Course Code:20ME0303 **R20**

SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY (AUTONOMOUS)

Siddharth Nagar, Narayanavanam Road – 517583

QUESTION BANK (DESCRIPTIVE)

Subject with Code: Basic Thermodynamics (20ME0303) **Course & Branch**: B. Tech – AGE

Year & Sem: I - B.Tech & I - Sem **Regulation:** R20

UNIT –I

BASIC CONCEPTS, WORK & HEAT TRANSFER, ZEROTH LAW OF THERMODYNAMICS

1	a)	Define the following terms a) System b) Boundary c) Surroundings d) control volume	[L1]	[CO1]	[6M]
	b)	List the difference between a closed system and an open system.	[L1]	[CO1]	[6M]
2	a)	What is a thermodynamic system? Explain different types of systems with suitable examples.	[L1&L2]	[CO1]	[6M]
	b)	What do mean by property? Distinguish between intensive and extensive property.	[L1], [L4]	[CO1]	[6M]
3		Define the following with their units a) Pressure b) volume c) Temperature d) Enthalpy e) Internal energy f) Density	[L1]	[CO1]	[12M]
4	a)	What do you understand by path function and point function?	[L1]	[CO1]	[6M]
	b)	Explain thermodynamic State, Process and Cycle	[L2]	[CO1]	[6M]
5		What is quasi static process? Explain in detail?	[L1&L2]	[CO1]	[12M]
6		What is meant by thermodynamic equilibrium? Explain its types briefly.	[L1&L2]	[CO1]	[12M]
7		Explain about Work and Heat transfer. And classify the work transfers.	[L2]	[CO1]	[12M]
8	a)	Compare work transfer and heat transfer with neat sketches	[L5]	[CO1]	[6M]
	b)	Show that work is a path function and not a property.	[L1]	[CO1]	[6M]
9	a)	Explain zeroth law of thermodynamics.	[L2]	[CO1]	[6M]
	b)	Describe the concept of temperature in zeroth law of thermodynamics	[L1]	[CO1]	[6M]
10		Define Heat, Temperature, and concept of thermal Equilibrium.	[L1]	[CO1]	[12M]

UNIT – II

FIRST LAW OF THERMODYNAMICS, SECOND LAW OF THERMODYNAMICS

1	a)	Define first law of thermodynamics. Justify that internal energy is a property of the system.	[L1&L5]	[CO2]	[6M]
	b)	An Iron casting of mass 10Kg has an original temperature of 200^{0}C.It is cooled to 50^{0} C. Find the direction and magnitude of heat transfer. Assume Specific Heat of iron as 0.477KJ/KgK.	[L4]	[CO2]	[6M]
2		What is Steady Flow Process? Derive Steady Flow Energy Equation(SFEE) for an open system	[L1&L3]	[CO2]	[12M]
3	a)	What are the limitations of the First law of Thermodynamics?	[L1]	[CO2]	[6M]
	b)	Give an expression for entropy changes for open systems.	[L2]	[CO2]	[6M]

Q.No		Question	Level	CO	Marks
4	a)	One kg of Air is heated from 20^0C to 105^0 C. Find the change of internal energy and change of enthalpy. Assume C_p=1.01 KJ/KgK and C_v=0.72 KJ/KgK.	[L3]	[CO2]	[6M]
	b)	In an air motor cylinder the compressed air has an internal energy of 450 kJ/kg at the beginning of the expansion and an internal energy of 220 kJ/kg after expansion. If the work done by the air during the expansion is 120 kJ/kg, calculate the heat flow to and from the cylinder.	[L4]	[CO2]	[6M]
5		A piston and cylinder machine contain a fluid system which passes through a complete cycle of four processes. During a cycle the sum of all heat transfer is -170 KJ. Complete the following table showing the method for each item, and computes the net rate of work output in kW.	[L3]	[CO2]	[12M]

