Sub Code:KME301

Paper Id: 140321 Roll No: | | | | | | | | | | | | | |

B. TECH
(SEM-III) THEORY EXAMINATION 2019-20
THERMODYNAMICS

Time: 3 Hours ***Total Marks: 100***

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt *all* questions in brief. 2 x 10 = 20

Q no.	Question	Marks	CO
a.	What is critical point and Triple point?	2	4
b.	State two limitations of First law of Thermodynamics.	2	1
c.	Explain Carnot theorem.	2	2
d.	State the third law of thermodynamics.	2	2
e.	Distinguish between Helmholtz and Gibbs function	2	5
f.	What do you understand by 1 ton of refrigeration?	2	1
g.	What are the causes of irreversibility of a process?	2	4
h.	Draw P-T diagram of pure substance.	2	3
i.	What is the effect of decrease in evaporator pressure and superheating on refrigeration effect and C.O.P. of vapour compression refrigeration cycle?	2	3
j.	What is inversion curve?	2	5

SECTION B

2. Attempt any *three* of the following: 3 x 10 = 30

Q no.	Question	Marks	CO
a.	Derive steady flow energy equation (SFEE).Also write the steady flow energy equation for heat exchanger, nozzle, turbine, pump and boiler with suitable assumptions.	10	1
b.	Two Carnot engines A and B are connected in series between two thermal reservoirs maintained at 1000 K and 100 K respectively. Engine A receives 1680 kJ of heat from the high-temperature reservoir and rejects heat to the Carnot engine B. Engine B takes in heat rejected by engine A and rejects heat to the low-temperature reservoir. If engines A and B have equal thermal efficiencies, determine (a) The heat rejected by engine B (b) The temperature at which heat is rejected by engine, A (c) The work done during the process by engines, A and B respectively. If engines A and B deliver equal work, determine (d) The amount of heat taken in by engine B (e) The efficiencies of engines A and B	10	2
c.	Prove that: $C_p - C_v = -T\left(\frac{\partial V}{\partial T}\right)_p^2 \cdot \left(\frac{\partial p}{\partial V}\right)_T$	10	3
d.	Explain Simple Rankine Cycle with neat sketch, P-V and T-S diagram. If 5 kg of water at 45 degree Celsius is heated at a constant pressure of 10 bar until it becomes superheated vapour at 300 degree Celsius. Find the change in volume, enthalpy, internal energy and entropy.	10	4
e.	Explain the desirable properties required for an ideal Refrigerant. Name some commonly used refrigerants and also explain their properties	10	5

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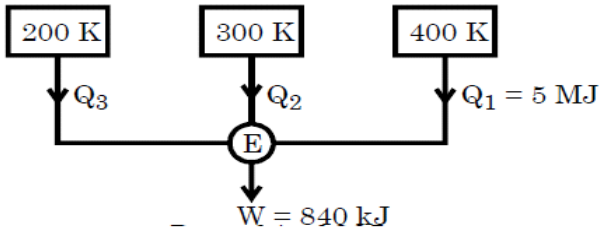
SECTION C

3. Attempt any *one* part of the following: 1 x 10 = 10

Q no.	Question	Marks	CO
a.	A gas undergoes a thermodynamic cycle consisting of three processes Beginning at an initial state where p_1 = 1 bar, V_1 = 1.5 m3 and U_1 = 512 kJ. The processes are as follows: (i) Process 1–2: Compression with pV = constant to p_2 = 2bar, U_2 = 690 kJ (ii) Process 2–3: W_{23} = 0, $Q23$ = –150 kJ, and (iii) Process 3–1: W_{31} = +50 kJ. Neglecting KE and PE changes, Determine the heat interactions Q_{12} and Q_{31}.	10	1
b.	A turbine operates under steady flow conditions, receiving steam at the following state: Pressure 1.2 MPa, temperature 188°C, enthalpy 2785 kJ/kg, velocity 33.3 m/s and elevation 3 m. The steam leaves the turbine at the following state: Pressure 20 kPa, enthalpy 2512 kJ/kg, velocity 100 m/s, and elevation 0 m. Heat is lost to the surroundings at the rate of 0.29 kJ/s. If the rate of steam flow through the turbine is 0.42 kg/s, what is the power output of the turbine in kW?	10	1

4. Attempt any *one* part of the following: 1 x 10 = 10

Q no.	Question	Marks	CO
a.	In a Carnot cycle, heat is supplied at 350°C and rejected at 27°C. The working fluid is water which, while receiving heat, evaporates from Liquid at 350°C to steam at 350°C. The associated entropy change is 1.44kJ/kg K. (a) If the cycle operates on a stationary mass of 1 kg of water, how much is the work done per cycle, and how much is the heat supplied? (b) If the cycle operates in steady flow with a power output of 20 kW, What is the steam flow rate? 	10	2
b.	Establish the equivalence of Kelvin Plank and Clausius Statement. Show that efficiency of a reversible heat engine operating between the same temperature limits is same.	10	2

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5. Attempt any *one* part of the following: 1 x 10 = 10

Q no.	Question	Marks	CO
a.	Discuss the Clapeyron equation and also explain the Joule-Kelvin effect with help of inversion curve and inversion temperature.	10	2
b.	Heat is supplied reversibly from a heat source to a reversible engine and during this process, the temperature of the working fluid increasesfrom 525Kto 875K.Taking water equivalent as 100kJ/Kand presuming that heat rejection during the cycle takes place at ambient temperature of 290K, determines the total heat abstracted, availability and the loss of available work.	10	2

6. Attempt any *one* part of the following: 1 x 10 = 10

Q no.	Question	Marks	CO
a.	A steam turbine working on a Rankine cycle is supplied with dry saturated steam at 25 barand the exhaust takes place at 0.2 bar. For a steam flow rate of 10kg/s, determine: i) Quality of steam at the end of expansion, ii) Turbine shaft work, iii) Power required to drive the pump, iv) Work ratio, v) Rankine efficiency, and vi) Heat flow in the condenser.	10	3
b.	Define and explain the following terms: i) Dry bulb temperature, wet bulb temperature and dew point temperature. ii) Relative humidity and specific humidity	10	3

7. Attempt any *one* part of the following: 1 x 10 = 10

Q no.	Question	Marks	CO
a.	Explain the vapour compression refrigeration cycle and find out its C.O.P. with the help of T-S, P-H, and flow diagram. Can this cycle be reversible? If not, why?	10	4
b.	The air supplied to an air-conditioned room is noted to be at temperature 20 degree Celsius and specific humidity 0.0085. Corresponding to these conditions, determine the partial pressure of vapour, relative humidity and dew point temperature. Take barometric or total pressure=1.0132 bar.	10	4