

Total No. of Questions – [4]

Total No. of Printed Pages – [2]

G.R. No.	
----------	--

Paper Code - U248-155 (T2)

OCTOBER 2018/ IN-SEM (T2)

S. Y. B. TECH. (MECHANICAL ENGINEERING) (SEMESTER - I)

COURSE NAME : THERMODYNAMICS

COURSE CODE : MEUA21175

(PATTERN 2017)

Time: [1 Hour]

[Max. Marks: 30]

(*) Instructions to candidates:

- 1) Answer Q. 1 OR Q. 2 and Q. 3 OR Q. 4
- 2) Figures to the right indicate full marks
- 3) Use of steam table, Mollier chart, scientific calculator is allowed
- 4) Use suitable data where ever required

- Q.1) a) A gas initially at 1.5 bar pressure, 0.15 m³ volume and 300 K was compressed polytropically ($pv^{1.25} = \text{constant}$) to 15 bar pressure. Determine the change in entropy and work done during the process. Take $c_p = 1.04 \text{ kJ/kg K}$, $c_v = 0.745 \text{ kJ/kg K}$. **6**
- b) Derive the expression for entropy change for isothermal process. **6**
- c) Define the terms available energy and unavailable energy **4**

OR

- Q.2) a) A rigid cylinder containing 0.005 m³ of nitrogen at 1 bar and 290 K is heated reversibly until the temperature becomes 360 K. Determine the heat supplied and entropy change. Assume nitrogen to be perfect gas. Take $\gamma = 1.4$ and $R = 296.93 \text{ J/kg K}$. **6**
- b) Represent following processes on T-s diagram: **6**
- i. isochoric ii. isobaric iii. isothermal

- c) Derive the expression for entropy change for reversible adiabatic process. 4

Q.3) a) A spherical shell of 30 cm in radius contains saturated steam and water at 300°C . Calculate the mass of each if their volumes are equal. 6

b) Define

- i. wet steam
- ii. Dry saturated steam
- iii. Superheated steam
- iv. Saturated liquid

4

- c) Explain the operation of a Rankine cycle with p-v and T-s diagram. 4

OR

Q.4) a) A tank contains 100 kg of liquid water and 5 kg of water vapour under saturation conditions at 20°C . If the specific volume of saturated vapour at that temperature is taken as $57.78\text{ m}^3/\text{kg}$, Calculate the volume of tank and moisture content of the mixture. 6

b) What is Superheated steam? List advantages of superheated steam if it is used in steam prime movers. 4

c) Derive the expression for Rankine cycle efficiency with the help of p - v & T - s diagram. 4

*****All The Best*****

Saturated water—Temperature

Temp., T °C	Sat. press., P _{sat} kPa	Specific volume, m ³ /kg		Internal energy, kJ/kg			Enthalpy, kJ/kg			Entropy, kJ/kg · K		
		Sat. liquid, v _f	Sat. vapor, v _g	Sat. liquid, u _f	Evap., u _{fg}	Sat. vapor, u _g	Sat. liquid, h _f	Evap., h _{fg}	Sat. vapor, h _g	Sat. liquid, s _f	Evap., s _{fg}	Sat. vapor, s _g
0.01	0.6117	0.001000	206.00	0.000	2374.9	2374.9	0.001	2500.9	2500.9	0.0000	9.1556	9.1556
5	0.8725	0.001000	147.03	21.019	2360.8	2381.8	21.020	2489.1	2510.1	0.0763	8.9487	9.0249
10	1.2281	0.001000	106.32	42.020	2346.6	2388.7	42.022	2477.2	2519.2	0.1511	8.7488	8.8999
15	1.7057	0.001001	77.885	62.980	2332.5	2395.5	62.982	2465.4	2528.3	0.2245	8.5559	8.7803
20	2.3392	0.001002	57.762	83.913	2318.4	2402.3	83.915	2453.5	2537.4	0.2965	8.3696	8.6661
280	6416.6	0.001333	0.030153	1228.2	1358.2	2586.4	1236.7	1543.2	2779.9	3.0681	2.7898	5.8579
285	6914.6	0.001349	0.027756	1253.7	1328.1	2581.8	1263.1	1510.7	2773.7	3.1144	2.7066	5.8210
290	7441.8	0.001366	0.025554	1279.7	1296.9	2576.5	1289.8	1476.9	2766.7	3.1608	2.6225	5.7834
295	7999.0	0.001384	0.023528	1306.0	1264.5	2570.5	1317.1	1441.6	2758.7	3.2076	2.5374	5.7450
300	8587.9	0.001404	0.021659	1332.7	1230.9	2563.6	1344.8	1404.8	2749.6	3.2548	2.4511	5.7059

Superheated water

v m ³ /kg	u kJ/kg	h kJ/kg	s kJ/kg · K	T °C	v m ³ /kg	u kJ/kg	h kJ/kg	s kJ/kg · K	
$P = 8.0 \text{ MPa (295.01 °C)}$					$P = 9.0 \text{ MPa (303.35 °C)}$				
Sat.	0.023525	2570.5	2758.7	5.7450	Sat.	0.020489	2558.5	2742.9	5.6791
300	0.024279	2592.3	2786.5	5.7937	325	0.023284	2647.6	2857.1	5.8738
350	0.029975	2748.3	2988.1	6.1321	350	0.025816	2725.0	2957.3	6.0380
400	0.034344	2864.6	3139.4	6.3658	400	0.029960	2849.2	3118.8	6.2876
450	0.038194	2967.8	3273.3	6.5579	450	0.033524	2956.3	3258.0	6.4872
500	0.041767	3065.4	3399.5	6.7266	500	0.036793	3056.3	3387.4	6.6603
550	0.045172	3160.5	3521.8	6.8800	550	0.039885	3153.0	3512.0	6.8164
600	0.048463	3254.7	3642.4	7.0221	600	0.042861	3248.4	3634.1	6.9605
700	0.054829	3443.6	3882.2	7.2822	650	0.045755	3343.4	3755.2	7.0954
800	0.061011	3635.7	4123.8	7.5185	700	0.048589	3438.8	3876.1	7.2229
900	0.067082	3832.7	4369.3	7.7372	800	0.054132	3632.0	4119.2	7.4606
1000	0.073079	4035.0	4619.6	7.9419	900	0.059562	3829.6	4365.7	7.6802
1100	0.079025	4242.8	4875.0	8.1350	1000	0.064919	4032.4	4616.7	7.8855
1200	0.084934	4456.1	5135.5	8.3181	1100	0.070224	4240.7	4872.7	8.0791
1300	0.090817	4674.5	5401.0	8.4925	1200	0.075492	4454.2	5133.6	8.2625
					1300	0.080733	4672.9	5399.5	8.4371