Process	Heat transfer in KJ/min	Work done in KJ/min	Change in internal energy KJ/min
a-b	0	2170	-
b-c	21,000	0	-
c-d	-2,100	-	-36,600
d-a	-	-	-

Q.No		Question	Level	CO	Marks
6		Explain the following applications of steady flow energy equation: (i) Boiler (ii) Nozzle (iii) Condenser (iv) Compressor	[L3]	[CO2]	[12M]
7	a)	Compare heat pump and a refrigerator.	[L5]	[CO2]	[6M]
	b)	Prove equivalence Clausius statement with Kelvin Plank	[L3]	[CO2]	[6M]
8		Define Statements of second law of thermodynamics i) Clausius statement ii) Kelvin-plank statement	[L1]	[CO2]	[12M]
9	a)	Explain reversibility and irreversibility. List examples	[L2&L1]	[CO2]	[6M]
	b)	Describe availability and unavailability.	[L1]	[CO2]	[6M]
10	a)	Explain the concept of change in entropy.	[L2]	[CO2]	[6M]
	b)	Explain the First law of Thermodynamics'. Formulate the equation for heat in a non-flow reversible constant pressure process.	[L2&L6]	[CO2]	[6M]

UNIT – III

LAW OF PERFECT GAS, THERMODYNAMIC PROCESSES ON GASES

Q.No		Question	Level	CO	Marks
1		Prove that for an ideal gas is C_p- C_v=R.	[L3]	[CO3]	[12M]
2		Define Avogadro law. Develop equation of state of an Ideal gas	[L1&L3]	[CO3]	[12M]
3		Derive the equation for computing the entropy change of an Ideal gas.	[L3]	[CO3]	[12M]
4	a)	State and Explain Dalton law of partial pressure.	[L1&L2]	[CO3]	[6M]
	b)	How the partial pressure in gas mixture related to mole fraction?	[L2]	[CO3]	[6M]
5		Develop the expression of work transfer for an ideal gas in reversible isothermal process.	[L3]	[CO3]	[12M]

6		Derive the relation for Work done, Heat Transfer and Change enthalpy of an Isochoric Process.	[L3]	[CO3]	[12M]
7	a)	What is a polytropic process?	[L1]	[CO3]	[4M]
	b)	An insulated cylinder of volume capacity 4 m^3 contains 20 kg of nitrogen. Paddle work is done on the gas by stirring it till the pressure in the vessel gets increased from 4 bar to 8 bar. Determine: (i) Change in internal energy, (ii) Work done, (iii) Heat transferred, and (iv) Change in entropy. Take for nitrogen: cp = 1.04 kJ/kg K, and cv = 0.7432 kJ/kg K	[L3]	[CO3]	[[8M]]
8		Derive the equation for work done in a reversible adiabatic process	[L3]	[CO3]	[12M]
9		A piston-cylinder arrangement contains 0.05 m3 of nitrogen at 1 bar and 280 K. The piston moves inwards and the gas is compressed isothermally and reversibly until the pressure becomes 5 bar. Determine :(i) Change in entropy. (ii) Work done. Assume nitrogen to be a perfect gas	[L3]	[CO3]	[12M]
10		A cylinder contains 0.45 m3 of a gas at 1 × 105 N/m2 and 80°C. The gas is compressed to a volume of 0.13 m3, the final pressure being 5 × 105 N/m2. Determine: (i) The mass of gas ; (ii) The value of index ‗n ‘for compression; (iii) The increase in internal energy of the gas; The heat received or rejected by the gas during compression. Take ɣ = 1.4, R = 294.2 J/kg°C.. .	[L3]	[CO3]	[12M]

