Exam. Code: 0940
Sub. Code: 33855

2015
B.E. (Mechanical Engineering)
Fourth Semester
MEC-401: Engineering Thermodynamics

Time allowed: 3 Hours **Max. Marks: 50**

NOTE: ***Attempt <u>five</u> questions in all, including Question No. I which is compulsory and selecting two questions from each Part. Use of property, steam and gas tables is permitted.***

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		Write briefly:	
I.	a	Is it possible for the entropy change of a closed system to be zero during an irreversible process. Explain.	(2x5)
	b	Define the term exergy. How does the exergy of a system different in different environments.	
	c	List the four processes of the Otto cycle.	
	d	State the Kay's rule for real-gas mixture.	
	e	State the Gibbs phase rule.	
		PART-A	
II.	a	Air at 27°C and 100 kPa is contained in a piston– cylinder device. When the air is compressed adiabatically, a minimum work input of 1000 kJ will increase the pressure to 600 kPa. Assuming air has constant specific heats evaluated at 300 K, determine the mass of air in the device. Take the properties of air at 300 K : Cv = 0.718 kJ/kg·K and k = 1.4.	(7)
	b	How is the entropy change of a reversible process estimated. Will it be different for an irreversible process between the same end states.	(3)
III.	a	A mass of 8 kg of helium undergoes a process from an initial state of 3 m^3/kg and 15°C to a final state of 0.5 m^3/kg and 80°C. Assuming the surroundings to be at 25°C and 100 kPa, determine the increase in the useful work potential of the helium during this process. Take the gas constant of helium is R = 2.0769 kJ/kg-K and the constant volume specific heat of helium is Cv = 3.1156 kJ/kg-K.	(7)
	b	What is the second-law efficiency. How does it differ from the first-law efficiency.	(3)
IV.	a	Show that the efficiency of the Brayton cycle depends only on the pressure ratio.	(3)

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	b	An ideal diesel engine has a compression ratio of 20 and uses air as the working fluid. The state of air at the beginning of the compression process is 95 kPa and 20°C. If the maximum temperature in the cycle is not to exceed 2200 K, determine the thermal efficiency of the cycle. Assume constant specific heats for air at room temperature.	**(7)**
		PART-B	
V.	a	A gas mixture has the following composition on a mole basis: 60 percent N_2 and 40 percent CO_2. Determine the gravimetric analysis of the mixture, its molar mass, and the gas constant.	**(6)**
	b	Express Dalton's law of additive pressures. Does this law hold exactly for ideal-gas mixtures. How about non ideal-gas mixtures.	**(4)**
VI.		Derive the expression for the equilibrium constant Kp of a chemical reaction in terms of the partial pressure of various components.	**(5)**
		A mixture of 2 kmol of CO and 3 kmol of O_2 is heated to 2600 K at a pressure of 304 kPa. Determine the equilibrium composition, assuming the mixture consists of CO_2, CO, and O_2.	**(5)**
VII.		Write short notes on any two of the following: (a) Entropy Generation (b) Working of a Tubo Prop Engine (c) Second law efficiency and its significance.	**(5,5)**

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