CBCS SCHEME

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BME304

Third Semester B.E./B.Tech. Degree Examination, June / July 2026
Basic Thermodynamics

ACHARYA INSTITUTE OF TECHNOLOGY LIBRARY 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 the thermodynamic data hand book is allowed.

		Module – 1	M	L	C
Q.1	a.	What do you understand by microscopic and macroscopic view points?	06	L1	CO1
	b.	Explain mechanical, chemical and thermal equilibrium with examples.	06	L2	CO1
	c.	With suitable examples distinguish between i) Open and Closed System ii) Path and Point – function iii) Intensive and Extensive properties.	08	L2	CO1
		OR			
Q.2	a.	Define heat and work in thermodynamics. Show that work is path function.	08	L1	CO1
	b.	Derive an expression for displacement work for polytrophic process.	06	L2	CO1
	c.	A cylinder contains one kg of air at 300 K and 100 KP_a. Air is compressed to one fourth of its initial volume by the law $PV^{1.25} = C$. Determine work done and heat interaction.	06	L3	CO1
		Module – 2			
Q.3	a.	State the First law of thermodynamics applied to cyclic process and non cyclic process.	06	L1	CO2
	b.	Prove that internal energy is a property of a system.	06	L3	CO2
	c.	A nozzle is a device used for increasing the velocity of steadily flowing steam. At inlet the enthalpy of fluid passing is 3000 KJ/Kg and velocity is 60 m/s. At discharge and the enthalpy is 2762 KJ /Kg. The nozzle is horizontal and there is negligible heat loss from it. i) Find the velocity at exit of nozzle ii) If inlet area is 0.1 m^2 and Specific volume at inlet is 0.187 m^3/kg find mass flow rate. iii) If the specific volume at exit is 0.498 m^3/Kg, find diameter at exit of nozzle.	08	L4	CO2
		OR			
Q.4	a.	What are PMMK – I and PMMK - 2? Explain why they are impossible to exist.	06	L1	CO2
	b.	With assumptions, derive SFEE for a steady flow stream of fluid entering and leaving the control volume.	06	L3	CO2

	c.	The working fluid in a steady flow process flows at the rate of 220 Kg/min. The fluid rejects 100 KJ/s of heat passing through the system. The fluid enters at a velocity of 320 m/s, pressure of 6 bar, internal energy of 2000 KJ/Kg, specific volume of 0.36 m^3 /Kg and leaves the system at a velocity of 140 m/s, pressure of 1.2 bar, internal energy 1400 KJ/Kg, specific volume of 1.3 m^3/Kg. Determine the power output in KW. The change in potential energy is neglected.	08	L3	2
		Module – 3			
Q.5	a.	State Kelvin – plank and Clausius statement of Second law of thermodynamics and show that they are equivalent.	10	L2	CO3
	b.	A Series combination of two Carnot engines operate between temperature of 120°C and 20°C. Calculate the intermediate temperature. i) If the engines produces equal amount of work ii) If the efficiencies of engines are equal.	10	L3	CO3
		OR			
Q.6	a.	Explain reversible and irreversible process. Mention the factors which render a process irreversible.	06	L2	CO3
	b.	State and prove Clausius inequality.	06	L2	CO3
	c.	5 Kg of copper block at 200°C is dropped to an insulated tank with 100 kg of oil at 30°C. Find the increase in entropy of the universe. Take specific heat of copper and ore as 0.4 KJ /kg - K and 2.1 KJ /Kg – k respectively.	08	L3	CO3
		Module – 4			
Q.7	a.	With T.S diagram, briefly explain available energy and unavailable energy.	06	L2	CO4
	b.	Define the following terms with reference to pure substance i) Latent heat of Vapourisation ii) Sensible heat iii) Saturation temperature iv) Tripple point v) Wet steam vi) Dryness fraction vii) Critical point	14	L1	CO4
		OR			
Q.8	a.	With neat sketch, explain the working of combined separating and throttling calorimeter.	10	L2	CO4
	b.	A pressure cooker contains 1.5 kg of saturated steam at 5 bar. Find the quantity of heat which must be rejected so as to reduce quality to 60 % dry. Determine the pressure and temperature at new state.	10	L4	CO4

Module – 5

Q.9	**a.**	State and explain Dalton's law of partial pressure and Amogot's law of additive volumes.	**06**	**L1**	**CO5**
	b.	Explain the following : i) Reduced properties ii) Law of corresponding states iii) Vander Waal's equation of state iv) Generalized compressibility chart	**14**	**L2**	**CO5**
		OR			
Q.10	**a.**	Define : i) Mole fraction ii) Mass fraction iii) Partial Pressure	**06**	**L1**	**CO5**
	b.	With usual notations write Clausius Clapeyron equation.	**06**	**L2**	**CO5**
	c.	Determine the pressure exerted by carbon dioxide in a container of 1.5 m^3 capacity when it contains 5 kg at 27° C, Using : i) Ideal gas equation ii) Vander Wall's equation Take Vander Wall's constants for Co_2 as a = 364.3 KN - m^4/Kg - mol^2, b = 0.0427 m^3/ k-mol	**08**	**L3**	**CO5**

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