DEPARTMENT OF MECHANICAL ENGINEERING

QUESTION BANK

Sub Code/Name: Engineering Thermodynamics **Year/Sem: II / III**

UNIT- I

PART – A (2 Marks)

1. Define Thermal Engg.
2. Define thermodynamic system and classify it.
3. Define open system with example.
4. Defme closed system with example.
5. Defme intensive and extensive properties.
6. Defme zeroth law of thermodynamics.
7. Define first law of thermodynamics.
8. What is meant by open cycle?
9. What is meant by closed cycle?
10. What is meant by point and path function?

PART –B (16 marks)

1. one kg of gas expands at CO&instant pressure from 0.085 m^3 to 0.13).if the initial temperature of the gas is 22.5 °c.find the final. Temperatures, net heat transfer, change in internal energy, pressure of gas.
2. A certain quantity of gas is head at constant pressure from 35 $^{\circ}0$ to 185°c. Estimate the amount of heat transferred, ideal work done, change in internal energy, when the initial volume of the gas is 0.6 m^3.
3. Explain and derive Isothermal process
4. Explain and derive Isobaric process.
5. 2kg of gas at a pressure of 1.5 bar. Occupies a volume of 2.5 m^3. If this gas compresses isothermally to 1/3 times the initial volume. Find initial. Final temperature, work done, heat transfer.
6. one kg of air is compressed polytropically (n=1.3) from 1 bar and 27 deg Celsius to 3 bar. Find I. work transfer 2. Heat transfer 3. Change in internal energy.

UNIT-2

PART-A (2 marks)

1. State second law of thermodynamics.
2. Write the clausius statement.
3. state carnot theorem
4. Define the term COP.
5. Sketch P-V and T-S diagram of camot cycle.
6. Define entropy.
7. What is meant by clausius inequality.
8. Define the term reversibility.
9. State the efficiency of camot cycle.
10. Define irreversibility.

PART-B (16 marks)

1. Air flows through an adiabatic compressor at 3 kg/s the inlet conditions are 2 bar and 310k and exit conditions are 20 bar and 560 k. compute the net rate of availability transfer and irreversibility.

2. Air in a closed vessel of fixed volume of 0.15 m_3, exerts pressure of 12 bar at 250 °c, if the vessel is cooled so that the pressure falls to 3.5 bar, determine the final temperature, heat transfer and change of entropy.

3. Explain Carnot engine cycle and its efficiency.

4. Explain the term availability and unavailability.

5. *A* heat engine operates between a source a 600 °c and a sink at 60 c Determine the least rate of heat rejection per KW net output of the engine.

6) 0.2 kg of air at 1.5 bar and 27 "c is compressed to a pressure of 15 bar according to the law $PV^{1.25}$ =C. determine work done heat flow to or from the air, increase or decrease in entropy

UNIT- 3

PART-A (2 marks)

1. Define latent heat of ice.
2. What is pure substance?
3. Define dryness fraction of steam
4. Define critical point for pure substance.
5. Define triple point.
6. Define- efficiency ratio.
7. List the advantages of reheat cycle.
8. Define sensible heat factor.
9. What are the disadvantages of reheating?
10. What is the function of condenser?

PART-B (16 Marks)

1) Find the specific volume and enthalpy of steam at 9 bar when the condition of steam is a)Wet with dryness fraction 0.95 b) dry saturated c) super heated temperature of 240°

2) Steam initially at 400 Kpa and 0.6 dry is heated in a rigid vessel of 0.1m3 volume. Thefinal condition is 600 Kpa. Find the amount of heat added and mass of steam.

3) Explain P-V diagram and P-V-T surface.

4) 2 kg of steam initially at *5* bar and 0.6 dry is heated at constant pressure until the temperature becomes 350 c.find the change in entropy and internal energy.
5) A steam plant working on a simple rankine cycle operated between the temperature of 260°c and 95°c .the steam is dry and saturated when it enters the turbine and expanded isentropically. Find rankine efficiency.

6) 2.5 kg of steam is heated at constant pressure of 250 kpa and 100°c, until temperature is 250°c. find the amount of heat added and change in entropy. (Use mollier chart)

7) A vessel of volume 0.04m^3 contains a mixture of saturated water and steam at a temperature of 250^0c .The mass of the liquid present is 9kg. Find the pressure, mass, specific volume, enthalpy, entropy and internal energy.

8) In steam generator compressed water at 10Mpa, 30^0c enters a 30mm diameter tube at the rate of 3liters/sec steam at 9Mpa, 400^0 C exit the tube. Find the rate of heat transfer.

9) Steam at 0.8MPa, 250^0 C and flowing at the rate of 1kg/s passes into a pipe carrying wet steam at 0.8MPa, 0.95 dry. After adiabatic mixing the flow rate is 2.3kg/s. determine the properties of the steam after mixing.

