Enrollment No......................................

Faculty of Engineering
End Sem (Odd) Examination Dec-2017
AU3CO04 / FT3CO04 / ME3CO04
Engineering Thermodynamics

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

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

Note: 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.

Q.1   i.   Work done in a free expansion process is   1
              (a) Zero   (b) Minimum   (c) Maximum (d) Positive

       ii.   The ratio of specific heat at constant pressure (C_p) and specific   1
              heat at constant volume (C_v) is
              (a) Equal to one   (b) Less than one
              (c) Greater than one   (d) None of these

       iii. Which of the following is the correct statement of the second   1
              law of thermodynamics?
              (a) It is impossible to transfer heat from a body at a lower
                  temperature to a higher temperature, without the aid of an
                  external source.
              (b) It is impossible to construct an engine working on a cyclic
                  process, whose sole purpose is to convert heat energy into
                  work.
              (c) All of these.
              (d) There is a definite amount of mechanical energy, which can
                  be obtained from a given quantity of heat energy.

       iv.   The entropy _____ in an irreversible cyclic process.   1
              (a) Remains constant   (b) Decreases
              (c) Increases   (d) None of these.

       v.   The area under the temperature-entropy curve (T – s curve) of any
              thermodynamic process represents

                                                                        P.T.O.

(a) Heat rejected. **1**

(b) Either heat absorbed or heat rejected.

(c) Heat absorbed.

(d) None of these.

vi. The Latent heat of steam at pressure greater than atmosphere in comparison to latent heat at atmospheric pressure **1**

(a) Less   (b) More   (c) Equal   (d) Unpredictable

vii. The compression ratio for petrol engines is **1**

(a) 3 to 6   (b) 5 to 8   (c) 15 to 20   (d) 20 to 30

viii. For the same compression ratio, the efficiency of dual combustion cycle is **1**

(a) Greater than Diesel cycle and less than Otto cycle.

(b) Less than Diesel cycle and greater than Otto cycle.

(c) Greater than Diesel cycle.

(d) Less than Diesel cycle.

ix. The relation of the vapour pressure to the enthalpy of vaporization is expressed in **1**

(a) Van der Waal's equation   (b) Energy equation

(c) Gas equation   (d) Clausius Clapeyron equation

x. The solubility of a gas in a liquid at small concentration is represented by **1**

(a) Henry's law   (b) Roults law

(c) Claperyon equation   (d) Joules equation

Q.2   i.   Define path function & point function. **2**

ii. State first law of thermodynamics & Prove "There exists a property of a closed system such that a change in its value is equal to the difference between heat supplied & work done during the change of state. **8**

iii. A certain water heater operates under steady flow conditions receiving 4.2 kg/s of water at 75^0C, enthalpy 313.93 kJ/kg. The water is heated by mixing with steam which is supplied to the heater at temperature 100.2^0C & 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? **8**

Q.3   i.   Write the Kelvin Planck & Clausius Statement. **2**

ii. What is Entropy Principle. Prove the Inequality of Clausius. **8**

OR   iii.   A reversible heat engine is supplied with heat from two constant temperature sources at 900 k and 600 K, rejects heat to a constant temperature sink at 300 K. The engine develops work equivalent to 90kJ/s and reject heat at the rate of 56 kJ/s. Determine : **8**

(a) Heat supplied from each source.

(b) Thermal efficiency of the engine.

Q.4   i.   What is dryness fraction? **2**

ii. Draw h-s, T-S, P-T diagram for pure substance. Also draw the p-v diagram of pure substance other than water, whose volume increases on melting. **8**

OR   iii.   A locomotive boiler develops 16tons of steam per hour at 10bar & 0.97 dry. The steam coming out of the boiler is passed through the super heater. The temperature of the steam coming out of the super heater is 250^0C. Find the heat supplied by the super heater per Kg per hour. Also calculate the change in specific volume & internal energy when it passé through the super heater. Take c_p=2.1kJ/Kg-k. **8**

Q.5   i.   Define clearance volume & swept volume & compression ratio. **3**

ii. Derive the relation for the air standard efficiency of the Otto cycle. **7**

OR   iii.   Find the air standard efficiencies of Otto & Diesel cycles on the basis of equal compression ratio of 10 & equal heat rejection of 840 kJ/kg. The suction conditions are 1 bar & 328 K. **7**

Q.6   Attempt any two:

i. What is Avogadro's law? Write four Maxewell's Equations. **5**

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

iii. Write the equation of Internal energy, Enthalpy, Specific heat of gas mixture & Entropy. **5**

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AU3CO04 / FT3CO04 / ME3CO04 Engineering Thermodynamics

Marking Scheme

Q.1   i.   Workdone in a free expansion process is   **1**
(a) Zero

ii.   The ratio of specific heat at constant pressure (C_p) and specific   **1**
heat at constant volume (C_v) is
(c) Greater than one

iii.   Which of the following is the correct statement of the second   **1**
law of thermodynamics?
(c) All of the above

iv.   The entropy _____ in an irreversible cyclic process.   **1**
(c) Increases

v.   The area under the temperature-entropy curve (T – s curve) of any   **1**
thermodynamic process represents
(b) Either heat absorbed or heat rejected

vi.   The Latent heat of steam at pressure greater than atmosphere in   **1**
comparison to latent heat at atmospheric pressure
(a) Less

vii.   The compression ratio for petrol engines is   **1**
(b) 5 to 8

viii.   For the same compression ratio, the efficiency of dual   **1**
combustion cycle is
(a) Greater than Diesel cycle and less than Otto cycle

ix.   The relation of the vapour pressure to the enthalpy of vaporization   **1**
is expressed in
(d) Clausius Clapeyron equation

x.   The solubility of a gas in a liquid at small concentration is   **1**
represented by
(b) Roults law

Q.2   i.   Path function & point function. 1 marks for each   **2**
(1 mark * 2 = 2 marks)

ii.   3 marks for statement   **8**
5 marks for prove

iii.   3 marks for formula   **8**
2 marks for diagram
3 marks for answer

Q.3   i.   Kelvin Planck & Clausius Statement.   **2**
1 marks for each (1 mark * 2 = 2 marks)

ii.   Entropy Principle. Prove the Inequality of Clausius.   **8**
3 marks for entropy principle
1 marks for diagram
4 marks for derivation

OR   iii.   2 marks for formula   **8**
3 marks for each right answer (3 marks * 2 = 6 marks)

Q.4   i.   Dryness fraction   **2**

ii.   h-s, T-S, P-T, p-v diagram for pure substance.   **8**
2 marks for each diagram (2 marks * 4 = 8 marks)

OR   iii.   1 marks for values from steam table   **8**
3 marks for heat
2 marks for sp volume
2 marks for internal energy

Q.5   i.   Clearance volume & swept volume & compression ratio.   **3**
1 marks for each (1 mark * 3 = 3 marks)

ii.   Relation for the air standard efficiency of the Otto cycle.   **7**
1 marks for diagram,
6 marks for derivation

OR   iii.   1 marks for diagram   **7**
3 marks for right steps
3 marks for answer.

Q.6   Attempt any two:

i.   Avogadro's law - 1 marks   **5**
Four Maxewell's Equations - 1 marks for each equation
(1 mark * 4 = 4 marks)

ii.   First TDS equation - 2 marks   **5**
Second TDS equation - 3 marks

iii.   Equation of Internal energy, Enthalpy, Specific heat of gas   **5**
mixture & Entropy

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