UNIT – IV
THERMODYNAMIC CYCLES, PURE SUBSTANCES

1.	a)	Develop an expression for Carnot Cycle and efficiency of cycle.	[L6]	[CO4]	[6M]
	b)	A carnot engine working between 400^0 C and 40^0 C produce 130 KJ of work. Determine i) The thermal efficiency. ii) the heat added iii) The entropy changes during the heat rejection process.	[L3]	[CO4]	[6M]
2.		Develop the expression for air standard efficiency, work done of an Otto cycle.	[L6]	[CO4]	[12M]
3.		Develop the expression for air standard efficiency for diesel engine.	[L6]	[CO4]	[12M]
4		An engine of 250 mm bore and 375 mm stroke works on Otto cycle. The clearance volume is 0.00263 m3. The initial pressure and temperature are 1 bar and 50°C. If the maximum pressure is limited to 25 bar, find the following: (i) The air standard efficiency of the cycle. (ii)The mean effective pressure for the cycle. Assume the ideal conditions	[L3]	[CO4]	[12M]
5		Develop an expression for air standard efficiency of dual combination cycle.	[L6]	[CO4]	[12M]
6		The Pressure and Temperature of a diesel cycle at the beginning are 1 bar and 15^0C.The Pressure at the end of compression stroke is 40 bar and that at the end of the expansion is 2 bar. Find the efficiency of the cycle	[L3]	[CO4]	[12M]
7		Develop the expression for air standard efficiency for sterling cycle	[L6]	[CO4]	[12M]

8		Develop the expression for air standard efficiency for Ericson cycle	[L6]	[CO4]	[12M]
9		Build the phase equilibrium diagram for a pure substance P-V , P-T T-S plot with relevant constant property line.	[L3]	[CO4]	[12M]
10	a)	Calculate Enthalpy, Entropy and Internal energy of Steam at a pressure of 15 bar and dryness fraction 0.9.	[L4]	[CO4]	[6M]
	b)	A Dry Saturated steam at a Pressure of 10 bar enters a turbine. Calculate its Enthalpy and entropy.	[L4]	[CO4]	[6M]

UNIT – V

VAPOUR POWER CYCLE, METHODS OF IMPROVING CYCLE PERFORMANCE

1		Describe the different operations of Rankine cycle and also derive the expression for its efficiency .	[L1]	[CO5]	[12M]
2		In a steam turbine steam at 20 bar, 360°C is expanded to 0.08 bar. It then enters a condenser, where it is condensed to saturated liquid water. The pump feeds back the water into the boiler. Assume ideal processes, find per kg of steam the network and the cycle efficiency.	[L3]	[CO5]	[12M]
3		Explain the Rankine cycle with PV and TS diagrams.	[L2]	[CO5]	[12M]
4		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.	[L3]	[CO5]	[12M]
5	a)	Compare Rankine cycle with Carnot cycle.	[L4]	[CO5]	[6M]
	b)	Explain with the help of neat diagram of Reheat cycle and Draw its T-S & H-S diagram.	[L1]	[CO5]	[6M]
6		Explain the process of improving Rankine cycle efficiency with regeneration.	[L2]	[CO5]	[12M]
7		The adiabatic enthalpy drop across the prime mover of the Rankine cycle is 840 kJ/kg. The enthalpy of steam supplied is 2940 kJ/kg. If the back pressure is 0.1 bar, find the specific steam consumption and thermal efficiency ?	[L1]	[CO5]	[12M]
8		List the advantages and disadvantages of Regenerative cycle over Simple Rankine cycle.	[L1]	[CO5]	[12M]
9		The adiabatic enthalpy drop across the prime mover of the Rankine cycle is 840 kJ/kg. The enthalpy of steam supplied is 2940 kJ/kg. If the back pressure is 0.1 bar, find the specific steam consumption and thermal efficiency	[L1]	[CO5]	[12M]
10		A power plant operating between 30 bar and 0.02 bars. If the steam supplied is 350 0 C and the cycle of operation is Rankine, find (i) Draw its TS & HS Diagrams (ii) cycle efficiency (ii) change in enthalpy.	[L3]	[CO5]	[12M]