Reg. No. : | | | | | | | | | | |

Question Paper Code: 51733

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2016

Third Semester

Mechanical Engineering

15UME303 - ENGINEERING THERMODYNAMICS

(Regulation 2015)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

(Use of Steam table, Mollier chart, Psychrometric chart are permitted)

PART A - (10 x 1 = 10 Marks)

1. A definite area or space where some thermodynamic process takes place is known as

   (a) Thermodynamic system (b) Thermodynamic cycle
   (c) Thermodynamic process (d) Thermodynamic law

2. In isothermal process

   (a) Volume remains constant (b) Pressure remains constant
   (c) Change in internal energy is zero (d) Change in enthalpy is zero

3. Kelvin-Planck's law deals with

   (a) conservation of energy (b) conservation of heat
   (c) conservation of mass (d) conversion of heat into work

4. The entropy may be expressed as a function of

   (a) pressure and temperature (b) temperature and volume
   (c) heat and work (d) all of the above

5. The quantity of heat absorbed by 1 *kg* of water when it is heated from 0°*C* (freezing point) to boiling point is known as

(a) critical point (b) dryness fraction
(c) Sensible heat (d) Latent heat

6. Choose the correct answer.

(a) Critical point involves equilibrium of solid and vapour phases
(b) Critical point involves equilibrium of solid and liquid phases
(c) Critical point involves equilibrium of solid, liquid and vapour phases
(d) Triple point involves equilibrium of solid, liquid and vapour phases

7. Boyle's law states that, when temperature is constant, the volume of a given mass of a perfect gas

(a) varies directly as the absolute pressure
(b) varies inversely as the absolute pressure
(c) varies as square of the absolute pressure
(d) does not vary with the absolute pressure.

8. Joule's law states that the specific internal energy of a gas depends only on

(a) the pressure of the gas (b) the volume of the gas
(c) the temperature of the gas (d) none of the above

9. During sensible cooling, the wet bulb temperature

(a) decreases (b) increases
(c) remains constant (d) can decrease or increase

10. When air is saturated, the dry bulb, wet bulb and dew point temperature is

(a) equal (b) increases (c) decreases (d) remains constant

PART - B (5 x 2 = 10 Marks)

11. Differentiate between closed and open systems.

12. Define the term COP.

13. Indicate the importance of dryness fraction (or) quality of steam.

14. State Dalton's law of partial pressure.

15. List the important psychrometric processes.

PART - C (5 x 16 = 80 Marks)

16. (a) 0.1 m^3 of an ideal gas at 300 *K* and 1 *bar* is compressed adiabatically to 8 *bar*. It is then cooled at constant volume and further expanded isothermally so as to reach the condition from where it started. Calculate:

(i) Pressure at the end of constant volume cooling

(ii) Change in internal energy during constant volume process

(iii) Net work done and heat transferred during the cycle

Assume C_p = 14.3 *kJ/kg K* and C_v = 10.2 *kJ/kg K*. (16)

Or

(b) A turbine, operating under steady-flow conditions, receives 4500 *kg* of steam *per hour*. The steam enters the turbine at a velocity of 2800 *m/min*, an elevation of 5.5 *m* and a specific enthalpy of 2800 *kJ/kg*. It leaves the turbine at a velocity of 5600 *m/min*, an elevation of 1.5 *m* and a specific enthalpy of 2300 *kJ/kg*. Heat losses from the turbine to the surroundings amount to 16000 *kJ/h*. Determine the power output of the turbine. (16)

17. (a) Describe the working of a Carnot cycle. List the assumptions made for describing the working of the Carnot engine. Reason out why Carnot cycle cannot be performed in practice. (16)

Or

(b) (i) A cyclic heat engine operates between a source temperature of 1000°*C* and a sink temperature of 40°*C*. Find the least rate of heat rejection per *kW* net output of the engine. (8)

(ii) Find the co-efficient of performance and heat transfer rate in the condenser of a refrigerator in *kJ/h* which has a refrigeration capacity of 12000 *kJ/h* when power input is 0.75 *kW*. (8)

18. (a) Describe the process of formation of steam and give its graphical representation. (16)

Or

(b) 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. (16)

19. (a) Derive the Maxwell relations and explain their importance in thermodynamics. (16)

Or

(b) The pressure and temperature of mixture of 4 *kg* of O_2 and 6 *kg* of N_2 are 4 *bar* and 27°*C* respectively. For the mixture determine the following :

(i) The mole fraction of each component

(ii) The average molecular weight

(iii) The specific gas constant

(iv) The volume and density

(v) The partial pressures and partial volumes. (16)

20. (a) Define the following terms:

(i) Dry bulb temperature

(ii) Wet bulb temperature

(iii) Dew point temperature

(iv) Relative humidity

(v) Specific humidity. (16)

Or

(b) 90 m^3 of air per minute at 20°*C* and 75% R.H. is heated until its temperature becomes 30°*C*. Calculate:

(i) R.H. of the heated air

(ii) Heat added to air per minute. (16)