MARIA COLLEGE OF ENGINEERING AND TECHNOLOGY

ATTOOR

MECHANICAL ENGINEERING

THIRD SEMESTER

ENGINEERING THERMODYNAMICS

(ME33)

(QUESTION BANK)

TWO MARK QUESTIONS

UNIT – 1 (BASIC COMCEPTS AND FIRST LAW)

1. What is meant by thermodynamic system? How do you classify it?
2 Differentiate closed and open system.
3 Define an isolated system.
4 Define: Specific heat capacity at constant pressure.
5 Define: Specific heat capacity at constant volume.
6 What is meant by surroundings?
7 What is boundary?
8 Differentiate Intensive and Extensive properties.
9 What do you understand by equilibrium of a system?
10 What is meant by thermodynamic equilibrium?
11 State the First law of thermodynamics.
12 Define the term process
13 Define the term Cycle
14 What is meant by open and closed cycle?
15 What is meant by reversible and irreversible process?
16 What is meant by Point and Path function?
17 Explain Zeroth Law of thermodynamics?
18 Define the term internal energy
19 What is Quasi – Static process?
20 Define the term enthalpy?

UNIT – 2 (SECOND LAW)

1. State the Kelvin – Plank statement of second law of thermodynamics
2. State Clausius statement of second law of thermodynamics.
3. What are the Corollaries of Carnot theorem?
4. State Carnot's theorem.
5. Define – PMM of second kind.
6. What is the difference between a heat pump and a refrigerator?
7. Define the term COP?
8. What is meant by heat engine?
9. Write the expression for COP of a heat pump and a refrigerator?
10. Name two alternative methods by which the efficiency of a Carnot cycle can be increased.
11. Why Carnot cycle cannot be realized in practice?
12. When will be the Carnot cycle efficiency is maximum?
13. What are the processes involved in Carnot cycle.
14. Define entropy.
15. Explain the term "Reversibility".
16. What do you mean by "Calusius inequality"?
17. Define the term absolute entropy.
18. Define change of entropy. How is entropy compared with heat transfer and absolute temperature?

19. Write the expression for efficiency of the carnot cycle
20. Why a heat engine cannot have 100% efficiency?

UNIT – 3 (PROPERTIES OF PURE SUBSTANCE)

1. Define latent heat of evaporation.
2. Find the saturation temp and latent heat of vaporization of steam at 1 Mpa
3. Define the terms 'Boiling point' and 'Melting point'
4. What is meant by super heated steam? and indicate its use.
5. Define dryness fraction of steam. (or) What is quality of steam?
6. Write the formula for calculating entropy change from saturated water to superheat steam condition
7. Define: sensible heat of water.
8. Define the term "Super heat enthalpy".
9. Explain the terms: Degree of super heat, Degree of subcooling.
10. Define triple point and critical point for pure substance.
11. Determine the condition of steam of 2 bar whose entropy is 6.27 kJ/kg.
12. Determine specific enthalpy and specific entropy of 120° C saturated steam.
13. Find the mass of 0.1 m^3 of wet steam at a temperature of 160° and 0.94 dry
14. One kg of steam at 10 bar has an enthalpy of 2500 kJ /kg. find its quality
15. Why Rankine cycle is modified?
16. Name the various vapour power cycle
17. What are the effects of condenser pressure on the Rankine Cycle?
18. Mention the improvements made to increase the ideal efficiency of Rankine cycle
19. What are the advantages of reheat cycle?
20. What is the purpose of reheating?

UNIT – 4 (IDEAL AND REAL GASES ANDTHERMODUNAMIC RELATIONS)

1. Define Ideal gas.
2. Define Real gas.
3. State Boyle's law.
4. What is equation of state?
5. State Charle's law.
6. State Joule's law.
7. What do you mean by reduced properties?
8. Explain the construction and give the use of generalized compressibility chart.
9. Explain law of corresponding states.
10. State Avogardo's Law.
11. Explain Dalton's law of partial pressure.
12. What is Joule-Thomson coefficient?
13. What is meant by virtual expansion?
14. What are Maxwell relations?
15. What is compressibility factor?
16. What is partial pressure?
17. How does the Vander Waal's equation differ from the ideal gas equation of state?
18. What is Clasius Clapeyron Equation?
19. State Gibbs function.

