Q. Code: 671853

Reg. No. | | | | | | | | | | | | | |

B.E. / B.TECH. DEGREE EXAMINATIONS, MAY 2024

Third Semester

ME22301 – ENGINEERING THERMODYNAMICS

(Mechanical Engineering)

(Regulation 2022)

(Use of Approved Steam Tables, Psychrometric chart and Data Book is permitted)

TIME: 3 HOURS **MAX. MARKS: 100**

COURSE OUTCOMES	STATEMENT	RBT LEVEL
CO 1	Students are able to analyze various Energy Transferring / transforming equipment using First law of thermodynamics.	**4**
CO 2	Students are able to analyze various Energy Transferring / transforming equipment using Second law of thermodynamics.	**4**
CO 3	Students are able to analyze the performance of steam power plant cycle with the help of steam table and charts.	**4**
CO 4	Students are able to obtain different thermodynamic relations and equations for ideal and real gases.	**3**
CO 5	Students will be able to analyze the various Psychrometric process and its applications and also able to analyze the properties of Gas mixtures.	**4**

PART- A (20 x 2 = 40 Marks)

(Answer all Questions)

		CO	RBT LEVEL
1.	State the law associated with thermal equilibrium of system.	**1**	**2**
2.	State the difference between path function and point function.	**1**	**2**
3.	What is PMM1? Why it is impossible?	**1**	**2**
4.	When a reversible polytropic process become a reversible adaiabatic process?	**1**	**3**
5.	What is the difference between a refrigerator and a heat pump?	**2**	**2**
6.	Define PMM of second kind. Why it is impossible?	**2**	**2**
7.	What are the processes involved in Carnot cycle?	**2**	**2**

8.	Entropy of universe never decrease. Justify	**2**	**2**	
9.	State the methods used for improving the performance of the Rankine cycle.	**3**	**2**	
10.	What do you mean by degree of superheat?	**3**	**2**	
11.	Define latent heat of vaporization.	**3**	**2**	
12.	One kg of water at 10bar has an enthalpy of 2500kJ. Find its quality.	**3**	**3**	
13.	Define equation of state. Write the same for an ideal gas.	**4**	**2**	
14.	Define Avogadro's law.	**4**	**2**	
15.	Define joule – Thompson coefficient.State its value for ideal gas.	**4**	**2**	
16.	Write the Maxwell's equations.	**4**	**2**	
17.	How does the wet bulb temperature differ from the dry bulb temperature?	**5**	**2**	
18.	Differentiate between relative and specific humidity.	**5**	**2**	
19.	In a psychometric chart, represent humidification and dehumidification process.	**5**	**2**	
20.	State Dalton's law of partial pressures.	**5**	**2**	

PART- B (5 x 10 = 50 Marks)

		Marks	CO	RBT LEVEL
21. (a)	One kg of air occupies 0.084m^3 at 12.5bar and 537°C. It is expanded at a constant temperature to a final volume of 0.336m^3. Calculate the pressure at the end of expansion, work done and heat absorbed .	**(10)**	**1**	**3**
	(OR)			
(b)	A nozzle is device for increasing the velocity of a steadily flowing stream. At	**(10)**	**1**	**3**

inlet to a certain nozzle, the enthalpy of the fluid passing is 3000kJ/kg and the velocity is 60m/sec. At the discharge end, the enthalpy is 2672kJ/kg. The nozzle is horizontal and there is negligible heat loss from it. (a) Find the velocity at exit from the nozzle. (b) If the inlet area is $0.1m^2$ and the specific volume at inlet is $0.178m^3/kg$, find the mass flow rate.

22. (a)	A reversible refrigerator is used to maintain a temperature of 0°C in a refrigerator when it rejects the heat to the surroundings at 25°C. If the heat removal rate from the refrigerator is 1440 kJ/min, determine the COP of the machine and work input required.	**(10)**	**2**	**3**
	(OR)			
(b)	State and prove Clausis inequality.	**(10)**	**2**	**3**
23. (a)	Steam at 30 bar, 400°C is expanded in a steam turbine to 0.1 bar. It then enters a condenser, where it is condensed to saturated liquid water. The pump feeds back the water into the boiler, assuming ideal process, find the network and cycle efficiency.	**(10)**	**3**	**3**
	(OR)			
(b)	A reheat cycle operating between 30bar to 0.04bar has a superheat and reheats temperature of 450°C. The first expansion takes place till the steam is dry saturated and then reheat is given. Neglecting feed pump work determines the ideal cycle efficiency.	**(10)**	**3**	**3**
24. (a)	**(i)** Derive the Clausis - Clayperon equation and discuss its significance	**(4)**	**4**	**3**
	(ii) Derive first and second Tds equations.	**(6)**	**4**	**3**
	(OR)			
(b)	The specific volume of R-134a at 60°C is $0.023m^3/kg$. Determine the pressure in bar by means of (i) Ideal gas equation (ii)) Compressibility chart.	**(10)**	**4**	**3**
25. (a)	**(i)** Atmospheric air at 1.0132 bar has DBT of 30°C and WBT of 25°C. Compute partial pressure of water vapour, specific humidity, relative humidity and the dew point temperature using formulas and equations.	**(5)**	**5**	**3**
	(ii) A gas mixture consists of 7 kg Nitrogen and 2kg Oxygen, at a 4 bar and 27°C. Calculate the mole fraction, partial pressures, equivalent	**(5)**	**5**	**3**

molecular weight and equivalent gas constant of the mixture.

(OR)

(b)	2kg of air at 30°C, 65% RH is mixed adiabatically with 5kg of air at 20°C, 10% RH. Determine final condition of the mixture.	**(10)**	**5**	**3**

PART- C (1 x 10 = 10 Marks)

(Q.No.26 is compulsory)

			Marks	CO	RBT LEVEL
26.	**(i)**	A reversible cycle consists of three processes. Assuming suitable heat interactions and associated temperatures for the processes of the cycle, prove Clausius theorem.	**(5)**	**2**	**4**
	(ii)	Is it possible to execute a Carnot cycle by eliminating any one of the isothermal process? Justify.	**(5)**	**1**	**4**

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