Hall Ticket Number:

Code No. : 13568 BO

VASAVI COLLEGE OF ENGINEERING *(AUTONOMOUS)*, HYDERABAD

Accredited by NAAC with A++ Grade

B.E. (Mech. Engg.) III-Semester Backlog Examinations, Jan./Feb.-2024

Thermodynamics

Time: **3 hours** Max. Marks: **60**

Note: Answer all questions from **Part-A** and any **FIVE** from **Part-B**

Part-A (10 × 2 = 20 Marks)

Q. No.	Stem of the question	M	L	CO	PO
1.	Give any four engineering applications for "open systems".	2	2	1	1
2.	Mention the names of two temperature measuring instruments and give the thermometric properties that form the basis for these instruments.	2	2	1	1
3.	Define and explain "Throttling Process".	2	1	2	1
4.	From the first law of thermodynamics to an isometric process deduce the relation for Constant Volume Specific Heat (c_v).	2	2	2	1
5.	Give two practical examples for "heat engines" and two practical examples for "reversed heat engines".	2	2	3	1
6.	Four reversible I C engines making use of Petrol (P), Diesel (D), Compressed Natural Gas (CNG) and Liquefied Petroleum Gas (LPG) are given to you. All work between the temperature limits of 1000 K and 300 K. Which IC engine do you prefer? Why?	2	3	3	1
7.	Define a "Pure Substance" with two examples.	2	1	4	1
8.	The "Triple Point" of a pure substance looks as a "point" on ________ thermodynamic plane and as a "horizontal straight line" on ________ thermodynamic plane.	2	2	4	1
9.	Give the names of two air-standard cycles that have identical thermal efficiency for a given compression ratio.	2	2	5	1
10.	Name three air-standard cycles having "isometric heat rejection" and one air-standard cycle having "isobaric heat rejection".	2	2	5	1
	Part-B (5 × 8 = 40 Marks)				
11. a)	Give the definitions of (i) Thermodynamic State, (ii) Change of State and (iii) Thermodynamic Cycle by sketching them all on a single Thermodynamic Plane.	4	2	1	1, 2
b)	A person climbing a mountain starts his climbing from a location where the barometer records 930 milli bar. He observes the barometer reading rising to 780 milli bar as he finishes his climbing. Calculate the vertical distance climbed by the mountain hiker. Assume air density to be about 1.2 kg/m^3 and consider standard value for local acceleration due to gravity.	4	4	1	1, 2
12. a)	Differentiate between "Nozzle" and "Diffuser". Through Steady Flow Energy Equation (SFEE) applied to "Steam Nozzle", deduce the expression for the exit steam velocity.	4	3	2	1, 2
b)	At the inlet to a certain nozzle, the enthalpy of the fluid passing is 3000 kJ/kg and the velocity is 60 m/s. At the discharge end, the enthalpy is 2762 kJ/kg. The nozzle is horizontal and adiabatic. Calculate the velocity of the fluid at the exit of the nozzle. If the inlet area of the nozzle is 0.1 m^2 and the specific volume at inlet is 0.187 m^3/kg, calculate the mass flow rate of the fluid.	4	4	2	1, 2

Contd... 2

13.	a)	Provide both Kelvin-Planck statement and Clausius statement for second law of thermodynamics. Derive their equivalence with sketches.	4	2	3	1, 2
	b)	It is proposed to connect two reversible heat engines 1 and 2 in series such that 1 is rejecting heat directly to 2. Engine 1 receives 200 kJ at a temperature 421°C from a hot source, while Engine 2 rejects heat to a cold sink that is at a temperature 4.4°C. The work output of the Engine 1 is two times that of Engine 2. Calculate (i) the intermediate temperature between the Engines 1 and 2, (ii) the efficiency of each Engine, and (iii) the heat rejected to the cold sink.	4	4	3	1, 2
14.	a)	Draw the T-s phase diagram of a pure substance by considering water as the example. Explain the Liquid-Vapor phase transformation with reference to this diagram.	4	3	4	1, 2
	b)	1 kg of steam at a pressure of 1 bar (abs) and 0.75 dry is compressed in a cylinder to a pressure of 3 bar (abs) as per the governing law $Pv^{1.35}$ = constant. Calculate (i) the final condition of steam, (ii) the change in internal energy and (iii) the net heat transfer.	4	4	4	1, 2
15.	a)	Together with relevant schematic diagram and T-s diagram, describe "Vapor Power Rankine Cycle".	4	2	5	1, 2
	b)	Air-standard Otto cycle works on a compression ratio of 8. At the beginning of the compression process, air is at 100 k Pa and 17°C. An amount of heat of 800 kJ/kg is transferred to air during the constant volume heat addition process. Determine (i) the maximum temperature and pressure that occur during the cycle, (ii) the net work output and (iii) the air-standard efficiency.	4	4	5	1, 2
16.	a)	Give the statements of (i) Charles' Law and (ii) Gay-Lussac Law as referred to an ideal gas.	4	1	1	1, 2
	b)	It is required to expand a given fluid reversibly in a process from a pressure of 2 MPa to 0.1 MPa in accordance with the relation: P = [2.2 - 1.5 v], where P is in MPa and v in m3/kg. The heat loss from the fluid to the surroundings during the process is found to be 250 kJ/kg. Calculate the change in internal energy of the fluid during the process.	4	4	2	1, 2
17.		Answer any *two* of the following:				
	a)	Draw the Carnot Cycle on T-s plane. Derive the expression for the thermal efficiency of the cycle.	4	3	3	1, 2
	b)	Explain the terms (i) Dryness Fraction and (ii) Critical Point as referred to pure substances.	4	3	4	1, 2
	c)	Describe the working of "Dual Combustion Cycle" supported by P-v and T-s diagrams.	4	3	5	1, 2

M : Marks; L: Bloom's Taxonomy Level; CO; Course Outcome; PO: Programme Outcome

i)	Blooms Taxonomy Level – 1	10%
ii)	Blooms Taxonomy Level – 2	30%
iii)	Blooms Taxonomy Level – 3 & 4	60%

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