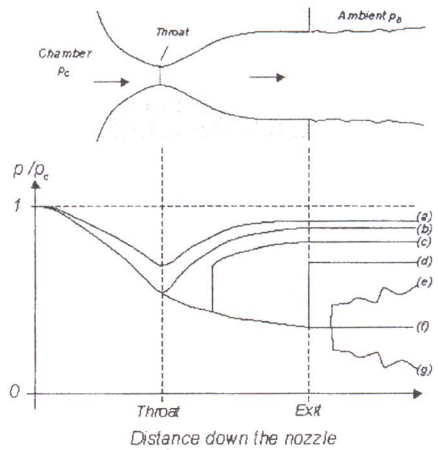
COLLEGE OF ENGINEERING, PUNE
2012-2013
End Semester Examination
ME-313: Energy Conversion

Programme: T.Y. B. Tech **Branch: Mechanical**
Time: 2.00 to 5.00 pm **Max. Marks: 50**

Instructions:
1. *Answer any FIVE questions. Write answer to each question separately.*
2. *Illustrate your answer with neat sketches wherever necessary.*
3. *Assume suitable standard data, if necessary and mention it correctly*
4. *Figures to the right indicate full marks.*
5. *Use of steam table, Mollier chart, psychometric chart, refrigerants' property table and non-programmable electronic calculator are permitted.*

Q.1 **a)** Read following figure carefully and explain the states (a) to (f) in one or two statements. **5**



b) Air enters a variable cross-sectional area at 1.0 MPa and 800 K with a negligible velocity. The flow is steady, one dimensional, and isentropic with k= 1.4. For an exit Mach number of Ma=2 and a throat area of 20 cm^2, determine (i) the throat conditions, (ii) the exit plane conditions, including the exit area and (iii) the mass flow rate through the nozzle. Take R = 0.287 kJ/kg **5**

Q.2 **a)** Following observations were made during a trial on steam condenser: **5**

Condenser vacuum = 680 mm of Hg; Barometer reading = 764 mm of Hg; Hot well temperature = 30 °C; Mean condenser temperature= 36.2 °C; Condensate formed 1780 kg/hr; Quantity of cooling water= 1250 kg/min; Circulating water inlet temperature = 20°C; Circulating water outlet temperature= 32°C.

Determine: (i) vacuum corresponding to standard barometer of 76 cm Hg; (ii) Vacuum Efficiency and Under-cooling of Condensate (iii) Condenser Efficiency, (iv) State of steam entering the condenser, (v) mass of air present per kg of uncondensed steam.

OR

a) Following data relate to a stage of reaction turbine: **5**

Mean Rotor diameter = 1.5 m; speed ratio = 0.72; blade outlet angle = 20°; rotor speed= 3000 rpm.

(i) Determine the diagram efficiency.

(ii) Determine the percentage increase in diagram efficiency and rotor speed if the rotor is designed to run at the best theoretical speed, the exit angle being 20°.

b) (i) Explain the significance of condenser in steam power plant. **1**

(ii) What are the main sources of Air in Condenser? **1**

(iii) List the effects of Air Leakage in Condenser. 1

(iv) Define Condenser Efficiency

Q.3 **a)** Prove that the thermal efficiency of an actual Gas Turbine Cycle is 5

$$(\eta_{th})_{actual} = \frac{W_T.\eta_T.\eta_C - W_C}{(Q_s)_{actual}.\eta_C}$$

Where W_T and W_C are Turbine and Compressor isentropic work respectively and η_T and η_C are isentropic efficiencies of turbine and compressor respectively.

b) (i) Explain the need of Compounding of steam turbine. 1

(ii)Explain with a neat sketch Pressure-Velocity Compounding. 2

(iii) State different internal losses in steam turbine. 2

Q.4 **a)** Draw a neat labeled block diagram of Aqua-Ammonia Vapour Absorption Refrigeration System and explain its working. Discuss the relative merits and demerits of the system over Vapour Compression System. 5

b) A businessman, after feasibility study found that the ice consumption in a locality is 300 kg/hr. he wanted to manufacture ice at -10 °C from the water available at 30 °C. Find out: 5

(a) The capacity of the refrigerator plant in Tons of Refrigeration if he decides 10 % over capacity than the demand.

(b) If above required ice is manufactured in a refrigeration plant and using vapour compression system using NH_3 as refrigerant when the cycle operates between the pressure 10 bar and 2 bar.

Find out the power required for a motor to run the compressor assuming Mechanical efficiency between the motor and compressor is 92 %. Assume all ideal conditions.

Q.5 **a)** Draw a neat diagram of air –cooling system (with all components), if used at Nagpur for summer cooling and explain the working. If air-cooling is replaced by air conditioning system, then represent the processes on Psychrometric chart in air-cooling and air-conditioning system separately. 5

b) An air-conditioning system is to be designed for a cinema hall of 500 seating capacity. The inside required condition is 25 °C DBT & 65 % RH where as the out-door design conditions are 32°C DBT and 82 % RH. If the air flow required is 0.35 m^3/person/min, find the capacity of each component. Draw line diagram of the components required for the purpose and assume all ideal conditions when the required processes are represented on Psychrometric chart. 5

Q.6 **a)** Define Load and diversity factor when one power generating plant is supplying the power to three different consumers in a big city and discuss the importance of both factors with the help of load curves. 5

What is the difference between a load factor of a consumer and load factor of a power plant and its importance in power generation system?

b) A thermal power plant of 100MW capacity supplies power to industry A and industry B simultaneously. Industry A runs in 3-shifts, each of 6 hours starting from 8 a. m with a break of 1 hour after every 3-hrs work and another 1-hr before starting the next shift. The same schedule is used for II-shift and III-shift also. 5

The industry B runs in 2-shifts starting at 10 am onwards with working schedule and breaks exactly same as industry A, except the power demand during working period, which is 50 MW.

Draw the load curves for industry A, industry B and the plant supplying the power to

both industries.

Find out:

(i) The load factors for industry A, industry B and power plant supplying the power to consumers A & B,

(ii) The thermal efficiency of the plant is given by

$$\eta_{th} = 0.45(LF)^{0.85}$$

Where LF is the load factor of the plant. Assuming the plant is running throughout the day of 24 hrs, find the fuel required to run the plant in Tons per day and cost of generation in Rs/kWh, if all other costs are 20 % of fuel cost.

Assume C.V. of fuel=40 MJ/kg. and cost of fuel = Rs. 10/kg.