Basavarajeswari Group of Institutions

BALLARI INSTITUTE OF TECHNOLOGY & MANAGEMENT

(Autonomous Institute under Visvesvaraya Technological University, Belagavi)

USN | | | | | | | | | | | **Course Code** | 2 | 2 | M | E | 3 | 6 | 1 |

Third Semester B.E. Degree Examinations, September 2024

BASIC THERMODYNAMICS

Duration: 3 hrs **Max. Marks: 100**

Note: ***1. Answer any* FIVE *full questions choosing ONE full Question from each Module.***
2. Thermodynamics Data Handbook is permitted
3. Missing data, if any, may be suitably assumed

Q. No		Question	Marks	(RBTL:CO:PI)
		Module-1		
1.	**a.**	Define the following with an example (i) Open system (ii) Closed system (iii) Isolated system	**06**	(1 :1 : 1.6.1)
	b.	Differentiate between (i) Intensive and extensive properties (ii) Cyclic and non-cyclic process.	**06**	(1 :1 : 1.6.1)
	c.	The temperature T on a thermometric scale is defined by T= a ln K+b, where a and b are constants. The values of K found to be 1.83 and 6.78 at 0^0C and 100^0C respectively. Calculate the temperature for the values of K = 2.42.	**08**	(3 :1 : 1.7.1)
		(OR)		
2.	**a.**	State Zeroth law of thermodynamics. What is its significance?	**06**	(1 :1 : 1.6.1)
	b.	What you mean by thermodynamic equilibrium.	**06**	(2 :1 : 1.6.1)
	c.	The resistance of a platinum wire is found to be 11 Ω, 15.247 Ω and 28.887 Ω at ice point, steam point and at sulphur point respectively, if boiling point of sulphur is 444.6 ^{0}C. Find the resistance of wire at 500 ^{0}C, if the resistance varies with temperature by the relation $R= R_0 (1+\alpha t+\beta t^2)$.	**08**	(3 :1 : 1.7.1)
		Module-2		
3.	**a.**	Define work from thermodynamic point of view. List the different types of work transfer.	**06**	(1 :2 : 1.6.1)
	b.	Derive an expression for displacement work done in polytrophic process.	**06**	(2 :2 : 1.6.1)
	c.	A mass of 1.5 kg of air is compressed in a quasi-static process from 0.1 MPa to 0.7 MPa for which pv = constant. The initial density of air is 1.16 kg/m^3. Find the work done by the piston to compress the air.	**08**	(3 :2 : 1.7.1)
		(OR)		
4.	**a.**	Show that energy is a property of system.	**06**	(2 :2 : 1.6.1)
	b.	Write the steady flow energy equation and simplify it for a steam turbine.	**06**	(2 :2 : 1.6.1)
	c.	A fluid system undergoes a non flow frictionless process following the p-v relation P = 5/v + 1.5 where P is in bar and v is in m^3. During the process volume changes from 0.15 m^3 to .05 m^3 and system rejects 45 kJ of heat determine (i) Change in internal energy (ii) Change in enthalpy.	**08**	(3 :2 : 1.7.1)

Note: (RBTL - Revised Bloom's Taxonomy Level: CO - Course Outcome: PI– Performance Indicator)

Module-3

			Marks	(RBTL : CO : PI)
5.	**a.**	With a neat sketch, explain (i) Heat engine (ii) Refrigerator and deduce their efficiency and cop.	**06**	(2 :3 : 1.6.1)
	b.	State the Kelvin Planck and Clausius statement of second law of thermodynamics.	**06**	(1 :3 : 1.6.1)
	c.	Two Carnot engines are connected in series between a thermal reservoirs maintained at 1000 ^{0}K and 300 ^{0}K respectively if engine one receives 1750 kJ of heat from high temperature reservoir and rejects heat to engine two. Engine two takes heat rejected by engine one and rejects heat to the low temperature reservoir if engine one and two have the same thermal efficiency determine (i) Intermediate temperature (ii) Efficiency of both the engines (iii) work done by both engines.	**08**	(3 :3 : 1.7.1)
		(OR)		
6.	**a.**	Show that entropy as a property of a system.	**06**	(2 :3 : 1.6.1)
	b.	Using Tds relation, find the change in entropy during constant volume process.	**06**	(2 :3 : 1.6.1)
	c.	5 kg of copper block at 200 ^{0}C is dropped to an insulated tank with 100 kg of oil at 30 ^{0}C. Find the increase in entropy of the universe. Take c_p of copper 0.4 kJ/kgK and C_p for oil as 2.1kJ/kgK.	**08**	(3 :3 : 1.7.1)

Module-4

7.	**a.**	Define (i) Critical point (ii) Triple point (iii) sublimation	**06**	(1 :4 : 1.6.1)
	b.	With a neat sketch explain separating and throttling calorimeter.	**06**	(2 :4 : 1.6.1)
	c.	The following data were obtained in a test on a combined separating and throttling calorimeter. Pressure of steam sample = 15 bar, Pressure of steam at exit = 1 bar, Temperature of steam at exit = 150 ^{0}C, Discharge from separating calorimeter = 0.5 kg/min, Condensate = 10 kg/min. Determine the dryness fraction of the sample steam.	**08**	(3 :4 : 1.7.1)
		(OR)		
8.	**a.**	Write Maxwell relations and explain the terms involved.	**06**	(2 :4 : 1.6.1)
	b.	Explain the concept of second law of efficiency.	**06**	(1 :4 : 1.6.1)
	c.	A heat engine working between 700 ^{0}C and 30 ^{0}C. The temperature of surrounding is 17 ^{0}C. Engine receives heat at the rate of 2×10^4 kJ/min and the measured output of engine is 0.13 MW. Determine (i) Availability (ii) Rate of Irreversibility (iii) Second law of efficiency of an engine.	**08**	(3 :4 : 1.7.1)

Module-5

9.	**a.**	Explain (i) Amagat's law of additive Volume (ii) Dalton's law of additive pressure (iii) DPT (iv) WBT (v) DBT	**10**	(1 :5 : 1.6.1)
	b.	A gas mixture contains 3 mole O_2, 5 mole of N_2 and 2 mole of CO_2. Determine (i) Mole fraction (ii) Mass fraction of each component (iii) Apparent molecular weight of mixture (iv) Apparent gas constant.	**10**	(3 :5 : 1.7.1)
		(OR)		
10	**a.**	Explain the reasons for deviation of wander walls equation from an ideal gas equation also write the equation and explain the terms.	**06**	(1 :5 : 1.6.1)
	b.	Write a note on (i) Compressibility factor (ii) Compressibility chart (iii) Law of corresponding states.	**06**	(1 :5 : 1.6.1)
	c.	Determine the specific volume of hydrogen gas when its pressure is 60 bar and temperature is 100 ^{0}K using (i) Compressibility chart (ii) Vander Waal's equation.	**08**	(3 :5 : 1.7.1)

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Note: (RBTL - Revised Bloom's Taxonomy Level: CO - Course Outcome: PI– Performance Indicator)