Third semester B.E. Degree Examinations, March/April 2024

Basic Thermodynamics (BME304)

Model Question paper.

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.

Module-1					
			M	**L**	**C**
Q.1	**a**	State and explain Zeroth law of Thermodynamics.	**4**	**L2**	**CO1**
	b	The resistance of a platinum wire is found to be 11 ohms at ice point, 15.247 ohms at steam point and 27.949 ohms at zinc point (419^0C). Find the constants in the equation $R = R_0 (1 + AT + BT^2)$, where T is in ^{0} C. Find the resistance at a temperature of 250^0 C.	**10**	**L3**	**CO1**
	c	Define Thermodynamic work and Compare Heat and Work	**6**	**L4**	**CO1**
OR					
Q.2	**a**	What is Thermometric property and explain Celsius temperature scale.	**6**	**L2**	**CO1**
	b	Derive an equation for work done during an Adiabatic process	**6**	**L3**	**CO1**
	c	One kg of certain fluid is contained in system at a pressureof 10 bar. The fluid is allowed to expand reversibly untill the volume becomes twice the initial volume according to the law PV^2=C. The fluid is then cooled reversibibly at constant pressure untill the piston regains its original position. Heat is then supplied with the piston firmly locked in position untill the pressure rises to the original value. Calculate the net work done by the fluid for an initial volume of $0.05m^3$.	**8**	**L3**	**CO1**
Module-2					
Q.3	**a**	Explain Briefly Joule's paddle wheel experiment	**6**	**L2**	**CO2**
	b	State and explain the first law of Thermodynamics for a closed system undergoing a cyclic process.	**4**	**L2**	**CO2**
	c	Air initially at 60 KPa pressure, 800K temperature and occupying a volume of 0.1 m^3 is compressed isothermally until the volume is halved(half) and after that, it goes further compression at constant pressure till the volume is halved again. Sketch the process on a P-V diagram and make calculations for total work done and total heat interaction for the processes. Assume ideal gas behavior. Take C_p = 1.005 kJ/kgK and R = 287 J/kgK	**10**	**L3**	**CO2**
OR					
Q.4	**a.**	Derive Steady Flow Energy Equation for an open system using First law of Thermodynamics	**10**	**L3**	**CO2**
	b.	A steam turbine receives steam with a flow rate of 900 kg/min and experiences a heat loss of 840 KJ/min. The exit pipe is 3	**10**	**L3**	**CO2**

		meters below the level of the inlet pipe. **Find** the power developed by the turbine if the pressure decreases from 62 bar to 9.86 Kpa, Velocity increases from 30.5 m/s to 274.3 m/s, internal energy decreases by 938.8 KJ/Kg and Specific Volume increases from 0.058 m^3/Kg to 13.36 m^3/Kg.			
		Module 3			
Q.5	**a**	Discuss the limitations of First law of thermodynamics	**4**	**L3**	**CO3**
	b.	State and explain Kelvin-Planck and Clausius statements of Second law of thermodynamics.	**8**	**L2**	**CO3**
	c	State and Prove Clausius inequality	**8**	**L3**	**CO3**
		OR			
Q.6	**a**	Define Entropy and Prove that it is a property of the system.	**10**	**L3**	**CO3**
	b	Represent the Carnot heat engine on a p-v diagram and **discus** all the processes derive an expression for the efficiency of the Carnot Cycle.	**10**	**L3**	**CO3**
		Module 4			
Q.7	**a.**	Explain the concept of Available energy and Unavailable energy.	**6**	**L2**	**CO4**
	b.	Air at $5x10^5$ N/m^2 and 500^0 C expands in a turbine to $1x10^5$ N/m^2 and 290^0C. During expansion 12 kJ/kg of heat is lost to the surroundings which is at $0.98x10^5$ N/m^2 and 20^0C. Neglecting changes in Kinetic Energy and Potential Energy, Determine per kg of air a) the decrease in availability, b) the max. work required and c) the irreversibility.	**10**	**L3**	**CO4**
	c	What is meant by pure substance? Explain with an example.	**4**	**L2**	**CO4**
		OR			
Q.8	**a.**	With a neat sketch explain P-T diagram for a pure substance.	**8**	**L2**	**CO4**
	b.	Steam enters an engine at a pressure of 10 bar and 400^0 C. It is exhausted at 0.2 bar. The steam at exhaust is 0.9 dry. Find, i) drop in enthalpy, ii) drop in entropy	**8**	**L3**	**CO4**
	c.	What do you understand by Dead state?	**4**	**L2**	**CO4**
		Module 5			
Q.9	**a**	Define the terms: i) Mass fraction, ii) Mole fraction, iii) Partial Pressure, iv) Volume fraction, v) Partial pressure ratio.	**10**	**L2**	**CO5**
	b	A mixture of gas contains 1 kg of CO_2 and 1.5 kg of N_2**.** The pressure and temperature of the mixture are 3.5 bar and 27ºC. Determine for the mixture: i) The mass fraction and mole fraction of each constituent gases, ii) molecular weight of the mixture, iii) the partial pressures, iv) Characteristic gas constant, v) volume fractions	**10**	**L3**	**CO5**
		OR			

Q. 10	**a**	Explain the following; 1) Maxwell's relations 2) Clausius-Clapeyron equation	**10**	**L2**	**CO5**
	b	State and explain Dalton's law of Partial pressure and Amagat's law of additive volumes.	**6**	**L2**	**CO5**
	c	Explain generalised Compressibility Chart	**4**	**L2**	**CO5**

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