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Question Paper Code: R4A02

B.E./B.Tech. DEGREE EXAMINATION, NOV 2025

Fourth Semester

Agricultural Engineering

R21UAG402 – FUNDAMENTALS OF THERMODYNAMICS FOR AGRICULTURAL
ENGINEERING

(Regulations R2021)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

- Find the workdone for the constant pressure process if the volume difference is 0.4 m^3 at 1 atmospheric pressure CO2-App
(a) 40 kJ (b) 20 k (c) 10 kJ (d) 30 kJ
- What is the SI unit of pressure? CO1- U
(a) bar (b) kPa (c) Pascal (d) fsi
- Find the COP of refrigerator which operates between the heat rejection is 4200 kJ and the work input is 840 kJ CO2-App
(a) 3 (b) 2 (c) 4 (d) 5
- The entropy of reversible adiabatic process is CO1- U
(a) 0 (b) 1 (c) 2 (d) 3
- Find the s_f value of 0° C CO2-App
(a) 3 (b) 1 (c) 2 (d) 0
- The difference between $s_g - s_f$ CO1- U
(a) s_{fg} (b) s_{gf} (c) s_g (d) h_g
- The formula for ideal gas equation is CO1- U
(a) $pv=RT$ (b) $pv= ZRT$ (c) $pv= \frac{1}{Z} RT$ (d) $pv= JRT$

8. The formula for real gas equation is CO1- U
 (a) $pV=RT$ (b) $pV= ZRT$ (c) $pV= \frac{1}{Z} RT$ (d) $pV= JRT$
9. Which branch of science deals with properties of air CO1- U
 (a) geometry (b) audiometry (c) psychrometry (d) trigonometry
10. For comfort zone what should be the range of RH CO1- U
 (a) 50-60% (b) 20-30% (c) 30-40% (d) 40-50%

PART – B (5 x 2= 10 Marks)

11. Why we draw the p-v Diagram in thermodynamics? CO1- U
12. Find the COP of refrigerator which operates between the heat rejection is 200 kJ and the work input is 80 kJ CO2-App
13. State phase rule of pure substances CO1- U
14. State Dalton's law of partial pressure. CO1- U
15. Infer wet bulb temperature. CO1- U

PART – C (5 x 16= 80 Marks)

16. (a) Derive the expression for adiabatic process $pV^\gamma = C$ CO2-App (16)
 Or
 (b) Air flows steadily at the rate of 0.5 kg/s through an air compressor entering at 7 m/s velocity, 100 Kpa pressure and 0.95 m³/kg specific volume and leaving at 5 m/s, 700 Kpa and 0.19 m³/kg. The internal energy of air is leaving is 90 kJ/ kg greater than that of the air entering. Cooling water jackets absorb heat at the rate of 58 kW. Calculate the rate of shaft work input to the compressor. CO2-App (16)
17. (a) A reversible heat engine operates between two reservoirs at temperature of 600°C and 40°C. The Engine drives a reversible refrigerator which operates between reservoirs at temperature of 40°C and – 20°C. The heat transfer to the heat engine is 2000KJ and network output of combined engine refrigerator plant is 360KJ. Evaluate the heat transfer to the refrigerator and the net heat transfer to the reservoir at 40°C. CO2-App (16)

Or

- (b) Two Carnot engines A and B are operated in series. CO2-App (16)
Engine A receives heat from a reservoir at 870 K and rejects heat to a reservoir at temperature T. Engine B receives heat rejected by engine A and in turn rejects it to a reservoir at 300 K. calculate the intermediate temperature for the following cases
1. The work output of the two engines are equal
 2. The efficiencies of the two engines are equal
18. (a) Steam initially 1.5Mpa, 300°C expands reversibly and adiabatically in a steam turbine at 40°C. Determine the ideal work output of the turbine per kg of steam. CO2-App (16)
- Or
- (b) In a Rankine cycle, the steam at inlet to turbine is saturated at a pressure of 35 bar and the exhaust pressure is 0.2 bar. Determine : CO2-App (16)
(i) The Rankine efficiency, (ii) The dryness at the end of expansion
19. (a) Analyze the 10 kmol of methane gas is stored in 5 m³ container at 300K. Calculate the pressure by CO3-Ana (16)
i. Perfect gas equation
ii. Vander walls equation
Use the following constants $a=228.296 \text{ kpa.m}^6/\text{kmol}^2$ and $b=0.043 \text{ m}^3/\text{kmol}$ for Van der Waals equation.
- Or
- (b) Analyze the practical applications of the Clausius-Clapeyron equation in real-world phenomena, such as meteorology and industrial processes. CO3-Ana (16)
20. (a) Design the sling psychrometer, the humidity ratio of atmospheric air at 28°C dry bulb temperature and 760 mm of mercury is 0.016 kg / kg of dry air. Determine: 1. partial pressure of Water vapour; 2. relative humidity; 3. dew point temperature; 4. specific enthalpy; and 5. vapour density. CO4-D (16)

Or

- (b) Design the air conditioning of a public hall: CO4-D (16)
Outdoor conditions = 40°C DBT, 20°C WBT
Required comfort conditions = 20°C DBT, 50% RH
Seating capacity of hall = 1000
Amount of outdoor air supplied = 0.3 m³/min/person
If the required condition is achieved first by adiabatic humidifying and then cooling, find: 1. The capacity of the cooling coil and surface temperature of the coil if the by-pass factor is 0.25; and 2. The capacity of the humidifier and its efficiency.