10) Ten kg of water of 450C is heated at a constant pressure of 10 bar until it becomes superheated vapour at 300^0C. Find the change in volume, enthalpy, internal energy and entropy.

11) In a steam power plant operating on an ideal reheat rankine cycle, the steam enters the high pressure turbine at 3MPa and 400^0 C. after expansion to 0.6MPa the steam is reheated to 400^0C and then expanded the low-pressure turbine to the condenser pressure of 10kPa. Determine the thermal efficiency of the cycle and the quality of the steam at the outlet of the low pressure turbine.

12) A reheat cycle operating between 30 and 0.04bar has a superheat and reheat temperature of 450^0C. The first expansion takes place till the steam is dry saturated and then reheat is given. Neglecting feed pump work, determine the ideal cycle efficiency.

13) In a regenerative cycle, the steam pressure at turbine inlet is 30 bar and the exhaust is at 0.04bar.the steam is initially saturated. Enough steam is bled off at the optimum pressure of 3 bar to heat the feed water. Determine the cycle efficiency. Neglect pump work.

14) A steam power plant uses steam at boiler pressure of 150bar and temperature 550^0C with reheat at 40bar and 550^0C at condenser pressure of 0.1bar. Find the quality of steam at turbine exhaust, cycle efficiency and the steam rate.

15) In a single heater regenerative cycle the seam enters the turbine at 30bar and 400^0C and the turbine exhaust pressure is 0.1bar.the condensate is heated in a direct contact type heater which operates at 5bar.find the efficiency and the steam rate of the cycle and the increase in mean temperature of heat addition, efficiency and steam rate as compared to the rankine cycle. Neglect pump work.

16) A steam boiler generates steam at 30bar, 300^0C at the rate of 2kg/s this steam is expanded isentropically in a turbine to a condenser pressure of 0.05 bar, condensed at constant pressure and pumped back to boiler.

a) Draw the schematic arrangement of the above plant and T-S diagram of rankine cycle.
b) Find heat supplied in the boiler per hour.
c) Determine the quality of steam after expansion
d) What is power generated by the turbine?
e) Estimate the rankine efficiency considering pump work

UNIT – 4

PART-A (2 marks)

1. State joules law.
2. State Avogadro's law.
3. State Dalton's law of partial pressure.
4. Define vanderWa1ls equation.
5. Distinguish between ideal and real gas.
6. What are Maxwell's relations?
7. Define joule-Thomson coefficient.
8. What is compressibility factor?
9. What is clapeyron equation?
10. State Helmholtz function.

PART-B (16 marks)

.1. Derive Dalton's law of partial pressure. Define amagat's law of partial volume.

2. Derive vandar Waals equation.

3. Derive Maxwell's equation

4. Derive clausius-clapeyron equation.

5. Derive Joule-Thomson coefficient equation.

6. A mixture of gases contains 50%nitrogen, 40% oxygen and 10% carbon dioxide by mass. 2 kg of mixture is compressed from 200 kpa and 293k to 400 kpa polytropically which follows the PV(I.25)=C. Determine the work done, heat transferred and change in entropy. (Take (cp) n2=1.04 (cp) o2= 0.918 kj / kg k, (cp) co2=O.846 k/kg k)

UNIT - 5

PART-A (2 marks)

1. Define psychrometry.
2. what is the difference between air conditioning and refrigeration
3. Define dry bulb temperature.
4. Define Relative humidity.
5. Define wet bulb temperature.
6. What is meant by specific humidity?
7. Defme dew point temperature.
8. Defme wet bulb depression.
9. Define dew point depression.
10. State Dalton's law of partial pressure.

PART-B (16 marks)

I. Dry bulb and wet temperatures of 1 atmospheric air stream are 40°0 and 30°c respectively. Determine (a)Humidity (b) Relative humidity (c) Specific humidity.

2. Atmospheric air with barometric pressure of 1.013 bar has 38°c dry bulb temperature and 28°c wet bulb temperature. Determine (a) Humidity ratio (b) Relative humidity (c) dew point temperature.

3. Atmospheric air at 760 mm of Hg has 45°c DBT and 30°c WBT, using psychometric chart calculate R.H, Humidity ratio, DPT, enthalpy, specific volume of air.

4. Atmospheric air at 1 bar pressure has 2.5°0 DBT and 75% RH using psychometric chart, calculate DBT, enthalpy, vapour pressure.

5. Explain sensible heating process, sensible cooling, and humidification process.

6. An air water vapour mixture at 0.1 Mpa, 30°0, 80% RH. Has a volume of 50 m3 Calculate the specific humidity, dew point, wet bulb temperature, mass of dry air and mass of water vapour.