Name: Enrolment No:	

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2022

Course: Engineering Thermodynamics
Semester: II
Program: B.Tech./Int. B.Tech in Food Technology & Biotechnology **Time : 03 hrs.**
Course Code: MECH 1006 **Max. Marks: 100**

Instructions:

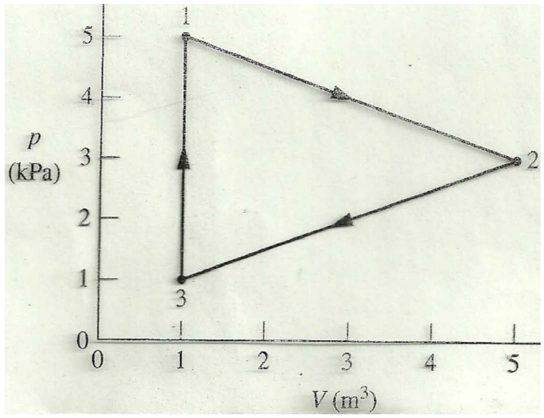
Q.No	Section A Short answer questions/ MCQ/T&F	(20Q x1.5M= 30 Marks)	COs
Q	Statement of question		CO
1.	Which of the following is not a property of the system? *(a)* Temperature (*b*) Specific volume (c) Heat.		CO1
2.	Work done in a free expansion process is *(a)* zero (*b*) negative (c) positive.		CO1
3.	In the polytropic process equation pv^n = constant, if $n = 0$, the process is termed as *(a)* isochoric (*b*) isobaric (*c*) isothermal.		CO1
4.	In the polytropic process equation pv^n = constant, if n is infinitely large, the process is termed as *(a)* isochoric (*b*) isobaric (*c*) isothermal.		CO1
5.	The processes or systems that do not involve heat are called *(a)* isothermal processes (*b*) thermal processes (c) adiabatic processes.		CO1
6.	If a process in which both the system and the surroundings cannot return to their original conditions, it is known as *(a)* reversible process (*b*) irreversible process (*c*) energyless process.		CO1
7.	The internal energy of a perfect (ideal) gas depends on (a) only T (*b*) T, P (*c*) T, P, c		CO2

	T = temperature, P = pressure, C_v = specific heat at constant volume		
8.	The gas constant (*R*) is equal to the *(a)* $c_p + c_v$ (b) $c_p - c_v$ (c) $c_p \cdot c_v$ C_p = specific heat at constant pressure, C_v = specific heat at constant volume		CO2
9.	In isothermal process *(a)* temperature increases gradually (*b*) volume remains constant (*c*) change in internal energy is zero.		CO2
10	During throttling process *(a)* internal energy does not change (*b*) pressure does not change (*c*) enthalpy does not change.		CO2
11	If all the variables of a stream are independent of time it is said to be in *(a)* steady flow (*b*) unsteady flow (*c*) uniform flow.		CO2
12	A control volume refers to a *(a)* fixed region in space (*b*) closed system (*c*) isolated system		CO2
13	A thermodynamic process can occur when it satisfies *(a)* First law only (*b*) Second law only (*c*) both the laws.		CO3
14	A reservoir that absorbs energy in the form of heat is called (a) Source (b) Sink (c) none of these.		CO3
15	Thermal efficiency of a heat engine is always *(a)* > 1 (*b*) < 1 (c) $= 0$.		CO3
16	The efficiencies of all reversible heat engines operating between the same two reservoirs are *(a)* not equal (*b*) equal (c) 100%		CO3
17	It is impossible for a process to proceed in a direction if the entropy generation (S_{gen}) is ------- *(a)* > 0 (*b*) < 0 (c) $= 0$.		CO4
18	An isentropic process is always (*a*) irreversible and adiabatic (*b*) reversible and isothermal (*c*) reversible and adiabatic.		CO4

19	Cyclic integral of $(\delta Q/T)$ for internally reversible cycles is $(a) > 0$ $(b) < 0$ (c) = 0.		CO4
20	Entropy generation (S_{gen}) for a reversible process is always $(a) > 0$ $(b) < 0$ (c) = 0.		CO4
	Section B	**(4Qx5M=20 Marks)**	CO
Q	Statement of question		
1.	How a closed system is different from an isolated system?	5	CO1
2.	Why specific heat at constant pressure (c_P) is bigger than specific heat at constant volume (c_V)?	5	CO2
3.	Write two statements of the second law of thermodynamics.	5	CO3
4.	Write first and second Gibbs equations and corresponding two Maxwell relations.	5	CO4
	Section C	**(2Qx15M=30 Marks)**	
Q	Statement of question (Case studies)		CO
1.	Classify the following processes of a closed system as possible, impossible, or intermediate.	15	CO4

	Entropy Change (ΔS)	Entropy Transfer (S_{trans})	Entropy generation (S_{gen})
(a)	>0	0	
(b)	<0		>0
(c)	0	>0	
(d)	>0	>0	
(e)	0	<0	
(f)	>0		<0
(g)	<0	<0	

2.	The figure shows a power cycle executed by a gas in a piston-cylinder assembly. For process 1-2, U_2-U_1 = 15kJ. For process 3-1, Q_{31} = 10kJ. There are no changes in kinetic or potential energy. Determine	(10+5) = 15	CO2

	(a) Determine work for each process (i.e. W_{1-2}, W_{2-3}, W_{3-1}) in kJ and (b) Prove $W_{cycle} = Q_{cycle}$ 		
	Section D	**(2Qx10M=20 Marks)**	
Q	Statement of question		CO
1.	A rigid tank contains 2 kg of air at 200 kPa and ambient temperature, 20°C. An electric current now passes through a resistor inside the tank. After a total of 100 kJ of electrical work has crossed the boundary, the air temperature inside is 80°C, is this possible? The average specific heat ($\overline{c}_v$) value over the temperature range is 0.7195 kJ/kg.K	10	CO4
2.	The data listed below are claimed for a power cycle operating between hot and cold reservoirs at 727°C and 27°C, respectively. For each case, determine whether the cycle operating reversibly, irreversibly, or is impossible. (a) Q_H = 600 kJ, W_{cycle} = 300 kJ, Q_C= 300 kJ (b) Q_H = 400 kJ, W_{cycle} = 280 kJ, Q_C= 120 kJ	(5 + 5) = 10	CO3