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Question Paper Code: 43703

B.E. / B.Tech. DEGREE EXAMINATION, MAY 2018

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 measurement of thermodynamic property known as temperature is based on

   (a) Zeroth law of thermodynamics (b) First law of thermodynamics
   (c) Second law of thermodynamics (d) None of these

3. The heat flows from a cold body to a hot body with the aid of an external source. This statement is given by

   (a) Kelvin (b) Joule (c) Clausius (d) Gay-Lussac

4. The condition for a reversible cyclic process is

   (a) $\oint \frac{dQ}{T} = 0$ (b) $\oint \frac{dQ}{T} < 0$ (c) $\oint \frac{dQ}{T} > 0$ (d) None of these

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. Determine the entropy per kg of steam at 2 MPa when the condition of the steam is dry saturated

(a) 6.336 kJ/kgK (b) 5.2 kJ/kgK
(c) 7.233 kJ/kgK (d) 0 kJ/kgK

7. For a given mass of gas at constant pressure, its volume is directly proportional to the absolute temperature. It belongs to which law

(a) Gay Lussa's law (b) Charle's law
(c) Joule's law (d) Boyle's law

8. Isothermal compressibility α

(a) $\alpha = -\frac{1}{V}\left(\frac{\partial V}{\partial P}\right)_T$ (b) $\alpha = -\frac{1}{V}\left(\frac{\partial P}{\partial V}\right)_T$
(c) $\alpha = \frac{1}{V}\left(\frac{\partial V}{\partial T}\right)_P$ (d) $\alpha = -\frac{1}{V}\left(\frac{\partial V}{\partial P}\right)_T$

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 relation between relative humidity (Φ) and degree of saturation (μ) is given by

(a) $\mu = \frac{(P_b - P_v)}{(P_b - P_s)}\Phi$ (b) $\mu = \frac{(P_b - P_s)}{(P_b - P_v)}\Phi$ (c) $\mu = \frac{P_v}{(P_b - P_s)}\Phi$ (d) $\mu = \frac{(P_b + P_s)}{(P_b - P_v)}\Phi$

PART - B (5 x 2 =10 Marks)

11. State the first law for a closed system undergoing a process and a cycle.

12. What is irreversibility?

13. What is mean by dryness fraction of steam?

14. Define Dalton's law of partial pressure.

15. What is a psychrometer?

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) Two heat engines operating in series are giving out equal amount of work. The total work is 50 kJ/cycle. If the reservoirs are at 1000 K and 250 K, find the intermediate temperature and the efficiency of each engine. Also find the heat extracted from the source. (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) Explain steam formation with relevant sketch and label all salient points and explain every point in detail. (16)

Or

(b) A steam turbine has an inlet of 2 *kg/s* water at 1000 *kPa* and 350° *C* with velocity of 15 *m/s*. The exit is at 100 *kPa,x* = 1 and very low velocity. Find the specific work and power produced. (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) Derive Maxwell equations from Helmohtz function and Gibbs function. (16)

20. (a) An industrial process requires an atmosphere having a *RH* of 88.4% at 22 ^{0}C, and involves a flow rate of 2000 m^3/h. The external conditions are 44.4% *RH*, 15^{0}C. The air intake is heated and then humidified by water spray at 20^{0}C. Determine the mass flow rate of spray water and the power required for heating, if the pressure throughout is 1 bar. (16)

Or

(b) A flow of moist air at 100 *kPa* 40° *C* and 40% relative humidity is cooled to 15° *C* in a constant pressure device. Find the humidity radio of inlet and the exit flow and the heat transfer in the device per *kg* of dry air. (16)

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