Total No. of Questions: 6 *Total No. of Printed Pages:3*

Enrollment No.....

Faculty of Engineering

End Sem (Odd) Examination Dec-2019

AU3CO04/FT3CO04/ME3CO04

Engineering Thermodynamics

Programme: B.Tech. Branch/Specialisation: AU/FT/ME

Duration: 3 Hrs. **Maximum Marks: 60**

Note: 1. All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d.
2. Use of Steam table is permitted.

Q.1 i. A system gains 12 kJ heat during a process while 6 kJ of work is done on it. The change in the energy of the system will be: **1**
(a) 6 kJ (b) -6 kJ (c) 18 kJ (d) -18 kJ

ii. During a quasi-equilibrium process: **1**
(a) Work output of an I.C. is maximum
(b) Work input to a compressor is minimum
(c) Work output of an I.C. engine is minimum
(d) Both (a) and (b) are correct.

iii. Heat transfer through finite temperature difference is: **1**
(a) Reversible (b) Irreversible
(c) Undefined (d) None of these

iv. In the absence of any friction and other irreversibilities and using only quasi- equilibrium expansion a heat engine can have efficiency: **1**
(a) 100% (b) Less than 100%
(c) Not defined (d) Infinity

v. At critical point $v_g - v_f$ is equal to: **1**
(a) Infinity (b) One (c) Zero (d) Unpredictable

vi. The temperature of a substance at which the vapour pressure is equal to 760 mm Hg is called as: **1**
(a) Normal vapour point (b) Normal boiling point
(c) Normal pressure point (d) None of these

vii. Brayton cycle efficiency for the same compression ratio is: **1**
(a) Greater than Otto cycle (b) Less than Otto cycle
(c) Equal to Otto cycle (d) Can't be related to Otto cycle

P.T.O.

viii. The compression ratio for diesel engines is: **1**
(a) 3 to 6 (b) 5 to 8 (c) 15-20 (d) 20 to 30

ix. Mixing of two or more gases to form a homogenous mixture is a: **1**
(a) Reversible process
(b) Irreversible process
(c) Reversible under controlled condition
(d) Not defined

x. Volume occupied by the single gas of a mixture at the same Temperature & pressure of the mixture is: **1**
(a) Partial volume
(b) Absolute volume
(c) Total volume of the mixture
(d) None of these

Q.2 i. Energy is a conserved property. Explain with suitable example. Also explain why work is called a high-grade energy and heat as a low-grade energy. **3**

ii. The lighting needs of a classroom are met by 30 fluorescent lamps, each consuming 80 W of electricity. The lights in the classroom are kept on for 12 hours and 250 days a year. For a unit electricity cost of 7 cents per kWh, determine annual energy cost of lighting for this class room. **7**
Also discuss the importance of energy conservation measures if LEDs were used instead of fluorescent tubes.

OR iii. A certain water heater operates under steady flow conditions receiving 4.2 kg/s of water at 75°C, enthalpy 313.93 kJ/kg. The water is heated by mixing with steam which is supplied to the heater at temperature 100°C & enthalpy 2676 kJ/kg. The mixture leaves the heater as liquid water at temperature 100^0C & enthalpy 419kJ/kg. How much steam must be supplied to the water heater per hour? **7**

Q.3 i. Is it possible for a heat engine to operate without rejecting any waste heat to a low temperature reservoir? Justify your answer. **3**

ii. Explain Carnot cycle with appropriate diagram. **7**
"All the processes in the Carnot cycle are reversible processes". Justify this statement.

OR iii. A reversible heat engine operates between two reservoirs at temperatures of 600°C and 40°C. The engine drives a reversible refrigerator which operates between reservoirs at temperatures of 40°C and -20°C. The heat transfer to the heat engine is 2000 kJ and the net work output of the combined engine refrigerator plant is 360 kJ. **7**
Evaluate the heat transfer to the refrigerant and the net heat transfer to the reservoir at 40°C.

Q.4 i. Define pure substance? **2**

ii. Draw and explain p-V diagram of water whose volume decreases on melting. **8**

OR iii. A vessel of volume 0.04 m^3 contains a mixture of saturated water saturated steam at a temperature of 250°C. The mass of the liquid present is 9 kg. Find the pressure, the mass, the specific volume, the enthalpy, the entropy and the internal energy. **8**

Q.5 i. Define mean effective pressure. **4**

ii. Using suitable P-V and T-S diagrams compare Otto, Diesel and Dual cycles: **6**
(a) For the same compression ratio
(b) For the same maximum pressure and temperature.

