R18/R15

Question Paper Code: R18A21ME02/R15A21ME02

ANURAG Engineering College

(An Autonomous Institution)

II B.Tech I Semester Supplementary Examinations, Jan/Feb-2024

THERMODYNAMICS

(MECHANICAL ENGINEERING)

Time: 3 Hours **Max. Marks: 75**

Section – A (Short Answer type questions) (25 Marks)

Answer All Questions

	Question	Course Outcome	B.T Level	Marks
1.	What are positive and negative work interactions?	CO1	L1	2M
2.	How the Zeroth law of Thermodynamics forms the basis for the measurement of temperature?	CO1	L2	3M
3.	Define enthalpy. How is it related to internal energy?	CO2	L1	2M
4.	Explain different causes of irreversibility associated with a process.	CO2	L2	3M
5.	Is it true that water boils at higher temperatures at higher pressures? Explain.	CO3	L2	2M
6.	Draw the phase equilibrium diagram for a pure substance on h-s plot with relevant constant property lines	CO3	L2	3M
7.	Define an ideal gas. What is universal gas constant?	CO4	L1	2M
8.	State and explain Amagat's law of partial volumes of a gas mixture	CO4	L1	3M
9.	Draw P-V, T-S diagrams of Sterling cycle	CO5	L2	2M
10.	Compare Otto and Dual cycle for the same maximum pressure and Temperature.	CO5	L2	3M

Section B (Essay Questions)

Answer all questions, each question carries equal marks. **(5 X 10M = 50M)**

	Question	Course Outcome	B.T Level	Marks
11. A)	A new scale N of temperature is divided in such a way that the Freezing point of ice 100^0N and the boiling point is 400^0N. What is the temperature reading on this new scale when the temperature is 160^0C? At what temperature both the Celsius and the new temperature scale reading would be the same.	CO1	L3	10M
	OR			
B)	A piston-cylinder device operates 1 kg of fluid at 20 atm. Pressure. The initial volume is 0.04 m^3 . The fluid is allowed to expand reversibly following a process $pV^{1.4}$ = constant so that the volume becomes double. The fluid is then cooled at a constant pressure until the piston comes back to the original position. Keeping the piston unaltered, heat is added reversibly to restore it to the initial pressure. Calculate the work done in the cycle.	CO1	L3	10M
12. A)	A mass of 8kg gas expands within a flexible container so that the p-v relationship is of the form $pv^{1.2}$=constant. The initial pressure is 1000kPa and the initial volume is $1m^3$. The final pressure is 5 kPa. If specific internal energy of the gas decreases by 40kJ/kg, find the heat transfer in magnitude and direction.	CO2	L3	10M
	OR			

B)	A heat pump working on the Carnot cycle takes in heat from a reservoir at 5°C and delivers heat to a reservoir at 60°C. The heat pump is driven by a reversible heat engine which takes in heat from a reservoir at 840°C and rejects heat to a reservoir at 60°C. The reversible heat engine also drives a machine that absorbs 30kW. If the heat pump extracts 17kJ/s from 5°C reservoir. Determine (a) rate of heat supply from the 840°C source and (b) the rate of heat rejection to the 60°C sink.	CO2	L3	10M
13. A)	A rigid vessel contains 1 kg of a mixture of saturated water and saturated steam at a pressure of 0.15 MPa. When the mixture is heated, the state passes through the critical point. Determine i) The volume of the vessel ii) The mass of liquid and of vapour in the vessel initially iii) The temperature of the mixture when the pressure has risen to 3 MPa iv) The heat transfer required to produce the final state.	CO3	L3	10M
	OR			
B)	A steam pressure of holding capacity 4 m^3 contains a mixture of saturated water and saturated steam at 250^0C. The mass of the liquid present is 1 ton. Determine i) Quality; ii) Specific Volume; iii) Specific Enthalpy; iv) Specific Entropy and v) Specific Internal Energy of steam.	CO3	L3	10M
14. A)	A fluid undergoes a reversible adiabatic compression from 0.5MPa, 0.2m^3 to 0.05m^3 according to the law, $pv^{1.3}$ = constant. Determine the change in enthalpy, internal energy and entropy, and the heat transfer and work transfer during the process.	CO4	L3	10M
	OR			
B)	The volumetric analysis of mixture of gases is 30 percent Oxygen, 40 per cent Carbon dioxide and 30 percent Nitrogen. The mixture is heated from 20^0 C to 200^0 C while flowing through a pipe in which the pressure is maintained at 150kPa. Determine the heat transfer to the mixture per unit mass of the mixture. Take Cp values of Oxygen, Carbon dioxide and Nitrogen as 0.918, 0.846 and 1.039kJ/kg K.	CO4	L3	10M
15. A)	Explain the Otto cycle with the help of P-V and T-S diagrams. Derive the expression for air standard efficiency mean effective pressure.	CO5	L3	10M
	OR			
B)	In a Diesel cycle, the compression ratio is 15. Compression begins at 0.1 MPa, 40^0C. The heat added is 1.675 MJ/kg. Find i) the maximum temperature in the cycle, ii) work done per kg of air iii) the cycle efficiency iv) the temperature at the end of the isentropic expansion v) the cut-off ratio.	CO5	L3	10M