Q. Code:554779

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

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

Third Semester

ME18301 – ENGINEERING THERMODYNAMICS

(Mechanical Engineering)

(Regulation2018/ 2018A)

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

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

CO 1	Students are able to analyze various Energy Transferring / transforming equipment using First law of thermodynamics
CO 2	Students are able to analyze various Energy Transferring / transforming equipment using Second law of thermodynamics
CO 3	Students are able to analyze the performance of steam power plant cycle with the help of steam table and charts
CO 4	Students are able to obtain different thermodynamic relations and equations for ideal and real gases
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

PART- A (10 x 2 = 20 Marks)

(Answer all Questions)

		CO	RBT LEVEL
1.	State zeroth law of thermodynamics.	**1**	**1**
2.	How intensive property differ from extensive property?	**1**	**2**
3.	State Kelvin Planck statement of second law of thermodynamics.	**2**	**1**
4.	State Clausius theorem.	**2**	**1**
5.	State the effects of reheating of steam.	**3**	**2**
6.	Define dryness fraction. State its value for dry and superheated steam.	**3**	**2**
7.	What do you mean by Joule Thomson coefficient?	**4**	**1**
8.	What are the assumptions of ideal gas?	**4**	**1**

9.	Define relative humidity.	**5**	**1**
10.	State Daltons law of partial pressure.	**5**	**1**

PART- B (5 x 14 = 70 Marks)

			Marks	CO	RBT LEVEL
11. (a)	0.44 kg of air at 180 ºC expands adiabatically to three times its original volume and during the process there is a fall in temperature to 15 ºC . The work done during the process is 52.5 kJ. Calculate C_p and C_v		**(14)**	**1**	**3**
	(OR)				
(b)	Derive the steady flow energy equation and reduce it for a turbine and heat exchanger.		**(14)**	**1**	**3**
12. (a)	An irreversible heat engine with 60 % efficiency of the maximum possible is operating between 1500 K and 300 K. If it delivers 3kW of work, determine the heat extracted from the high temperature reservoir and heat rejected to low temperature reservoir.		**(14)**	**2**	**3**
	(OR)				
(b)	**(i)**	Derive Clausius inequality and mention the criteria for reversibility and irreversibility of a cycle.	**(8)**	**2**	**3**
	(ii)	Obtain an expression for change in entropy during an irreversible process.	**(6)**	**2**	**3**
13. (a)	A steam power plant operates on a simple ideal Rankine cycle between the pressure limits 3 MPa and 50kPa. The temperature of the steam at the turbine inlet is 300°C, and the mass flow rate of steam through the cycle is 35kg/s. Show the cycle on a T-S diagram with respect to saturation lines and determine the thermal efficiency of the cycle and the net power output of the power plant.		**(14)**	**3**	**3**
	(OR)				
(b)	In a steam power plant operating on an ideal reheat Rankine's cycle, the steam enters the high pressure turbine at 3Mpa and 400°C. After expansion to 0.6Mpa, the steam is reheated to 400°C and then expanded in the low		**(14)**	**3**	**3**

pressure turbine to the condenser pressure of 10kPa. Determine the thermal efficiency of the cycle and the quality of the steam at the outlet of low pressure turbine.

			Marks	CO	RBT LEVEL
14. (a)	**(i)**	Derive Maxwell relations.	**(6)**	**4**	**3**
	(ii)	Prove that $C_p - C_v = TV\beta^2 / k$	**(8)**	**4**	**3**
		(OR)			
(b)	**(i)**	How ideal gas differed from real gas? State the limitations of ideal gas.	**(6)**	**4**	**3**
	(ii)	Explain the physical significance of generalised compressibility chart. How it differ from compressibility chart?	**(8)**	**4**	**3**
15. (a)	**(i)**	A sling psychrometer reads 35°C DBT and 30°C WBT. Find the humidity ratio, relative humidity, dew point temperature, specific volume, and enthalpy of air.	**(8)**	**5**	**3**
	(ii)	A mixture of ideal gases consists of 3kg nitrogen and 5kg of CO_2 at a pressure of 3 bar and a temperature of 20°C. Find mole fraction of each constituent, the equivalent molecular weight of the mixture, the equivalent gas constant of the mixture and the partial pressures.	**(6)**	**5**	**3**
		(OR)			
(b)		Saturated air at 20°C at a rate of 70 m^3/min is mixed adiabatically with the outside air at 35°C and 50 % relative humidity at a rate 30 m^3/min. Assuming that the mixing process occurs at a pressure of 1 atm, determine the specific humidity, the relative humidity, the dry bulb temperature, and the volume flow rate of the mixture.	**(14)**	**5**	**3**

PART- C (1 x 10 = 10 Marks)

		Marks	CO	RBT LEVEL
16.	A refrigerator is used to maintain the temperature of a room at 2°C when the atmospheric temperature is at 40°C. Heat extracted by the refrigerator is 45 kW. Design a suitable power input to the refrigerator to make this refrigerator possible. Justify your design through second law of thermodynamics.	**(10)**	**2**	**4**

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