Course Code: 23ME0303 **R23**

SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY :: PUTTUR
(Autonomous)
Siddharth Nagar, Narayanavanam Road – 517583 QUESTION BANK (DESCRIPTIVE)

Subject with code: Thermodynamics (23ME0303) **Year & Sem: II B.Tech & I**
Branch: ME **Regulation:** R23

UNIT-I

1.	(a)	What is a System in thermodynamics?	**[L1][CO1]**	**[2M]**
	(b)	What do you mean by Boundary?	**[L1][CO1]**	**[2M]**
	(c)	Define the term Surroundings.	**[L1][CO1]**	**[2M]**
	(d)	Define Universe.	**[L1][CO1]**	**[2M]**
	(e)	What do you mean by control volume?	**[L1][CO1]**	**[2M]**
2.	(a)	What is meant by thermodynamic equilibrium? Explain in brief.	**[L1][CO1]**	**[5M]**
	(b)	Differentiate between Macroscopic and Microscopic view points.	**[L2][CO1]**	**[5M]**
3.	(a)	Explain the concept of continuum in brief.	**[L2][CO1]**	**[5M]**
	(b)	Compare closed system with an open system.	**[L2][CO1]**	**[5M]**
4.	(a)	Distinguish between intensive and extensive property.	**[L2][CO1]**	**[5M]**
	(b)	Determine the work done by the air which enters into an evacuated vessel from atmosphere when the valve is opened. The atmospheric pressure is 1.013 bar and 1.5 m3 of air at atmospheric condition enters into the vessel.	**[L3][CO1]**	**[5M]**
5.		Explain the types of system with neat sketches.	**[L2][CO1]**	**[10M]**
6.	(a)	Convert the following readings of pressure to kPa assuming that barometer reads 760 mm of Hg. (i) 80 cm of Hg (ii) 30 cm Hg vacuum(iii) 1.35 m H_2O gauge(iv) 4.2 bar.	**[L2][CO1]**	**[5M]**
	(b)	On a piston of 10 cm diameter a force of 1000 N is uniformly applied. Find the pressure on the piston.	**[L3][CO1]**	**[5M]**
7.	(a)	Write short notes on following terms in detail: a)State b) Process c) Property d) Cycle	**[L1][CO1]**	**[10M]**
8.	(b)	Comment whether the following quantities can be called as properties or not (i) pdV , (ii) Vdp ,and (iii) pdV + Vdp	**[L4][CO1]**	**[5M]**
	(a)	A vacuum recorded in the condenser of a steam power plant is 740 mm of Hg. Find the absolute pressure in the condenser in Pa. The barometric reading is 760 mm of Hg.	**[L2][CO1]**	**[5M]**
9.		What is quasi static process? Explain in detail?	**[L1][CO1]**	**[10M]**
10.	(a)	Explain reversible process with an example.	**[L2][CO1]**	**[5M]**
	(b)	With an example explain irreversible process.	**[L2][CO1]**	**[5M]**
11.	(a)	Differentiate between reversible and irreversible process with examples.	**[L2][CO1]**	**[5M]**
	(b)	What are the causes for irreversibility?	**[L1][CO1]**	**[5M]**

