CBCS SCHEME - Make-Up Exam

USN | | | | | | | | | |

BME304

Third Semester B.E./B.Tech. Degree Examination, June/July 2025
Basic Thermodynamics

ACHARYA INSTITUTE OF TECHNOLOGY
MCA Library
Date ....
BANGALORE

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.
3. Use of Thermodynamic data hand book and steam table is permitted.

		Module – 1	M	L	C
Q.1	a.	State and explain Zeroth law of thermodynamics.	4	L2	CO1
	b.	The readings t_A and t_B of two Celsius thermometers, A and B agree at the ice point (0°C) and the steam point (100°C), but elsewhere are related by the equation $t_A = \ell + mt_B + nt_B^2$ where ℓ, m and n are constants, when both thermometers are immersed in a well stirred oil bath, A registers 51°C, while B registers 50°C. Determine the reading on B when A reads 25°C	10	L3	CO1
	c.	Define Thermodynamic Work. Compare Heat and Work.	6	L4	CO1
		OR			
Q.2	a.	Explain the Path and Point function with PV diagram.	6	L2	CO1
	b.	Derive an expressions for displacement work in various processes through P-V diagrams.	10	L3	CO1
	c.	Gas from a bottle of compressed helium is used to inflate in elastic flexible balloon, originally folded completely flat to a volume of 0.5 m^3. If the barometer reads 760 mm Hg, what is the amount of work done upon the atmosphere by the balloon? Sketch the system before and after the process.	4	L3	CO1
		Module – 2			
Q.3	a.	Explain first law for a closed system executing a cycle with neat sketch.	6	L2	CO2
	b.	Demonstrate the concept of enthalpy and its relation with heat transfer.	6	L3	CO2
	c.	A fluid is confined in a cylinder by a spring loaded frictionless piston so that the pressure in the fluid is a linear function of the volume (P = a + bV). The internal energy of the fluid is given by the following equation, $U = 34 + 3.15PV$ Where "U" is in KJ, P in KPa and V in cubicmetre. If the fluid changes from an initial state of 170 KPa , 0.03 m^3 to a final state of 400 KPa , 0.06 m^3, with no work other than that done on the piston. Find the direction and magnitude of the work and heat transfer.	8	L3	CO2
		OR			
Q.4	a.	Derive steady flow energy equation for an open system using First law of thermodynamics.	10	L3	CO2

	b.	In a gas turbine the gas enters at the rate of 5 kg/sec with a velocity of 50 m/sec and enthalpy of 900 KJ/kg and leaves the turbine with a velocity of 150 m/sec and enthalpy of 400 KJ/kg. The loss of heat from the gases to the surroundings is 25 KJ/kg. Assume for gas R = 0.285 KJ/kg.K and C_V = 1.004 KJ/kgK and the inlet conditions to be at 100 KPa and 27°C. Determine the power output of the turbine and the diameter of the inlet pipe.	10	L3	CO2
		Module – 3			
Q.5	a.	Explain the heat engines in both closed and open system with neat sketch.	6	L2	CO3
	b.	State and explain Kelvin-Planck and Clausius statements of second law of thermodynamics.	8	L2	CO3
	c.	Establish the equivalence of Kelvin-Planck and Clausius statements.	6	L3	CO3
		OR			
Q.6	a.	Define Entropy and prove that it is a property of the system.	10	L3	CO3
	b.	State and prove the corollary of Carnot's theorem.	10	L3	CO3
		Module – 4			
Q.7	a.	Explain the concept of available energy and unavailable energy.	6	L2	CO4
	b.	Explain the relation between increase in unavailable energy and increase in entropy.	6	L2	CO4
	c.	State and prove the maximum work in a reversible process.	8	L3	CO4
		OR			
Q.8	a.	With a neat sketch, explain P-T diagram for a pure substance.	8	L2	CO4
	b.	A vessel of volume 0.04 m^3 contains a mixture of saturated water and saturated steam at a temperature of 250°C. 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.	12	L3	CO4
		Module – 5			
Q.9	a.	Distinguish between Ideal and Real gas.	5	L2	CO5
	b.	Derive an expressions for the constants a, b and R interms of the critical properties for a Vander Waal gas.	10	L3	CO5
	c.	1 kg of propane (C_3H_8) is at a pressure of 7 MPa and a temperature of 150°C. The critical properties of propane are P_C = 4.26 MPa, T_C = 370 K and V_C = 0.00454 m^3/kg. Compressibility factor is 0.54. Calculate (i) the reduced pressure, volume and temperature (ii) Specific volume of propane using ideal gas equation.	5	L3	CO5

		OR			
Q.10	a.	Explain the following : (i) Joule-Kelvin effect (ii) Clausius-Clapeyron equation.	8	L2	CO5
	b.	State and explain Dalton's law of partial pressure and Amagat's law of additive volumes.	8	L2	CO5
	c.	Explain generalized compressibility chart.	4	L2	CO5

* * * * *

VTU-16-10-2025 08:49:07am AY - AY - AY - AY - AY - AY - AY - AY 16-10-2025 09:05:25am