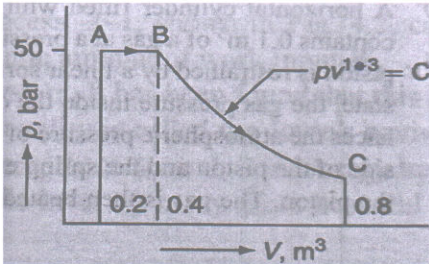


**PRAGATI ENGINEERING COLLEGE: SURAMPALEM**  
**(AUTONOMOUS)**  
**II B.Tech I Semester Supplementary Examinations, June - 2024**  
**THERMODYNAMICS**  
**(ME)**

Time: 3 hours

Max. Marks: 70

Answer ONE Question from each Unit  
 All Questions Carry Equal Marks  
 Allow Steam Tables

Q. No.	Questions	BTL	CO	Marks
<b>UNIT – I</b>				
1.	a) Explain the concept of Macroscopic and Microscopic viewpoints applied to the study of thermodynamics.	K2	CO1	7M
	b) Determine the total work done by a gas system following an expansion process as shown in Fig 	K3	CO1	7M
<b>OR</b>				
2.	a) What do you understand by “Energy in State and in Transition”? Explain it.	K2	CO1	7M
	b) A new scale N of temperature is divided in such a way that the freezing point ice is 100°N and the boiling point is 400°N. What is the temperature reading on this new scale when the temperature is 150°C and 200°C? Also determine at what temperature both the Celsius scale and the new temperature scale reading would be the same.	K3	CO1	7M
<b>UNIT – II</b>				
3.	a) Explain Joules experiment and state the first law of thermodynamics applied to a closed system undergone by a cyclic process.	K2	CO2	7M
	b) A gas of mass 1.5 kg undergoes a quasi-static expansion which follows a relationship $p = a + bV$ where a and b are constants. The initial and final pressures are 1000 kPa and 200 kPa respectively and the corresponding volumes are 0.2m³ and 1.2m³. The specific internal energy of the gas is given by the relation, $u = 1.5pv - 85\text{kJ / kg}$ where p is in kPa and v is in m³/kg. Calculate the net heat transfer and the maximum internal energy of the gas attained during expansion.	K3	CO2	7M
<b>OR</b>				
4.	a) Derive the steady flow energy equation for a simple steady flow process.	K2	CO2	7M
	b) Air flows steadily at the rate of 0.4 kg/s through an air compressor, entering at 6 m/s with a pressure of 1 bar and a specific volume of 0.85 m³/kg, and leaving at 4.5 m/s with a pressure of 6.9 bar and a specific volume of 0.16 m³/kg. The internal energy of the air leaving is 88 kJ/kg greater than that of	K3	CO2	7M

		the air entering. Cooling water in a jacket, surrounding the cylinder absorbs heat from the air at the rate of 59 W. Calculate the power required to drive the compressor and the inlet and outlet cross-sectional areas.			
<b>UNIT – III</b>					
5.	a)	Prove that a reversible engine is more efficient than an irreversible engine operating between the same temperatures limits.	K2	CO3	7M
	b)	A Carnot heat engine receives heat from a reservoir at 1173 K at a rate of 800 kJ/min and reject the waste heat to the ambient air at 300 K. the entire work output of the heat engine is used to drive a refrigerator that removes heat from the refrigerated space at 268 K and transfers it to the same ambient air at 300K. Determine the maximum rate of the heat removal from the refrigerated space and the total rate of heat rejection to the ambient air.	K3	CO3	7M
<b>OR</b>					
6.	a)	Establish the inequality of Clausius.	K2	CO3	7M
	b)	Derive Maxwell relations.	K2	CO3	7M
<b>UNIT – IV</b>					
7.	a)	Draw the pv diagram of a pure substance and explain how it is formed.	K2	CO4	7M
	b)	A pressure cooker contains 2 kg of steam at 6 bar and 0.9 dryness fraction, find the heat must be rejected to make the quality of steam 0.5	K3	CO4	7M
<b>OR</b>					
8.	a)	Explain Dalton's law of additive pressures and Amagat's law of additive volumes.	K2	CO4	7M
	b)	A mixture of ideal gases consists of 5 kg of nitrogen and 6 kg of carbon dioxide at a pressure of 4 bar and a temperature of 27°C. Find (a) The mole fraction of each constituent, (b) The equivalent molecular weight of the mixture, (c) The equivalent gas constant of the mixture, (d) The partial pressures and partial volumes, and (e) The volume and density of the mixture.	K3	CO4	7M
<b>UNIT – V</b>					
9.	a)	Explain the working of Brayton cycle and derive the expression for thermal efficiency.	K2	CO5	7M
	b)	An engine working on the Otto cycle is supplied with air at 0.1 MPa, 35 °C. The compression ratio is 8. Heat supplied is 2100 kJ/kg. Calculate the maximum pressure and temperature of the cycle, the cycle efficiency, and the mean effective pressure. (For air, $C_p = 1.005$ , $C_v = 0.718$ , and $R = 0.287$ kJ/kg K).	K3	CO5	7M
<b>OR</b>					
10.	a)	Explain the Atkinson cycle with p-v and T-S diagrams.	K2	CO5	7M
	b)	A theoretical diesel engine operates at suction conditions of 1 bar and 300 K. At the end of compression stroke, the pressure rises to 24 bar. The maximum temperature limit of the cycle is 1473K. Determine (i) cut-off ratio; (ii) net work output of the cycle and (iii) thermal efficiency of the cycle. For air, assume specific heat at constant pressure and volume as 1.005 kJ/kg.K and 0.717 kJ/kg.K.	K3	CO5	7M