QUESTION BANK

CHAPTER 1: INTRODUCTION, BASIC CONCEPTS

1	Explain briefly the following terms (i) Thermodynamic system (ii) Surroundings (iii) Boundary (iv) Universe (v) Process (vi) State (vii) Cycle (viii) Control Volume (ix) Thermodynamic equilibrium.
2	Differentiate between the following: I. Statistical and classical thermodynamics II. Open system and control volume III. Intensive properties and extensive properties IV. Microscopic approach and macroscopic approach V. system and control volume
3	Define a thermodynamic system. Differentiate between open system, closed system and an isolated system.
4	Explain the following terms: Point Function, Homogenous system, First law of thermodynamics, Quasi-static process, pure substance.
5	Explain path function and point function.

CHAPTER 2: FIRST LAW OF THERMODYNAMICS, SECOND LAW OF THERMODYNAMICS

1	Explain first law of thermodynamics for a closed system undergoing a change of state and derive energy equation $Q = W + \Delta U$.
2	Justify that energy is property of the system.
3	Derive the steady flow energy equation for a single stream entering and a single stream leaving a control volume and explain the various terms in it. Also write SFEE for following Applications: (i) Cooling Tower (ii) Centrifugal Pump (iii) Expansion valve of refrigerator (iv) Boiler.
4	What is unsteady state flow process? Explain bottle filling process.
5	Write the limitation of first law of thermodynamics. Explain the second law of thermodynamics by Clausius statement and Kelvin-Plank statement.
6	Establish the equivalence of Kelvin-Planck and Clausius statements.
7	What is the Carnot cycle? What are the four processes which constitute the cycle?
8	Show that all reversible engines operating between the two constant temperature thermal reservoirs have the same efficiency.
9	Explain the operation of a cyclic refrigerator plant with a block diagram.
10	Evaluate the following statements: I. Heat pump provides a thermodynamic advantage over direct heating. II. Kelvin temperature scale is independent of the peculiar characteristics of any particular substance.
11	Define following terms (I) Heat Engine (II) Thermal Energy Reservoir (III) Refrigerator

CHAPTER 3: ENTROPY, EXERGY

1	What is entropy principle? With the help of it prove that adiabatic mixing of two fluids is irreversible.
2	In case of heating the gas at constant volume, show that the change in entropy is given by $$s_2 - s_1 = C_v \log\frac{T_2}{T_1}$$
3	Show that the efficiency of a reversible engine operating between two given constant temperatures is the maximum.
4	With usual notations prove that: $$\oint \frac{\delta Q}{T} \leq 0$$
5	Prove that entropy is a property of system.
6	Identify the cause of irreversibility.
7	Write down the first and second T-ds equations, and derive the expression for the difference in heat capacities, Cp and Cv. What does the expression signify?
8	Define following terms (I) Availability (II) Dead State (III) High Graded Energy
9	Explain the concept of available and unavailable energy.
10	Explain the concept of decrease in available energy when heat is transferred through a finite temperature difference with the aid of temperature-entropy diagram.
11	Explain the available energy referred to finite heat source.
12	Define available and unavailable energy. With usual notations, show that the

	availability of a closed system is given by $\boldsymbol{\varphi_1 - \varphi_0 = (u_1 + p_0 v_1 - T_0 s_1) - (u_0 + p_0 v_0 - T_0 s_0)}$
13	Identify the reasons for the impracticability of Carnot cycle.

CHAPTER 4: VAPOR POWER CYCLES, GAS POWER CYCLES, REFRIGERATION CYCLES

1	With the help of schematic diagram, derive an expression for Rankine cycle. Also represent it on p-v, T-s and h-s diagram. Identify the reheating process and locate the increase in work done due to reheating in both graph.
2	Compare the Carnot and Rankine cycle with the help of T-s diagram.
3	Explain the effect of following on the efficiency of Rankine cycle. (i) superheating of steam (ii) Turbine inlet steam pressure (iii) condenser pressure
4	What is the effect of regeneration? On the (i) specific output, (ii) mean temperature of heat addition (iii) cycle efficiency and (iv) steam rate
5	What do you understand by steam rate and heat rate? What are their units?
6	What do you understand by the mean temperature of heat addition? For a given T_2, show how the Rankine cycle efficiency depends on the mean temperature of heat addition.
7	Explain using p-v and T-s diagram, which of the two cycles – Otto cycle and Diesel cycle, will have higher efficiency for a given maximum pressure and temperature in the cycle?
8	Compare Otto, Diesel and Dual cycle for (i) Same compression ratio and heat supplied. (ii) Same maximum pressure and temperature.
9	What are the air standard assumptions? Show that the air standard efficiency of Brayton cycle is given by $$\eta = 1 - \frac{1}{r_p^{\frac{\gamma-1}{\gamma}}}$$ Where rp is pressure ratio and γ is ratio of specific heats.

10	Sketch the air-standard Brayton cycle on P-v and T-s diagrams. What are the advantages of the Brayton cycle over the conventional heat engine cycles?
11	Explain standard vapour compression refrigeration cycle with T-s and P-h diagram. What is the effect of sub-cooling on the performance of vapour compression refrigeration system?
12	Explain the effects of change of suction pressure and delivery pressure on performance of vapour compression refrigeration using p-h and T-s diagram.
13	What is the difference between Ideal and Actual vapour compression cycles?
14	Draw p-h diagrams for dry compression, wet compression, superheating after compression, superheating before compression and sub-cooling.
15	Define COP and EER.
16	Explain reversed Carnot cycle. What are its limitations?

CHAPTER 5: COMBUSTION

1	What do you mean by stoichiometric equation?
2	Discuss methods for finding the volumetric analysis of flue gases.
3	Define Adiabatic Flame Temperature.
4	What do you mean by calorific value of fuel: lower and higher calorific value of fuel?
5	Describe the construction and working principle of the Junker's gas calorimeter.
6	Describe the construction and working principle of Bomb Calorimeter.