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Question Paper Code: U3703

B.E./B.Tech. DEGREE EXAMINATION, NOV 2023

Third Semester

Mechanical Engineering

21UME303 – ENGINEERING THERMODYNAMICS

(Regulations 2021)

(Use of standard Steam table and Mollier diagram, Psychrometric Chart are permitted)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

- Properties do not change with time in CO1- U
(a) Laminar flow (b) Turbulent flow (c) Unsteady flow (d) Steady flow
- Unit for specific heat CO1- U
(a) KJ/Kg (b) Kg/KJ (c) KJ (d) KJ/KgK
- The efficiency of Carnot cycle depends upon CO1- U
(a) temperature limits (b) pressure ratio
(c) volume compression ratio (d) cut-off ratio and compression ratio
- Example of reversed heat engine CO1- U
(a) heat pump (b) refrigerator
(c) both (a) & (b) (d) none of the above
- Pure substance example is CO1- U
(a) H₂ (b) Table Salt (c) Gold (d) All the above
- In Rankine cycle, heat rejection takes place at CO1- U
(a) V=C (b) P=C (c) T=C (d) S=C
- Which of the following is not a Maxwell equation? CO1- U
(a) $(\partial T/\partial V) = -(\partial p/\partial S)$ (b) $(\partial T/\partial p) = -(\partial V/\partial S)$
(c) $(\partial p/\partial T) = (\partial S/\partial V)$ (d) $(\partial V/\partial T) = -(\partial S/\partial p)$

8. A pure substance which exists in a single phase has ____ independent variables. CO1- U
- (a) zero (b) one (c) two (d) three
9. In adiabatic evaporative cooling, heat transfer between chamber and surroundings is CO1- U
- (a) zero (b) high
(c) low (d) none of the mentioned
10. The wet bulb temperature is the ____ temperature recorded by moistened bulb. CO1- U
- (a) lowest (b) highest
(c) atmospheric (d) none of the mentioned

PART – B (5 x 2= 10Marks)

11. Explain all assumptions made for SFEE CO1-U
12. Illustrate the causes of Irreversibility. CO1-U
13. Explain specific steam rate and give its unit CO1-U
14. Summarize the examples of real gases. CO1-U
15. Explain Psychometry. CO1-U

PART – C (5 x 16= 80Marks)

16. (a) A Fluid is confined in a cylinder by a spring loaded frictionless piston, so that the pressure in a fluid is a linear function of volume $P=a+bV$. The Internal Energy of the fluid is given by the following equation $U= 34+3.15PV$ Where U is in KJ, P is in KPa, V is in m^3 . If fluid changes from an initial state of 170 KPa, $0.03 m^3$ to a final state of 400 KPa, $0.06 m^3$ with no work transfer other than that done on the piston. Find the direction and magnitude of work and heat transfer. CO2 - App (16)
- Or
- (b) Derive an expression for steady flow energy equation and apply it to deduce an expression for steam turbine. 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 reservoir at a temperature of 40°C and -20°C . The heat to the heat engine is 2000 KJ and the network output of the combined engine and refrigerator plant is 360 KJ . Evaluate the heat transfer to the refrigerator and net heat transfer to the reservoir at 40°C . CO2 - App (16)

Or

- (b) 3 kg of air at 500 kPa , 90°C expands adiabatically in a closed system until its volume is doubled and its temperature becomes equal to that of the surroundings at 100 kPa and 10°C . Calculate the maximum work and irreversibility. (ii) Briefly discuss about the concept of entropy. CO2 - App (16)
18. (a) 2 Kg of steam initially at 5 bar and 0.6 dry is heated at constant pressure until the temperature becomes 350°C . Find the change in specific volume, change in Enthalpy, change in entropy, change in Internal Energy. CO3 - App (16)

Or

- (b) Determine the rankine cycle efficiency working between 6 bar and 0.4 bar when supplied with dry saturated steam. By what percentage is the efficiency increased by supplying superheated steam of 300°C . CO4 - App (16)
19. (a) A vessel of volume 0.3m^3 contains 15 kg of air at 303K . Determine the pressure exerted by the air using 1. Perfect gas equation, 2. Vander waals equation, 3. Generalized compressibility chart. Take critical temperature of air is 132.8K , critical pressure of air is 37.7 bar and $Z = 0.99$. CO3 - App (16)

Or

- (b) Derive the Maxwell relations and explain their importance in thermodynamics. CO3 - App (16)
20. (a) Consider a room that contains air at 1 atm , 35°C and 40% relative humidity using the Psychometric chart. Determine the: Specific humidity, enthalpy, Wet bulb temperature, Dew point temperature and specific volume of the air. CO4 - App (16)

Or

- (b) An air conditioning system has the following conditions **CO4 - APP (16)**
- 1) outdoor conditions 32°C dry bulb temperature and 75% relative humidity
 - 2) required indoor conditions 25°C DBT and 70% relative humidity, amount of pre air circulated $200\text{ m}^3/\text{min}$ per person
 - 3) seating capacity 50 person to required conditions is achieved first by cooling and dehumidification and then by heating
- Determine the following
- 1) capacity of cooling coil in tonnes
 - 2) capacity of heating coil
 - iii) Mass of water vapour removed if coil dew temp 14°C .