SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY :: PUTTUR
(AUTONOMOUS)
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QUESTION BANK

Subject with Code : Advanced thermodynamics (16ME8801) **Course & Specialization**: M.Tech – Th. Engg

Year & Sem: I & I-Sem **Regulation:** R16

UNIT-I

1.	(a)	Show that heat transfer through finite temperature difference is irreversible.	(5M)
	(b)	Two Carnot engines work in series between the sources and sink temperature limit of 600°K and 350°K. If both engines develop equal power determine the intermediate temperature.	(5M)
2.		Derive the Maxwell relation.	(10M)
3.		Explain the mathematical theorems for thermodynamics.	
4.		Air expands through a turbine from 500kPa, 520°C, 100kPa, 300°C . During expansion 10kJ/ kg of heat is loss to the surroundings where is at 98kPa and 20°C. Neglecting the kinetic energy and potential energy changes determine per kg of air.	
		(a)Decrease in availability	(3M)
		(b) Maximum work	(4M)
		(c)Irreversibility	(3M)
5.		Calculate the decrease in available energy when 25kg of water at 95°C mix with 35kg of water at 45°C. The pressure being taken as constant and temperature of the surroundings being 15°C. (Assume Cpw as 4.2)	(10M)
6.	(a)	Prove that $C_p - C_v = -T\left(\frac{\partial v}{\partial T}\right)_p^2 \left(\frac{\partial p}{\partial V}\right)_T$	(5M)
	(b)	Derive an internal energy equation.	(5M)
7.	(a)	Water flows through turbine in which friction causes the water temperature to rise from 35°C to 37°C.If there is no heat transfer, how much does the entropy of the water change in passing through the turbine? (Water is incompressible and the process can be taken to be a constant volume)	(5M)
	(b)	What are the different laws of thermodynamics? Explain them along with properties developed based on these laws.	(5M)
8.	(a)	Calculate the exergy 40kg of water at 75° C with respect to the surroundings at 5° C.The pressure of water be at 1 atm .Also calculate the unavailable energy.	(4M)
	(b)	Discuss about transient flow.	(6M)
9.		Derive the Clapeyron equation. for enthalpy change.	(10M)
10.		Discuss the throttling process and Joule Thomson porous plug experiment.	(10M)

UNIT-II

1.	(a)	Discuss about Avogadro's Law.	(5M)
	(b)	Explain Dalton's law of partial pressure.	(5M)
2.		State and explain Gibbs function of a mixture of inert ideal gases.	(10M)
3.	(a)	The tyre of an automobile contains the certain volume of air. Gauge pressure of 2bar at 20°C. The barometer reads 75cm.The temperature of air in the tyre rises to 80°C due to the running of the automobile for 2hrs. Find the new pressure of the tyre. Assume the air is an ideal gas and tyre does not stretch due to heating.	(7M)
	(b)	Define compressibility factor.	(3M)
4.	(a)	Explain fugacity and activity.	(5M)
	(b)	Discuss about Gibbs phase rule.	(5M)
5.	(a)	Explain Vander Wall's equation of state for real gas.	(5M)
	(b)	Find the gas constant and the molecular of the gas whose specific heats are given by C_p= 1.967 kJ/ kg°K, C_v= 1.507 kJ /kg°K.	(5M)
6.		Derive the equations for the following. Specific heat, Internal energy and enthalpy of ideal gas.	(10M)
7.	(a)	Give the equation for computing the entropy change between any two states of an ideal gas.	(5M)
	(b)	Give the relations among p, v and T in a reversible adiabatic process for an ideal gas.	(5M)
8.		A fluid at 200kPa and 300°C has a volume of 0.8m^3. In a frictionless process at constant volume the pressure changes to 100kPa. Find the final temperature and the heat transferred (a) if fluid is air (b) if the fluid is steam.	(10M)
9.	(a)	Show that for an ideal gas, the slope of the constant volume line on the diagram is more than that of the constant pressure line.	(5M)
	(b)	The gas neon has a molecular weight of 20.183and its critical temperature, pressure and volume are 44.5 K, 2.73 MPa and 0.0416 m^3 / kg mol. From compressibility chart Pr=2 and Tr =1.3and Z =0.7. What are the corresponding specific volume, pressure, temperature and reduced volume?	(5M)
10.		For the Berthelot Equation of state $P = \frac{RT}{v-b} - \frac{a}{Tv^2}$ Show that	
		(a) $\lim_{\substack{P\to 0 \\ T\to \infty}} (RT - pv) = 0$	(4M)
		(b) $\lim_{T\to \infty} \frac{v}{T} = \frac{R}{p}$	(3M)
		(c) Boyle temperature, $T_B = \sqrt{\frac{a}{bR}}$	(4M)

