Hall Ticket Number: 1 6 0 2 2 0 7 3 6 0 3 0

Code No. : 13548 S

VASAVI COLLEGE OF ENGINEERING *(AUTONOMOUS)*, HYDERABAD

Accredited by NAAC with A++ Grade

B.E. (Mech. Engg.) III-Semester Supplementary Examinations, August-2022

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.	List any four engineering applications that could be called as "control volumes".	2	2	1	1
2.	Name any two temperature measuring instruments used in engineering practice. Mention the thermometric property that forms the basis for temperature measurement in each of them.	2	2	1	1
3.	Define "Throttling Process". Mention any two throttling devices you are aware of.	2	1	2	1
4.	Employing the first law of thermodynamics to an isometric process deduce the relation for Constant Volume Specific Heat (c_v).	2	2	2	1
5.	Mention any two practical examples for "heat engines" and any two practical examples for "reversed heat engines".	2	2	3	1
6.	State the Carnot's theorem and mention its usefulness in engineering practice.	2	2	3	1
7.	Define a "Pure Substance". Give two examples for the same.	2	1	4	1
8.	Define the triple point of a pure substance. What is its value for water?	2	2	4	1
9.	Name the two air-standard cycles that have identical thermal efficiency for a given compression ratio.	2	2	5	1
10.	Define compression ratio and cut-off ration as applied to Diesel Cycle.	2	2	5	1
	Part-B (5 × 8 = 40 Marks)				
11. a)	Define (i) Thermodynamic State, (ii) Change of State and (iii) Thermodynamic Cycle. Show them all on a single Thermodynamic Plane.	4	2	1	1, 2
b)	A mountain hiker starts climbing a mountain from a location where the barometer records 930 milli bar. He observes the barometer reading rising up 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)	Define "Nozzle" and "Diffuser". Apply the Steady Flow Energy Equation (SFEE) to a Steam Nozzle and 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

13. a)	Write the Kelvin-Planck statement and the Clausius statement of the second law of thermodynamics. Derive their equivalence with neat sketches.	4	2	3	1, 2
b)	Two reversible heat engines 1 and 2 are connected 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 P-T phase diagram of a pure substance by considering water as the example. Explain the Solid-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 0.80 dry is compressed in a cylinder to a pressure of 2 bar (abs) as per the governing law $Pv^{1.2}$ = 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)	Explain, along with relevant schematic diagram and T-s diagram, the Vapor Power Rankine Cycle.	4	2	5	1, 2
b)	An ideal 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)	State and explain (i) Charles' Law and (ii) Gay-Lussac Law as referred to an ideal gas.	4	1	1	1, 2
b)	A fluid expands 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 m^3/kg. The heat loss from the fluid to the surroundings during the process is found to be 200 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)	Show the Carnot Cycle on T-s thermodynamic plane and thus derive the expression for the thermal efficiency of the cycle.	4	2	3	1, 2
b)	Define and explain the terms,viz., (i) Dryness Fraction and (ii) Critical Point vis-à-vis a pure substance.	4	3	4	1, 2
c)	Explain the working of the Otto Cycle with neat 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 &2	50%
iii)	Blooms Taxonomy Level – 3 & 4	50%

*****