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

Question Paper Code: 43703

B.E. / B.Tech. DEGREE EXAMINATION, APRIL 2019

Third Semester

Mechanical Engineering

14UME303 – ENGINEERING THERMODYNAMICS

(Regulation 2014)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

(Use of Steam table and Psychrometric chart are permitted)

PART A - (10 x 1 = 10 Marks)

1. As differentials, heat and work would be described mathematically as

   (a) inexact (b) exact (c) discontinuity (d) point function

2. The characteristic gas equation $pv = mRT$ is essentially valid for a

   (a) real gas (b) ideal gas (c) monoatomic gas (d) mixture of gas

3. The efficiency of Carnot cycle engine depends on

   (a) speed of the engine (b) working fluid
   (c) operating temperature limits (d) all of the above

4. No engine which gives higher efficiency other than Carnot engine when working at same temperature limits is called

   (a) Kelvin statement (b) Clausius statement
   (c) Carnot theorem (d) Clausius inequality

5. The heat absorbed by water at its saturation temperature to get converted into dry steam at the same temperature is called

(a) sensible heat (b) specific heat (c) total heat (d) latent heat

6. Name the parameter that decreases with increase in steam pressure

(a) sensible heat (b) specific entropy
(c) boiling point (d) latent heat of vaporization

7. The difference of specific heats for the ideal gases is

(a) Joule - Thomson coefficient (b) Characteristics gas constant
(c) Molecular mass (d) None

8. Joule – Thomson coefficient for ideal gas

(a) zero (b) one (c) γ (d) none

9. A humidification process means

(a) Decrease in relative humidity (b) An increase in specific humidity
(c) A decrease in temperature (d) An increase in temperature

10. The difference between the dry bulb and wet bulb temperatures is known as

(a) degree of saturation (b) dew point temperature
(c) specific humidity (d) wet bulb depression

PART - B (5 x 2 =10 Marks)

11. What is PMM-I?

12. What is irreversibility?

13. What is the difference between saturated vapour and superheated vapour?

14. What is the value of the Clapeyron equation in thermodynamics?

15. What is evaporative cooling?

PART - C (5 x 16 = 80 Marks)

16. (a) Air goes through a polytropic process from 125 *kPa* and 325 *K* to 300 *kP*a and 500 *K*. Find the polytropic exponent and the specific work in the process. (16)

Or

(b) The compressor of a large gas turbine receives air from the ambient surrounding at 95 *kPa*and 20° *C* with a low velocity. At the compressor discharge, air exits at 1.52 *MPa* and 430° *C* with celocity of 90 *m/s*. The power input to the compressor is 5000*kW*. Determine the mass flow rate of air through the unit. (16)

17. (a) 1 *kg* of fluid is contained in a cylinder at an initial pressure of 20 *bar* and an initial volume of 0.05 m^3. The fluid is allowed to expand reversibly behind a piston according to the law $PV_2 = C$ until the volume is doubled. The fluid is then cooled at constant pressure until the piston regains its initial position. Heat is then supplied reversibly with the piston firmly locked in position until the pressure rises to the original value of 20 *bar*. Calculate the net work done by the fluid. Sketch the processes on P-V diagram. (16)

Or

(b) 50kg of water is at 313 K and enough ice at -5°C is mixed with water in an adiabatic vessel such that at the end of the process all the ice melts and water at 0°C is obtained. Find the mass of ice required and the entropy change of water and ice. Take C_p of water = 4.2 kJ/kgK, C_p of ice = 2.1 kJ/kgK and latent heat of ice = 335 kJ/kg. (16)

18. (a) Steam at 20 *bar*, 360^o *C* is expanded in a steam turbine to 0.08 *bar*. It then enters a condenser, where it is condensed to saturated liquid water. The pump feeds back the water into the boiler. If the turbine and pump have each 80% efficiency, find the net work and Rankine efficiency. (16)

Or

(b) Calculate the increase in entropy of ice as it heated from -5^o*C* to steam at 250^o*C* at 1 *atm*. Use the following data

Cp of ice = 2.093 *kJ/kgK*

Latent heat of fusion of ice = 334.96 *kJ/kg*

Cp of water = 4.187 *kJ/kgK*

Latent heat of vaporization 2257 *kJ/kg* and

Cp of steam at 250^o*C* = 2.093 *kJ/kgK* (16)

19. (a) What is meant by phase change process? Derive Clausius-Clapeyron equation for a phase change process. Give the significance of this equation. (16)

Or

(b) Weighing of mass gives a mixture at 60° *C* 225 *kPa* with 0.5 *kg* O_2, 1.5 *kg* N_2 and 0.5 *kg* CH_4. Find the partial pressures of each component, the mixture specific volume, mixture molecular weight and the total volume. (16)

20. (a) Two moist air streams with 85% relative humidity, both flowing at a rate of 0.1 *kg/s* of dry sir, are mixed in a steady flow setup. One inlet stream is at 32.5° *C* and the other at 16° *C.* Find the exit relative humidity. (16)

Or

(b) Explain the following with neat sketches

(i) Adiabatic saturation process

(ii) Adiabatic evaporative cooling

(iii) Cooling tower (16)