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UNIT-II

<table>
<tr><td rowspan="5">1.</td><td>a)</td><td>Define the term work.</td><td>[L1][CO2]</td><td>[2M]</td></tr>
<tr><td>b)</td><td>Enumerate the term heat.</td><td>[L1][CO2]</td><td>[2M]</td></tr>
<tr><td>c)</td><td>What do you mean by Thermal reservoir?</td><td>[L1][CO2]</td><td>[2M]</td></tr>
<tr><td>d)</td><td>Define Enthalpy.</td><td>[L1][CO2]</td><td>[2M]</td></tr>
<tr><td>e)</td><td>State PMM-1.</td><td>[L1][CO2]</td><td>[2M]</td></tr>
<tr><td>2.</td><td></td><td>Explain about Work and Heat transfer. And classify the work transfers.</td><td>[L2][CO2]</td><td>[10M]</td></tr>
<tr><td rowspan="2">3.</td><td>(a)</td><td>Compare work transfer and heat transfer with neat sketches</td><td>[L2][CO2]</td><td>[5M]</td></tr>
<tr><td>(b)</td><td>Show that work is a path function and not a property.</td><td>[L1][CO2]</td><td>[5M]</td></tr>
<tr><td rowspan="2">4.</td><td>(a)</td><td>What do you understand by path function and point function?</td><td>[L1][CO2]</td><td>[5M]</td></tr>
<tr><td>(b)</td><td>Explain zeroth law of thermodynamics with neat sketch.</td><td>[L2][CO2]</td><td>[5M]</td></tr>
<tr><td>5.</td><td></td><td>Explain Joule’s experiment with neat sketch.</td><td>[L2][CO2]</td><td>[10M]</td></tr>
<tr><td rowspan="2">6.</td><td>(a)</td><td>Differentiate between heat engine and heat pump.</td><td>[L2][CO2]</td><td>[5M]</td></tr>
<tr><td>(b)</td><td>What are the limitations of the First law of Thermodynamics?</td><td>[L1][CO2]</td><td>[5M]</td></tr>
<tr><td>7.</td><td></td><td>A piston and cylinder machine contain a fluid system which passes through a complete cycle of four processes. During a cycle the sum of all heat transfer is -170 KJ. Complete the following table showing the method for each item, and computes the net rate of work output in kW.
<table>
<tr><th>Process</th><th>Heat transfer in KJ/min</th><th>Work done in KJ/min</th><th>Change in internal energy KJ/min</th></tr>
<tr><td>a-b</td><td>0</td><td>2170</td><td>-</td></tr>
<tr><td>b-c</td><td>21,000</td><td>0</td><td>-</td></tr>
<tr><td>c-d</td><td>-2,100</td><td>-</td><td>-36,600</td></tr>
<tr><td>d-a</td><td>-</td><td>-</td><td>-</td></tr>
</table></td><td>[L3][CO2]</td><td>[10M]</td></tr>
<tr><td rowspan="2">8.</td><td>a)</td><td>An Iron casting of mass 10Kg has an original temperature of 200^0C. It is cooled to 50^0 C. Find the direction and magnitude of heat transfer. Assume Specific Heat of iron as 0.477KJ/Kg K.</td><td>[L3][CO2]</td><td>[5M]</td></tr>
<tr><td>b)</td><td>In an air motor cylinder the compressed air has an internal energy of 450 kJ/kg at the beginning of the expansion and an internal energy of 220 kJ/kg after expansion. If the work done by the air during the expansion is 120 kJ/kg, calculate the heat flow to and from the cylinder.</td><td>[L4][CO2]</td><td>[5M]</td></tr>
<tr><td>9</td><td></td><td>State First law of thermodynamics and its applications in brief.</td><td>[L1][CO2]</td><td>[10M]</td></tr>
<tr><td rowspan="2">10</td><td>a)</td><td>One kg of Air is heated from 20^0C to 105^0 C. Find the change of internal energy and change of enthalpy. Assume C_P=1.01 KJ/KgK and C_v=0.72 KJ/KgK.</td><td>[L3][CO2]</td><td>[5M]</td></tr>
<tr><td>b)</td><td>In an internal combustion engine, during the compression stroke the heat rejected to the cooling water is 50 kJ/kg and the work input is 100 kJ/kg. Calculate the change in internal energy of the working fluid stating whether it is a gain or loss.</td><td>[L4][CO2]</td><td>[5M]</td></tr>
<tr><td rowspan="2">11</td><td>a)</td><td>The properties of a closed system change following the relation between pressure and volume as pV = 3.0 where p is in bar V is in m^3. Calculate the work done when the pressure increases from 1.5 bar to 7.5 bar.</td><td>[L4][CO2]</td><td>[5M]</td></tr>
<tr><td>b)</td><td>To a closed system 150 kJ of work is supplied. If the initial volume is 0.6 m^3 and pressure of the system changes as p = 8 – 4V, where p is in bar and V is in m^3,determine the final volume and pressure of the system.</td><td>[L2][CO2]</td><td>[5M]</td></tr>
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UNIT-III

