow rate of steam in a nozzle with the following data :  
     Inlet pressure and temperature = 10 bar and 200<sup>o</sup> C;  
     Back pressure = 0.5 bar; Throat diameter = 12 mm. (12)
- III a) What is the fundamental difference between the operation of impulse and reaction turbines? Explain the same with neat sketches. (8)
- b) Steam at 300 m/s is supplied to a single stage impulse turbine through a nozzle. The nozzle angle is 25<sup>o</sup>. The mean diameter of the blade rotor is 100 cm and it has a speed of 2000 rpm. Find suitable blade angles if there is no axial thrust. If the blade velocity coefficient is 0.9 and the steam flow rate is 10 kg/s, find the power developed. (12)
- OR**
- IV a) Derive an expression for the thermal efficiency of a gas turbine plant. (10)
- b) A gas turbine plant with a pressure ratio of 1 : 5 takes in air at 15<sup>o</sup> C. The maximum temperature is 600<sup>o</sup> C and develops 2200 kW. The turbine and compressor efficiencies are equal to 0.85. Taking  $C_p = 1 \text{ kJ/kg.K}$  and  $C_v = 0.714 \text{ kJ/kg.K}$ ; determine  
     i) Actual overall efficiency of the turbine  
     ii) Mass of air circulated by the turbine. (10)
- V a) Draw a neat sketch of air – refrigeration system working on Bell-Coleman cycle and explain its working. (10)
- b) An air-refrigerator working on Bell-Coleman Cycle operates between pressure limits of 1.05 bar and 8.5 bar. Air is drawn from the cold chamber at 10<sup>o</sup> C, compressed and then it is cooled to 30<sup>o</sup> C before entering the expansion cylinder. The expansion and compression follow the law  $PV^{1.3} = \text{constant}$ . Determine the theoretical c.o.p. of the system. (10)
- OR**
- VI a) State the properties of a good refrigerant. What are the common refrigerants used? (10)

(Turn over)

- b) A R-12 vapour compression refrigeration system has a condensing temperature of  $50^{\circ}\text{C}$  and evaporating temperature of  $0^{\circ}\text{C}$ . The refrigeration capacity is 7 TR. The liquid leaving the condenser is saturated liquid and the compression is isentropic. Determine.

- i) power required to drive the compressor.  
ii) C O P of the system.

Use the properties of R-12 as listed in the table below.

(10)

Temp. ( $^{\circ}\text{C}$ )	Pressure (bar)	Hf KJ/kg	Hg KJ/kg	Sf KJ/kg-K	Sg KJ/kg-K
50	12.199	84.868	206.298	0.3034	0.6792
0	3.086	36.022	187.397	0.1418	0.6960
Take enthalpy at the end of compression = 210 kJ/kg					

- VII a) Define the term 'by-pass' factor used for cooling and heating coil and derive the expression for the same. (10)
- b)  $40\text{m}^3$  of air per minute at  $31^{\circ}\text{C}$  DBT and  $18.5^{\circ}\text{C}$  WBT is passed over the cooling coil whose surface temperature is  $4.4^{\circ}\text{C}$ . The cooling coil capacity is 3.56 TR under the given condition of air. Determine DBT and WBT of the air leaving the cooling coil. (10)

OR

- VIII a) Explain, with a neat diagram, an air-conditioning system required in winter season. (10)
- b) A theatre of 1200 seating capacity is to be air-conditioned for Summer Condition for the following data.
- Outdoor conditions :  $30^{\circ}\text{C}$  DBT and 55% RH
- Required conditions :  $20^{\circ}\text{C}$  DBT and 60% RH
- Amount of air supplied :  $0.25\text{ m}^3/\text{min}/\text{person}$ .
- Find the sensible heat, latent heat removed from the air per minute and sensible heat factor for the system. (10)

- IX a) What are the differences between steam power plant and gas turbine power plant concerning their fundamental working. (10)
- b) Discuss the various types of ash handling system. (10)

OR

- X a) Draw a neat diagram of a boiling water reactor and discuss its relative advantages and disadvantages over pressurized water reactor. (10)
- b) Explain the general layout of a hydro electric power plant. (10)

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