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Question Paper Code: 50733

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

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 define area where some thermodynamic process takes place is known as
 - (a) Thermodynamic system
 - (b) Thermodynamic cycle
 - (c) Thermodynamic process
 - (d) Thermodynamic law
2. An open system is one which
 - (a) Heat and work cross the boundary of the system by the mass of the working substances does not
 - (b) Mass of working substances crosses the boundary of the system but the heat and work do not
 - (c) Both the heat and work as well as mass of the working substances cross the boundary of the system
 - (d) Neither the heat and work nor the mass of the working substances cross the boundary of the system
3. The second law of thermodynamics defines
 - (a) Heat
 - (b) Work
 - (c) Enthalpy
 - (d) None of these
4. For a reversible adiabatic process, the change in entropy is
 - (a) Zero
 - (b) Minimum
 - (c) Maximum
 - (d) None of these

5. Choose the correct Answer
- (a) Specific volume of water decreases on freezing
 - (b) Boiling point of water decreases with increasing pressure
 - (c) Specific volume of CO₂ increases on freezing
 - (d) Freezing temperature of water decreases with increasing pressure
6. Choose the correct Answer
- (a) The slope of vaporization curve is always negative
 - (b) The slope of vaporization curve is always positive
 - (c) The slope of sublimation curve is negative for all pure substance
 - (d) The slope of fusion curve is positive for all pure substances
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. Charles's law states that if any gas is heated at constant pressure its volume
- (a) Changes directly as its absolute temperature
 - (b) Changes inversely as its absolute temperature
 - (c) Changes as square of the absolute temperature
 - (d) Does not change with absolute temperature
9. In an unsaturated air the state of a vapour is
- (a) Wet
 - (b) Super heated
 - (c) Saturated
 - (d) Unsaturated
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. Define a thermodynamic system.
12. Write the Clausius Statement.
13. What is meant by 'Pure substance'?
14. Write Boyle's law.
15. What is meant by Psychrometry Processes?

PART - C (5 x 16 = 80 Marks)

16. (a) A temperature scale of certain thermometer is given by the relation $T = \alpha \ln p + b$ where α and b are constants and p is thermometric property of the fluid in the thermometer. If at the ice point and steam point the thermometric properties are found to be 1.5 and 7.5 respectively. What will be the temperature corresponding to the thermometric properties of 3.5 on Celsius scale. (16)

Or

- (b) The specific heat capacity of the system during a certain process is given by $C_n = (0.4 + 0.004 T)$ kJ/kg°C. If the mass of the gas is 6 kg and its temperature changes from 25°C to 125°C find (i) Heat transferred (ii) Mean specific heat of the gas. (16)
17. (a) An ice plant working on a reversed Carnot cycle heat pump produces 15 tonnes of ice per day. The ice is formed from water at 0°C and the formed ice is maintained at 0°C. The heat is rejected to the atmosphere at 25°C. The heat pump used to run the ice plant is coupled to a Carnot engine which absorbs heat from a source which is maintained at 220°C by burning liquid fuel of 44500 kJ/kg calorific value and rejects the heat to the atmosphere. Determine (i) Power developed by engine (ii) Fuel consumed per hour. Take enthalpy of fusion of ice = 334.5 kJ/kg. (16)

Or

- (b) Two Carnot engines work in series between the source and sink temperature of 550K and 350K. If both engines develop equal power. Determine the intermediate temperature. (16)
18. (a) A vessel having a volume of 0.6 m³ contains 3 kg of liquid water and water vapour mixture in equilibrium at a pressure of 0.5 MPa. Calculate (i) Mass and volume of liquid (ii) Mass and volume of vapour. (16)

Or

- (b) A vessel having a capacity of 0.05 m³ contains a mixture of saturated water and saturated steam at a temperature of 245°C. The mass of the liquid present is 10 kg. Find the following (i) Pressure (ii) Mass (iii) Specific volume (iv) Specific enthalpy (v) Specific entropy. (16)
19. (a) The volume of a high altitude chamber is 40 m³. It is put into operation by reducing pressure from 1 bar to 0.4 bar and temperature from 25°C to 5°C. How many kg of air must be removed from the chamber during the process? Express this mass as a volume measured at 1 bar and 25°C. (16)

Or

(b) A steel flask of 0.04m^3 capacity is to be used to store nitrogen at 120 bar, 20°C . The flask is to be protected against excessive pressure by a fusible plug which will melt and allow the gas to escape if the temperature rises too high. (i) How many kg of nitrogen will the flask hold at the designed conditions? (ii) At what temperature must the fusible plug melt in order to limit the pressure of a full flask to maximum of 150 bar. (16)

20. (a) The air supplied to a room of a building in winter is to be at 17°C and have a relative humidity of 60%. If the barometric pressure is 1.01325 bar, find (i) The specific humidity (ii) Dew point under these conditions. (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)
