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Question Paper Code: 41733

B.E. / B.Tech. DEGREE EXAMINATION, MAY 2017

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)

- In an extensive property of a thermodynamics system
 - Extensive heat is transferred
 - Extensive work is done
 - Extensive energy is utilized
 - None of these
- When two bodies are in thermal equilibrium with a third body, they are also in thermal equilibrium with each other. This statement is called
 - Zeroth law of thermodynamics
 - First law of thermodynamics
 - Second law of thermodynamics
 - None of these
- The heat flows from a cold body to a hot body with the aid of an external source. This statement is given by
 - Kelvin
 - Joule
 - Clausius
 - Gay-Lussac
- The condition for a reversible cyclic process is
 - $\oint \frac{dQ}{T} = 0$
 - $\oint \frac{dQ}{T} < 0$
 - $\oint \frac{dQ}{T} > 0$
 - None of these

5. Ice melts in to water at a constant temperature of 0°C. What is the peculiarity of the water
- (a) Volume increase (b) Pressure increase
(c) Volume decrease (d) Pressure decrease
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. In an adiabatic saturation process
- (a) The enthalpy remains constant (b) The temperature remains constant
(c) The absolute humidity remains constant (d) The relative humidity remains constant

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 sensible heating?

PART - C (5 x 16 = 80 Marks)

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

Or

- (b) A steam turbine operates under steady flow conditions receives steam at the following state: pressure 13.8 bar; specific volume 0.143 m³/kg; internal energy 2590 kJ/kg; velocity 30 m/s. The state of the steam leaving the turbine is: pressure 0.35bar; specific volume 4.37 m³/kg; internal energy 2360 kJ/kg; velocity 90 m/s. Heat is lost to the surroundings at the rate of 0.25 kJ/s. If the rate of steam flow is 0.38 kg/s, what is the power developed by the turbine. (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 Helmholtz function and Gibbs function. (16)

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

Or

(b) With the aid of model psychometric chart explain the following process (i) Sensible heating and cooling (ii) Cooling and dehumidification (iii) Adiabatic mixing (iv) Evaporative cooling. (16)