UNIT-III

1.	(a)	Explain the combustion of fuels.	(5M)
	(b)	What are combustion reactions?	(5M)
2.		Discuss the following.	
		(i) Enthalpy of formation.	(5M)
		(ii) Entropy of formation.	(5M)
3.	(a)	Discuss adiabatic flame Temperature.	(5M)
	(b)	Calculate ΔU_o in kJ/ kg for the combustion of benzene vapour at 25℃ given that ΔH_o =-3169100 kJ / mole and the H_2O is in vapour phase.	(5M)
4.		Discuss about heat of reaction and standard heat of reaction.	(10M)
5.		Derive the Van Hoff's equation.	(10M)
6.	(a)	Explain the Helmholtz free energy.	(5M)
	(b)	Write short note on (i) Heat of formation (ii) Heat of combustion	(5M)
7.	(a)	The chemical formula for alcohol is C_2H_6O. Calculate the stoichiometric air fuel ratio by mass and the % composition of the products of combustion per kg of C_2H_6O.	(6M)
	(b)	Explain chemical potential and phase equilibrium.	(4M)
8.		The products of combustion of an unknown hydrocarbon C_x H_y have the following composition as measured by an Orsat apparatus. $CO_2$8.0%, CO 0.9%, O_2n8.8% and N_2 82.2%. Determine:	
		(a) the composition of the fuel	(5M)
		(b) the air- fuel ratio, and	(3M)
		(c) the percentage excess air used.	(2M)
9.	(a)	What you understand about chemical equilibrium	(4M)
	(b)	Calculate ΔH_o in kJ/ kg for the combustion of benzene(C_6H_6) vapour at 25°C given that ΔH_o =-3169100 kJ / mole and the H_2O is in vapour phase.	(6M)
10.		An IC engine burns liquid octane and uses 160% theoretical air. The air and fuel at 25°C and the products leave the engine exhaust ports at 900 °K. In the engine 80% of the carbon burns to CO_2 and the remainder burns to CO. The heat transfer from this engine is just equal to the work done by the engine. Determine:	
		(i) The power output of the engine if the engine burns 0.006 kg/sec of fuel	(5M)
		(ii) The composition and the dew point of the product of combustion.	(5M)

UNIT-IV

1.	(a)	What are phenomenological laws? What do they describe?	(5M)
	(b)	Define generalized forces and fluxes.	(5M)
2.		Explain about heat flux and entropy production.	(10M)
3.		Drive Onsagar reciprocity relation.	(10M)
4.		With neat sketch explain working principle of thermoelectric energy.	(10M)
5.		What is the basic concept of thermoelectric circuits?	(10M)
6.		Discuss about thermodynamic phenomenon.	(10M)
7.		Explain the applicability of the phenomenological relations.	(10M)
8.		What are the causes of irreversibility?	(10M)
9.		Give the types of irreversibility in thermodynamics.	(10M)
10.		Acyclic heat engine operates between a source temperature of 800°C and a sink temperature of 30°C. What is the least rate of heat rejection per kW net output of the engine?	(10M)

UNIT-V

1.		Write short note on:	
		(i) Seeback effect	(4M)
		(ii) Joule effect	(3M)
		(iii)Peltier Effect	(3M)
2.	(a)	What are the direct energy conversion systems for power generation? Explain solar cell.	(5M)
	(b)	Discuss about the Thermo ionic converter.	(5M)
3.		With the help of neat sketch explain magneto hydrodynamic generator	(10M)
4.		Explain Hydrogen-Oxygen fuel cell with neat diagram.	(10M)
5.	(a)	Discuss fuel cells.	(5M)
	(b)	Discuss photovoltaic cells	(5M)
6.		Write short note on	
		(a)Oxidation hydro carbon fuel cell	(4M)
		(b)Indirect oxidation fuel cell	(6M)
7.	(a)	Discuss about Alkaline fuel cell.	(5M)
	(b)	With neat sketch explain proton exchange membrane fuel cell.	(5M)
8.		What is hydrogen generator? How implementation of hydrogen as fuel? How it is stored?	(10M)
9.	(a)	What is DBFC? Explain with neat sketch.	(6M)
	(b)	What is joule Thomson effect?	(4M)
10.		Discuss about chemical hydrogen generator	(10M)

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