Q. Code: 488936

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

B.E. / B.TECH. DEGREE EXAMINATIONS, DEC 2019

Third Semester

ME18301 – Engineering Thermodynamics

(Mechanical Engineering)

(Regulation 2018)

Time: Three Hours **Maximum : 100 Marks**

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

Answer **ALL** questions

PART A - (10 X 2 = 20 Marks)

		CO	RBT
1.	In a power plant cycle whether the boiler and turbine have to be considered as open system or closed system? Justify.	1	AP
2.	Show that work transfer during a non flow process is a path function.	1	AP
3.	State claussius theorm.	2	R
4.	State the principle of entropy increase.	2	U
5.	Distinguish between sensible heat and latent heat.	3	U
6.	In a T-S diagram show that reheating will increase the dryness fraction at turbine exhaust.	3	AP
7.	State the condition for exact differential.	4	R
8.	State law of corresponding states.	4	R
9.	State Daltons law of partial pressure.	5	R
10.	Define dew point temperature.	5	R

PART B - (5 X16 = 80 Marks)

11.	(a)	1 Kg of air at a pressure of 1bar and 30 ^{o}C is heated at constant volume till the pressure is doubled. It is then expanded isothermally to the original pressure and then cooled to the initial condition at constant pressure. Show the process on P-V and T-S diagrams and calculate the work and heat interactions during the cycle.	**(16)**	1	AP

(OR)

	(b)	In a steady flow apparatus, 135kJ of work is done by each kg of fluid. The specific volume of the fluid, pressure, and velocity at the inlet are $0.37m^3/kg$, 600kPa, and 16m/s. The inlet is 32m above the floor, and the discharge pipe is at floor level. The discharge conditions are $0.62m^3/kg$, 100kPa, and 270m/s. The total heat loss between the inlet and discharge is 9kJ/kg of fluid. In flowing through this apparatus, does the specific internal energy increase, and by how much?	**(16)**	**1**	**AN**
12.	(a)	(i) One kg of water at 400 K is brought into contact with a heat reservoir at 523 K. When the water has reached 523 K, find the entropy change of water, of the reservoir, and of the universe.	**(8)**	**2**	**AP**
		(ii) Is it possible to execute a carnot cycle by eliminating any one of the isothermal process? Justify.	**(8)**	**2**	**AP**

(OR)

	(b)	A reversible heat engine operates between two reservoirs at temperatures of 600°C and 40°C. The engine drives a reversible refrigerator which operates between reservoirs at temperatures of 40°C and -20°C. The heat transfer to the engine is 2000 kJ and the net work output of the combined engine-refrigerator plant is 360 kJ. If the efficiency of the heat engine and the COP of the refrigerator are 40% of their maximum possible values, evaluate the heat transfer to the refrigerant and the net heat transfer to the reservoir at 40°C.	**(16)**	**2**	**AP**
13.	(a)	A steam power plant uses steam as working fluid and operates at a boiler pressure of 50 bar, dry saturated and a condenser pressure of 0.05 bar. Verify Carnot theorem for this steam power plant cycle.	**(16)**	**3**	**AP**

(OR)

	(b)	A steam power plant operates on a theoretical reheat cycle. Steam at boiler at 100 bar, 500°C expands through the high pressure turbine. It is reheated at a constant pressure of 30 bar to 500°C and expands through the low pressure turbine to a condenser at 0.1 bar. Find: (i) Quality of steam at turbine exhaust (ii) Cycle efficiency (iii) Steam rate in kg/kWh	**(16)**	**3**	**AP**

14.	(a)	(i)	Show that $$T\,ds = C_v\,dT + \frac{T\beta}{K}\,dV$$ $$\left(\frac{\partial U}{\partial V}\right)_T = \frac{T\beta}{K} - P$$	**(10)**	**4**	**U**
		(ii)	Show that Joule – Thomson coefficient for ideal gas is zero	**(6)**	**4**	**U**
			(OR)			
	(b)	(i)	Determine the specific volume in m^3/kg of CO_2 at 20 bar and 350 K by means of (i) ideal gas equation (ii) Compressibility chart.	**(10)**	**4**	**AP**
		(ii)	Define compressibility factor. What is its value for ideal gas and real gas?	**(6)**	**4**	**U**
15.	(a)	(i)	A gas mixture consists of 4 kg of ethane and 8 kg ethylene, at a 5 bar and 30°C. Calculate the mole fraction, partial pressures, equivalent molar mass and equivalent gas constant.	**(8)**	**5**	**AP**
		(ii)	Atmospheric air at 1.01232 bar has a DBT of 36°C and WBT of 30°C. Using formulae determine (i) partial pressure of water vapour (ii) specific humidity (iii) relative humidity (iv) dew point temperature (v) enthalpy.	**(8)**	**5**	**AP**
			(OR)			
	(b)		Two streams of moist air, one having flow rate of 3 kg/s at 30°C and 30% relative humidity, other having flow rate of 2 kg/s at 35°C and 80% relative humidity get mixed adiabatically. For the mixture, determine (i) DBT (ii) specific humidity and (iii) partial pressure of water vapour.	**(16)**	**5**	**AP**