OR iii. Derive an expression for efficiency of Diesel cycle using appropriate diagram. **6**

Q.6 Attempt any two:

i. State Dalton's law of partial pressures. Also explain its practical importance. **5**

ii. Derive the first & second TDS equation. **5**

iii. Define internal energy, enthalpy and specific heats of gas mixtures. What is Gibbs theorem of gas mixtures? **5**

******

Marking Scheme
AU3CO04/FT3CO04/ME3CO04
Engineering Thermodynamics

Q.1	i.	A system gains 12 kJ heat during a process while 6 kJ of work is done on it. The change in the energy of the system will be: (c) 18 kJ		**1**
	ii.	During a quasi-equilibrium process: (d) Both (a) and (b) are correct.		**1**
	iii.	Heat transfer through finite temperature difference is: (b) Irreversible		**1**
	iv.	In the absence of any friction and other irreversibilities and using only quasi- equilibrium expansion a heat engine can have efficiency: (b) Less than 100%		**1**
	v.	At critical point $v_g - v_f$ is equal to: (c) Zero		**1**
	vi.	The temperature of a substance at which the vapour pressure is equal to 760 mm Hg is called as: (b) Normal boiling point		**1**
	vii.	Brayton cycle efficiency for the same compression ratio is: (c) Equal to Otto cycle		**1**
	viii.	The compression ratio for diesel engines is: (c) 15-20		**1**
	ix.	Mixing of two or more gases to form a homogenous mixture is a: (b) Irreversible process		**1**
	x.	Volume occupied by the single gas of a mixture at the same Temperature & pressure of the mixture is: (a) Partial volume		**1**
Q.2	i.	Energy is a conserved property. Example Work is called a high-grade energy and heat as a low-grade energy	1 mark 1 mark 1 mark	**3**
	ii.	Determine annual energy cost of lighting for this class room Importance of energy conservation measures if LEDs were used instead of fluorescent tubes	5 marks 2 marks	**7**
OR	iii.	How much steam must be supplied to the water heater per hour Diagram Energy balance equation Calculation and answer	1 mark 2 marks 4 marks	**7**
Q.3	i.	Is it possible for a heat engine to operate without rejecting any waste heat to a low temperature reservoir? Justify your answer.		**3**
	ii.	Explanation of Carnot cycle With diagram Justification of statement	4 marks 1 mark 2 marks	**7**
OR	iii.	Evaluate the heat transfer to the refrigerant and the net heat transfer to the reservoir at 40°C. Diagram Solution Heat transfer to the refrigerant = 3899 kJ Heat transfer to the reservoir at 40°C= 5539 kJ	1 mark 6 marks	**7**
Q.4	i.	Definition of pure substance		**2**
	ii.	p-V diagram Explanation of water whose volume decreases on melting	2 marks 6 marks	**8**
OR	iii.	Determining thermodynamic properties from table Find the pressure The mass The specific volume The enthalpy The entropy The internal energy	2 marks 1 mark 1 mark 1 mark 1 mark 1 mark 1 mark	**8**
Q.5	i.	Definition of mean effective pressure Formula	2 marks 2 marks	**4**
	ii.	Using suitable P-V and T-S diagrams compare Otto, Diesel and Dual cycles: (a) For the same compression ratio Diagram Explanation (b) For the same maximum pressure and temperature. Diagram Explanation	1.5 marks 1.5 marks 1.5 marks 1.5 marks	**6**
OR	iii.	Derive an expression for efficiency of Diesel cycle		**6**

		Derivation	4 marks	
		Diagram	1 mark	
		Formula	1 mark	
Q.6		Attempt any two:		
	i.	State Dalton's law of partial pressures	3 marks	**5**
		Its practical importance	2 marks	
	ii.	First TDS equation	2.5 marks	**5**
		Second TDS equation.	2.5 marks	
	iii.	Define internal energy, enthalpy and specific heats of gas mixtures.		**5**
		1 mark for each definition (1 mark * 3)	3 marks	
		Gibbs theorem of gas mixtures	2 marks	

******