20. State Tds Equations.

UNIT – 5 (PSYCHROMETRY)

1. Define psychrometry.
2. What is humidification and dehumidification?
3. Define specific humidity.
4. Differentiate absolute humidity and relative humidity.
5. What is effective temperature?
6. Represent the following psychrometric process using skeleton psychrometric chart?
7. Define Relative humidity.
8. Define degree of saturation.
9. What is meant by adiabatic saturation temperature (or) thermodynamic wet bulb temperature?
10. What is dew point temperature? How it is related to dry bulb and wet bulb temperature at the saturation condition?
11. What is meant by dry bulb temperature (DBT)?
12. What is meant by wet bulb temperature (WBT)?
13. Define dew point depression.
14. What is psychrometer?
15. What is psychrometric chart?
16. Define sensible heat and latent heat.
17. What are the important psychrometric processes?
18. Define bypass factor (BPF) of a coil.
19. Define Dalton's law of partial pressure.
20. What is meant by adiabatic mixing?

SIXTEEN MARK QUESTIONS

1. A reciprocating air compressor takes in $2m^3$/min air at 0.11Mpa, 298K which it delivers at 1.5 MPa, 384K to an after cooler where the air is cooled at constant pressure to 298K. The power absorbed by the compressor is 4.15Kw. Determine the heat transfer in (i) the compressor (ii) the cooler. State your assumptions.

2. In a turbo machine handling a incompressible fluid with a density of $1000kg/m^3$ the condition of the fluid at the rotor entry and exit are given below

	Inlet	exit
Pressure	1.15MPa	0.05MPa
Velocity	30m/s	15.5m/s
Height above datum	10m	2m

If the volume flow rate of the fluid is $40m^3/s$, estimate the net energy transfer from the fluid as work.

3. A rigid tank containing $0.4m^3$ of air at 400kPa and 30^oC is connected by a valve to a piston cylinder device with zero clearance. The mass of the piston is such that a pressure of 200KPa is required to raise the piston. The valve is opened slightly and air is allowed to flow in to the cylinder until the pressure of the tank drops to 200KPa. During this process heat is exchanged with the surrounding such that the entire air remains at 30^o C at all times. Determine the heat transfer for this process.

4. The electric heating system used in many houses consists of a simple duct with resistance wire. Air is heated as it flows over resistance wire. Consider a 15KW electric heating system. Air enters the heating section at 100kPa and 17^oC with a volume flow rate of 150m^3/min. If heat is lost from the air in the duct to the surrounding at the rate of 200W, determine the exit temperature of air.

5. A frictionless piston cylinder device contains 2kg of nitrogen at 100kPa and 300K. Nitrogen is now compressed slowly according to the relation $PV^{1.4} = C$ until it reaches a final temperature of 360K. Calculate the work input during this process.

6. A reversible heat engine operating between reservoirs at 900k and 300k drives a reversible refrigerator between reservoirs at 300k and 250k. the heat engine receives 1800kj heat from 900k reservoir. The net output from the combined engine refrigerator is 360kj. Find the heat transfer to the refrigerator and the net heat rejected to the reservoir at 300k

7. The interior lighting of refrigerator is provided by incandescent lamps whose switches are actuated by the opening of refrigerator door. Consider a refrigerator whose 40W light bulb remains on continuously as a result of malfunction of the switch. If the refrigerator has a coefficient of 1.3 and the cost of electricity of Rs 8per kWh. Determine the increase in energy consumption of the refrigerator and its cost per year if the switch is not fixed.

8. A Carnot heat engine receives heat from a reservoir at 1173K at a rate of 800KJ/min and rejects the waste heat to the ambient air at 300K. The entire work out put of the heat engine is used to drive a refrigerator that removes heat from the refrigerated space at 268K and transfers it to the same ambient air at 300k. Determine the maximum rate of heat rejection to the ambient air.

