PVP 20

Code: 20ES1304

II B.Tech - I Semester – Regular / Supplementary Examinations
DECEMBER 2023

BASIC THERMODYNAMICS
(MECHANICAL ENGINEERING)

Duration: 3 hours Max. Marks: 70

Note: 1. This paper contains questions from 5 units of Syllabus. Each unit carries 14 marks and have an internal choice of Questions.
2. All parts of Question must be answered in one place.

BL – Blooms Level CO – Course Outcome

			BL	CO	Max. Marks
UNIT-I					
1	a)	Explain the concept of macroscopic and microscopic view point as applied to the study of thermodynamics.	L2	CO1	7 M
	b)	Show that heat is a path function, and not a property.	L2	CO1	7 M
OR					
2	a)	Explain the perpetual motion machine of first kind.	L2	CO1	7 M
	b)	0.2 m^3 of an ideal gas at a pressure of 2 MPa and 600 K is expanded isothermally to 5 times the initial volume. It is then cooled to 300 K at constant volume and then compressed back polytropically to its initial state. Determine the network done and heat transfer during the cycle.	L3	CO1	7 M

UNIT-II					
3	a)	Explain the limitations of first law of thermodynamics.	L3	CO2	7 M
	b)	In a steady flow apparatus, 135 kJ of work is done by each kg of fluid. The specific volume of the fluid, pressure, and velocity at the inlet are 0.37 m^3/kg, 600 kPa, and 16 m/s. The inlet is 32 m above the floor, and the discharge pipe is at floor level. The discharge conditions are 0.62 m^3/kg, 100 kPa, and 270 m/s. In flowing through this apparatus, does the specific internal energy increase or decrease, and by how much?	L3	CO2	7 M
OR					
4	a)	State the Kelvin-Planck and Clausius statements of the second law of thermodynamics, and establish the equivalence between them.	L3	CO2	7 M
	b)	A domestic food freezer maintains a temperature of -15 ^oC. The ambient air temperature is 30 ^oC. If heat leaks into the freezer at the continuous rate of 1.75 kJ/s. What is the least power necessary to pump this heat out continuously?	L3	CO2	7 M
UNIT-III					
5	a)	Show that COP of a heat pump is greater than COP of a refrigerator by unity.	L3	CO3	7 M

	b)	A reversible heat engine is supplied 900 kJ of heat from a heat source at 500 K. The engine develops 300 kJ of net work and rejects heat to two heat sinks at 400 K and 300 K. Determine the engine thermal efficiency and magnitude of heat interaction with each of the sink.	L3	CO3	7 M
OR					
6	a)	Explain the concept of Clausius inequality.	L3	CO3	7 M
	b)	5 kg of air expands isothermally from $1m^3$ to 5 m^3. Assuming air to be an ideal gas with constant specific heats, compute the change in entropy of air during the process.	L3	CO3	7 M
UNIT-IV					
7	a)	Explain availability of a non flow or closed system.	L3	CO4	7 M
	b)	Air expands through a turbine from 500 kPa, 520 ^oC to 100 kPa, 300 ^oC. During expansion 10 kJ/kg of heat is lost to the surroundings which is at 98 kPa, 20^oC. Neglecting the K.E and P.E. changes, determine per kg of air (i) the decrease in availability, (ii) the maximum work and (iii) the irreversibility. For air take C_p=1.005 kJ/kgK, h=C_pT where C_p is constant and pV=mRT.	L3	CO4	7 M
OR					
8	a)	Explain the changes in enthalpy during formation of steam.	L3	CO4	7 M

	b)	A vessel of volume 0.04 m^3 contains a mixture of saturated water steam at a temperature of 250^oC. The mass of the liquid present is 9 kg. Find the pressure, the mass, the specific volume, the enthalpy, the entropy, and the internal energy.	L3	CO4	7 M
UNIT-V					
9	Draw the P-V and T-s diagrams of Diesel cycle and derive an expression for thermal efficiency.		L3	CO5	14 M
OR					
10	In an air standard diesel cycle, the compression ratio is 16, and at the beginning of isentropic compression, the temperature is 15 ^oC and the pressure is 0.1 MPa. Heat is added until the temperature at the end of the constant pressure is 1480 ^oC. Calculate (i) the cut-off ratio, (ii) the heat supplied per kg of air, (iii) the cycle efficiency and (iv) the mean effective pressure.		L3	CO5	14 M