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Question Paper Code: 54A05

B.E. / B.Tech. DEGREE EXAMINATION, MAY 2022

Fourth Semester

Agricultural Engineering

15UAG405- FUNDAMENTALS OF THERMODYNAMICS

(Regulation 2015)

(Provide Scientific Calculator, Steam table & Psychrometric Chart)

Duration: Three hours

Maximum: 100 Marks

PART A - (10 x 1 = 10 Marks)

1. The first law of thermodynamics is law of CO1-R
(a) Conversion of mass (b) Conversion of energy
(c) Conversion of momentum (d) Conversion of heat
2. Which of the following is true in regard to the energy of an isolated system? CO1-R
(a) $dQ \neq 0$ (b) $dW \neq 0$ (c) $E = \text{constant}$ (d) all of the mentioned
3. A Carnot engine operates between 327° and 27° . If the engine produces 300KJ of work, the entropy change during heat addition is CO2-R
(a) 0.5KJ/K (b) 1 KJ/K (c) 1.5KJ/K (d) 2KJ/K
4. A series of operations, which take place in a certain order and restore the initial condition is known as CO2-R
(a) reversible cycle (b) irreversible cycle
(c) Thermodynamic cycle (d) non of the above
5. Thermal power plant works on CO3-R
(a) Carnot cycle (b) Joule cycle (c) Rankine cycle (d) Otto cycle
6. The point at which three phases of water vapour exists is called as CO3-R

a) Triple point (b) Freezing point (c) Boiling point (d) Gaseous point

7. The heating and expanding of gas is called CO4-R
 (a) Thermodynamic system (b) Thermodynamic cycle
 (c) Thermodynamic process (d) Thermodynamic law
8. When a real gas undergoes Joule-Thomson expansion the CO4-R
 temperature
 (a) may remain constant (b) always decrease
 (c) always increase (d) may increase or decrease
9. When the rate of evaporation of water is zero, the relative humidity CO5-R
 of the air is
 (a) 0% (b) 100% (c) 50% (d) unpredictable
10. The dew point temperature is less than the wet bulb temperature for CO5-R
 (a) saturated air (b) unsaturated air
 (c) both saturated and unsaturated air (d) none of the above

PART – B (5 x 2= 10Marks)

11. State the law of conservation of energy? CO1-R
12. What is meant by Irreversible process? CO2-R
13. Name and explain the two types of properties. CO3-R
14. State Charles's law. CO4-R
15. Define sensible heat and latent heat. CO5-R

PART – C (5 x 16= 80Marks)

16. (a) In an isentropic flow through nozzle, air flows at the rate of CO1-App (16)
 600 kg/hr. At inlet to the nozzle, pressure is 2 MPa and
 temperature is 127°C. The exit pressure is 0.5 MPa. Initial air
 velocity is 300 m/s
 Determine
 (i) Exit velocity of air
 (ii) Inlet and exit area of nozzle
- Or
- (b) A centrifugal pump delivers 2750 kg of water per minute from CO1-App (16)
 initial pressure of 0.8 bar absolute to a final pressure of 2.8 bar
 absolute. The suction is 2 m below and the delivery is 5 m
 above the centre of pump. If the suction and delivery pipes are
 of 15 cm and 1.0 cm diameter respectively, make calculation
 for power required to run the pump.

17. (a) A reversible heat engine operates between two reservoirs at $820\text{ }^{\circ}\text{C}$ and $27\text{ }^{\circ}\text{C}$ engines drives a reversible refrigerator which operates between reservoirs at temperature of $27\text{ }^{\circ}\text{C}$ and $-15\text{ }^{\circ}\text{C}$. The heat transfer to the engine is 2000kJ and network available for the combined cycle is 300kJ .
 (a) How much heat is transferred to the refrigerant and also determine the total that rejected to the reservoir at $27\text{ }^{\circ}\text{C}$.
 (b) If the efficiency of the heat engine and COP of the refrigerator is each 40% of their maximum values, determine heat transfer to the refrigerator and also heat rejected to the reservoir at $27\text{ }^{\circ}\text{C}$ CO2-App (16)
- Or
- (b) Explain Carnot engine cycle and its efficiency. CO2-App (16)
18. (a) In a thermal power plant operating on a Rankine cycle, superheated steam at 50 bar and $500\text{ }^{\circ}\text{C}$ enters the turbine, the isentropic efficiency of which is 0.8 . The condenser pressure is 0.05 bar and it delivers the saturated liquid to a feed pump, the isentropic efficiency of which is 0.7 . Determine the thermal efficiency of the power plant and the mass flow rate of steam required for 50MW net power generation. CO3-Ana (16)
- Or
- (b) Steam flows through a turbine at the rate of 5000kg/h entering at 15bar , $300\text{ }^{\circ}\text{C}$ and leaving at 0.1bar with 4% moisture. The steam enters at 80 m/s at a point 2m above the discharge and leaves at 40m/s . compute the shaft power assuming that, the device is adiabatic but considering kinetic and potential energy changes. Calculate the diameters of the inlet and discharge tubes. CO3 -Ana (16)
19. (a) Derive Maxwell's equation. CO4-U (16)
- Or
- (b) A mixture of ideal gases consists of 2.5kg of N_2 and 4.5 kg of CO_2 at pressure of 4bar and a temperature of 25°C . Determine
 (i) Mole fraction of each consistent,
 (ii) Equivalent molecular weight of the mixture,
 (iii) Equivalent gas constant of the mixture,
 (iv) The partial pressure and partial volumes. CO4-Ana (16)

20. (a) Consider a room that contains air at 1atm, 35°C and 40% relative humidity. Using psychometric chart determine i. The specific humidity ii. The enthalpy iii. The wet- bulb temperature iv. The dry- bulb temperature v. Specific volume of air. CO5-U (16)

Or

- (b) Explain sensible heating process, sensible cooling and humidification process. CO5-U (16)