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Question Paper Code: R4A02

B.E. / B.Tech. DEGREE EXAMINATION, APR/MAY 2025

Fourth Semester

Agricultural Engineering

R21UAG402 – FUNDAMENTALS OF THERMODYNAMICS FOR AGRICULTURE ENGINEERING

(Regulation- R2021)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. 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

2. First law of thermodynamics states that CO1-U

   a) mass b) energy c) enthalpy d) entropy

3. A carnot engine receives heat from 600° C source. The efficiency of the engine is 59%. Find the heat supply if the 1 kw of work output CO2-App

   (a) 1.695 (b) 0 (c) 1.23 (d) 1.3

4. The best example of heat engine operates refrigerator is CO1-U

   (a) car (b) bike (c) source (d) sink

5. The heat does not change the temperature during the phase change is called CO1-U

   (a) sensible heat (b) latent heat (c) adiabatic heat (d) variable heat

6. Find the $h_f$value of 5° C CO2-App

   (a) 30 kJ/ kg (b) 21 kJ/ kg (c) 15 kJ/ kg (d) 10 kJ/ kg

7. Gibbs function states that CO1-U

   (a) G= h-TS (b) H= u-TS (c) G= u+ TS (d) H= u+ TS

8. Charles law states that CO1-U

(a) vα S (b) vα R (c) vα P (d) vα T

9. Which branch of science deals with properties of air CO1-U

(a) geometry (b) audiometry (c) physhrometry (d) trigonometry

10. The wet bulb depression is zero, when relative humidity is equal to CO1-U

(a) 100% (b) 0% (c) 60% (d) 20%

PART – B (5 x 2= 10 Marks)

11. Differ closed and open system CO1-U

12. State Kelvin Planck Statement CO1-U

13. What is saturation temperature and saturation pressure? CO1-U

14. Define Joule – Thomson Co-efficient CO1-U

15. What is the difference between air conditioning and refrigeration? 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) A turbine operates under steady flow condition receiving steam at following state pressure= 1.2 MPa, temperature= 188° C, enthalpy = 2785 kJ/kg, velocity is 33.3 m/s. & elevation = 3 m, steam leaves the turbine at the following state, pressure= 20 kPa, enthalpy = 2512 kJ/kg, velocity= 100 m/s& elevation= 0 m, heat loss to the surroundings at the rate of 0.29 kJ/s with the steam flow through the turbine is 0.42 kg/s. find the power output of the turbine in kilowatt. 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 35°C and – 18°C. The heat transfer to the heat engine is 1900KJ and network output of combined engine refrigerator plant is 350KJ. Evaluate the heat transfer to the refrigerator and the net heat transfer to the reservoir at 35°C. CO2-App (16)

Or

(b) Two Carnot engines A and B are operated in series. Engine A receives heat from a reservoir at 870 K and rejects heat to a reservoir heat to 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 workout of the two engines are equal
2. The efficiencies of the two engines are equal

CO2-App (16)

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) A simple Rankine cycle works between pressures 28 bar and 0.06 bar, the initial condition of steam being dry saturated. Calculate the cycle efficiency, work ratio and specific steam consumption.

CO2-App (16)

19. (a) Analyze the 10 kmol of methane gas is stored in 5 m^3 container at 300K.Calculate the pressure by
i. Perfect gas equation
ii. Vander walls equation

Use the following constants a=228.296 kpa.m6/kmol2 and b=0.043 m3/kmol for Van der Waals equation.

CO3-Ana (16)

Or

(b) Analyze and derive the Clausius-Clapeyron equation, which describes the relationship between pressure and temperature during a phase change.

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.