1.	a)	State second law of thermodynamics.	**[L1][CO3]**	**[2M]**
	b)	State third law of thermodynamics.	**[L1][CO3]**	**[2M]**
	c)	Define the term Entropy.	**[L1][CO3]**	**[2M]**
	d)	What is PMM-II?	**[L1][CO3]**	**[2M]**
	e)	What do you mean by availability?	**[L1][CO3]**	**[2M]**
2.		Explain Clausius inequality in detail.	**[L2][CO3]**	**[10M]**
3.		An iron cube at a temperature of 400^{o}c is dropped into an insulated bath containing 10 kg water at 25^{0}c. The water finally reaches a temperature of 50^{0}c at steadystate.Given that the specific heat of water is equal to 4186 J/kgK. Find the entropy changes for the iron cube and water.	**[L3][CO3]**	**[10M]**
4.	a)	Define Statements of second law of thermodynamics i) Clausius statement. ii) Kelvin-plank statement.	**[L1][CO3]**	**[5M]**
	b)	Explain the principle of entropy in brief.	**[L2][CO3]**	**[5M]**
5.		Develop an expression for Carnot Cycle and efficiency of cycle.	**[L3][CO3]**	**[10M]**
6.	a)	Describe availability and unavailability.	**[L2][CO3]**	**[5M]**
	b)	Two Carnot engines work in series between the source and sink temperatures of 550 K and 350 K. If both engines develop equal power determine the intermediate temperature	**[L3][CO3]**	**[5M]**
7.		A carnot engine working between 400^{0} C and 40^{0} C produce 130 KJ of work. Determine i) The thermal efficiency. ii) the heat added iii) The entropy changes during the heat rejection process.	**[L3][CO4]**	**[10M]**
8.		An ice plant working on a reversed Carnot cycle heat pump produces 15 tonnes of ice per day. The ice is formed from water at 0°C and the formed ice is maintained at0°C. The heat is rejected to the atmosphere at 25°C. The heat pump used to run the ice plant is coupled to a Carnot engine which absorbs heat from a source which is maintained at 220°C by burning liquid fuel of 44500 kJ/kg calorific value and rejects the heat to the atmosphere. Determine : (i) Power developed by the engine. (ii) Fuel consumed per hour. Take enthalpy of fusion of ice = 334.5 kJ/kg.	**[L3][CO4]**	**[10M]**
9.	a)	Derive an equation for Gibbs and Helmholtz functions.	**[L3][CO4]**	**[5M]**
	b)	Derive the Maxwell relations.	**[L3][CO4]**	**[5M]**
10.		5 kg of air at 550 K and 4 bar is enclosed in a closed system. (i) Determine the availability of the system if the surrounding pressure and temperature are 1 bar and 290 K respectively. (ii) If the air is cooled at constant pressure to the atmospheric temperature determine the availability.	**[L3][CO4]**	**[10M]**
11.		0.04 m^3 of nitrogen contained in a cylinder behind a piston is initially at1.05 bar and 15°C. The gas is compressed isotherm ally and reversibly until the pressure is 4.8 bar. Calculate : (i) The change of entropy, (ii) The heat flow, and (iii) The work done. Sketch the process on a p-v and T-s diagram. Assume nitrogen to act as a perfect gas. Molecular weight of nitrogen = 28.	**[L3][CO4]**	**[10M]**