9. 1.6kg of air compressed according to the law $PV^{1.3} = C$ from a pressure of 1.2 bar and temperature of 20^o C to a pressure of 17.5 bar. Calculate (a) the final volume and temperature (b) work done (c) heat transfer (d) change in entropy.

10. 5 kg of air at 2 bar and 30^oC is compressed at 24bar pressure according to the law $pV^{1.2} = C$. After compression air is cooled at a constant volume to 30^oC. Determine (i) volume and temperature at the end of compression (ii) change of entropy during compression (iii) change in entropy during constant volume cooling. Take $C_p = 1.005$ kJ/kg K, $C_v = 0.718$ kJ/kg K.

11. A mass of 0.9kg of steam initially at a pressure of 1.5MPa and temperature of 250^o C expands to 150KPa. Assume the process is isentropic. Find the condition of steam and work transfer.

12. Ten kg of water of 45^oC is heated at constant pressure of 10 bar until it becomes superheated vapour at 300^oC. Find the change in volume, enthalpy, internal energy and entropy.

13. In a steam generator compressed water at 190 MPa, 30^oC enters at a 30mm diameter tube at the rate of 3 liters/ sec. steam at 9 MPa , 400^oC exit the tube. Find the rate of heat transfer.

14. Consider a steam power plant operating on the ideal Rankine cycle. Steam enters the turbine at 3MPa and 623K and is condensed in the condenser at a pressure of 10kPa. Determine (i) the thermal efficiency of this power plant, (ii) the thermal efficiency, if steam is superheated to 873K instead of 623K, and (iii) the thermal efficiency, if the boiler pressure is raised to 15MPa while the turbine inlet temperature is maintained at 873K.

15. Consider a steam power plant operating on the ideal Rankine cycle. Steam enters the high pressure turbine at 16MPa and 873K and is condensed in the condenser at a pressure 10kPa. If the moisture content of the steam at the exit of the low-pressure turbine is not to exceed 10.4 percent, determine (i) the pressure at which the steam should be reheated and (ii) the thermal energy efficiency of the cycle. Assume the steam is reheated to the inlet temperature of the high-pressure turbine.

16. Using the Clapeyron equation, estimate the value of the enthalpy of vaporization of refrigerant R-134a at 293K, and compare it with the tabulated value.

17. Show that the Joule-Thomson co-efficient of an ideal gas is zero

18. Using the cycle relation and the first Maxwell relation, derive the other three Maxwell relations.

19. A rigid tank contains 2kmol of N_2 and 6kmol ofCO_2 gases at 300K and 15MPa. Estimate the volume of the tank on the basis of (i) the ideal-gas equation of state,(ii)compressibility factors and Amagat's law, and (iii) compressibility factors and Dalton's law.

20. Derive expressions $(\partial u/\partial p)_T$ and $(\partial h/\partial v)_T$ in terms of p,v and T.

21. Air at 20^{o}C, 40% RH is mixed adiabatically with air at 40^{o}C, 40%RH in the ratio of 1 kg of the former with 2 kg of the later (on dry basis).find the final condition of air.

22. Consider a room that contains air at 1 atm., 35^{o}C and 40 percent relative humidity. Using psychrometric chart, determine (i) the specific humidity (ii) the enthalpy (iii) the wet-bulb temperature (iv) the dew-point temperature, and (v) specific volume of air.

23. An air – water vapour mixture at 0.1MPa, 30^{o}C, 80% RH has a volume of 50m^3. Calculate the specific humidity, dew point, wet bulb temperature, mass of dry air and mass of water vapour.

24. Air at 16^{o}C and 25% relative humidity passes through a heater and then through a humidifier to reach final dry bulb temperature of 30^{o}C and 50% relative humidity. Calculative the heat and moisture added to the air. What is the sensible heat factor?

25. Saturated air at 20^{o}C at a rate of 1.16m^3/sec is mixed adiabatically with the outside air at 35^{o}C and 50% relative humidity at a rate of 0.5m^3/sec. assuming adiabatic mixing

condition at 1 atm, determine specific humidity, relative humidity, dry bulb temperature and volume flow rate of the mixture.