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UNIT-IV

1.	a)	Define the term pure substance.	**[L1][CO4]**	**[2M]**
	b)	What do you mean by triple point?	**[L1][CO4]**	**[2M]**
	c)	Define dryness fraction.	**[L1][CO4]**	**[2M]**
	d)	Explain about steam Calorimeter in brief.	**[L2][CO4]**	**[2M]**
	e)	What is a Mollier chart?	**[L1][CO4]**	**[2M]**
2.	Build the phase equilibrium diagram for a pure substance P-V , P-T T-S plot with relevant constant property line.		**[L3][CO4]**	**[10M]**
3.	A certain gas has c_p = 1.968 kJ/kg K, and c_v = 1.507 kJ/kg K. Find its molecular weight and gas constant. A constant volume chamber of 0.3m^3 capacity contains 2kg of this gas at 5^0C. Heat is transferred to the gas until the temperature is 100^0C. Find the work done, heat transferred and the changes in internal energy, enthalpy and entropy.		**[L3][CO4]**	**[10M]**
4.	An insulated cylinder of volume capacity 4 m^3 contains 20 kg of nitrogen. Paddle work is done on the gas by stirring it till the pressure in the vessel gets increased from 4 bar to 8 bar. Determine : (i) Change in internal energy, (ii) Work done, (iii) Heat transferred, and (iv) Change in entropy. Take for nitrogen : C_p = 1.04 kJ/kg K, and C_v = 0.7432 kJ/kg K.		**[L3][CO4]**	**[10M]**
5.	Derive the Clausius-Clapeyron equation with neat sketch.		**[L3][CO4]**	**[10M]**
6.	a)	Calculate the dryness fraction (quality) of steam which has 1.5 kg of water in suspension with 50 kg of steam.	**[L3][CO4]**	**[5M]**
	b)	Find the specific volume, enthalpy and internal energy of wet steam at 18 bar, dryness fraction 0.85	**[L3][CO4]**	**[5M]**
7.	A vessel having a volume of 0.6 m^3 contains 3.0 kg of liquid water and water vapour mixture in equilibrium at a pressure of 0.5 M Pa. Calculate : (i) Mass and volume of liquid ; (ii) Mass and volume of vapour		**[L3][CO5]**	**[10M]**
8.	A vessel having a capacity of 0.05 m^3 contains a mixture of saturated water and saturated steam at a temperature of 245°C. The mass of the liquid present is 10 kg. Find the following : (i) The pressure, (ii) The mass, (iii) The specific volume, (iv) The specific enthalpy, (v) The specific entropy.		**[L3][CO5]**	**[10M]**
9.	Determine the amount of heat, which should be supplied to 2 kg of water at 25°C to convert it into steam at 5 bar and 0.9 dry.		**[L3][CO5]**	**[10M]**
10.	Steam enters an engine at a pressure 10 bar absolute and 400°C. It is exhausted at 0.2 bar. The steam at exhaust is 0.9 dry. Find : (i) Drop in enthalpy ;(ii) Change in entropy.		**[L3][CO5]**	**[10M]**
11.	A piston-cylinder contains 3 kg of wet steam at 1.4 bar. The initial volume is 2.25 m3. The steam is heated until its temperature reaches 400°C . The piston is free to move up or down unless it reaches the stops at the top. When the piston is up against the stops the cylinder volume is 4.65 m^3. Determine the amount of work and heat transfer to or from steam.		**[L3][CO5]**	**[10M]**

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UNIT-V

1.	a)	What is meant by refrigeration?	**[L1][CO5]**	**[2M]**
	b)	What do you mean by air conditioning?	**[L1][CO5]**	**[2M]**
	c)	Define COP.	**[L1][CO5]**	**[2M]**
	d)	Define the term refrigerant.	**[L1][CO5]**	**[2M]**
	e)	Explain the term psychometry in brief.	**[L2][CO5]**	**[2M]**
2.	Derive an expression for C.O.P. for an air refrigeration system working on reversed Brayton cycle.		**[L3][CO5]**	**[10M]**
3.	Describe a simple vapour compression cycle with the help of p-h and t-s diagram.		**[L2][CO5]**	**[10M]**
4.	State the functions of the following parts of a simple vapour compression system : (*i*) Compressor(*ii*) Condenser(*iii*) Expansion valve and (*iv*) Evaporator.		**[L1][CO5]**	**[10M]**
5.	A refrigerating system operates on the reversed Carnot cycle. The higher temperature of the refrigerant in the system is 35°C and the lower temperature is – 15°C. The capacity is to be 12 tonnes. Neglect all losses. Determine : (i) Co-efficient of performance. (ii) Heat rejected from the system per hour.(iii) Power required		**[L3][CO5]**	**[10M]**
6.	Explain the psychometric properties in brief.		**[L2][CO5]**	**[10M]**
7.	Describe any five psychometric processes with neat sketches.		**[L2][CO6]**	**[10M]**
8.	a)	State the requirements of human comfort in brief.	**[L1][CO6]**	**[5M]**
	b)	Define the following terms: a)sensible heat load b) latent heat load	**[L1][CO6]**	**[5M]**
9.	200 m^3 of air per minute at 15ºC DBT and 75% R.H. is heated until its temperature is 25ºC. Find : (i) R.H. of heated air. (ii) Wet bulb temperature of heated air. (iii) Heat added to air per minute.		**[L3][CO6]**	**[10M]**
10.	Explain the desirable properties of refrigerant in detail.		**[L2][CO5]**	**[10M]**
11.	a)	Explain the types of refrigerant in brief with examples.	**[L2][CO5]**	**[5M]**
	b)	What are the factors that effect human comfort?	**[L1][CO6]**	**[5M]**