Reg. No. :

Question Paper Code: U3703

B.E./B.Tech. DEGREE EXAMINATION, APRIL 2024

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)

1. Properties do not change with time in   CO1- U

    (a) Slush casting   (b) Turbulent flow   (c) Unsteady flow   (d) Steady flow

2. Unit for specific heat   CO1- U

    (a) KJ/Kg   (b) Kg/KJ   (c) KJ   (d) KJ/KgK

3. Kelvin –Planck's law deals with   CO1- U

    (a) Conservation of work   (b) conservation of heat

    (c) conversion of heat into work   (d) conversion of work into heat

4. 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

5. Steam Power Plant is working based on   CO1- U

    (a) Carnotcycle   (b) Otto cycle   (c) Joulecycle   (d) Rankine cycle

6. In Rankine cycle, heat rejection takesplace at   CO1- U

    (a) V=C   (b) P=C   (c) T=C   (d) S =C

7. Which of the following relation is correct?   CO1- U

    (a) dU=TdS-pdV   (b) dH=TdS+Vdp   (c) dG=Vdp-SdT   (d) all of the above

8. 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) $(\partial V/\partial T) = -(\partial S/\partial p)$

9. When the adiabatic mixing is carried out, the air having _____ enthalpies and   CO1- U
_____ specific humidities are mixed.

(a) similar, similar   (b) different, similar

(c) similar, different   (d) different, different

10. In adiabatic evaporative cooling, heat transfer between chamber and   CO1- U
surroundings is

(a) zero   (b) high   (c) low   (d) none of the above

<div align="center">PART – B (5 x 2= 10Marks)</div>

11. Explain all assumptions made for SFEE   CO1- U

12. Explain dead state   CO1- U

13. Explain the term pure substance. Give Examples   CO1- U

14. Explain Maxwell's relations?   CO1- U

15. Explain Relative Humidity   CO1- U

<div align="center">PART – C (5 x 16= 80 Marks)</div>

16. (a) A Fluid is confined in a cylinder by a spring loaded frictionless CO2-App   (16)
          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 .

<div align="center">Or</div>

     (b) Derive steady flow energy equation and apply it to deduce an CO2-App   (16)
          expression for steam turbine.

17. (a) Two carnot Engine A and B operated in Series. The first one A CO2-App   (16)
          receives heat at 870 K and rejects to a reservoir at temperature(T).
          The second engine receives the heat rejected by the first engine and
          in turn rejects to a heat reservoir at 300K.Calculate the
          Intermediate temperature(T) in kelvin between two heat engines for
          the following cases. i) Two work output of the engines are equal ii)
          Efficiency of the two heat engines are equal

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Or

(b) A Closed system contains air pressure of 1 bar, temperature   CO2-App   (16)
300K,and volume 0.018 m^3 . The system undergoes a
thermodynamic cycle consisting of the following three process in
series i) Constant volume heat addition till heat pressure becomes 5
bar ii) constant pressure cooling and isothermal heating to initial
state . Draw the PV Diagram and find out change in entropy for
every process. State Cv= 0.718 KJ/KgK R= 0.287 KJ/KgK.

18. (a) A Vessel of volume 0.04 m^3 contains a mixture of saturated water   CO3- App   (16)
and saturated steam at a temperature of 250^0 C. The mass of liquid
present is 9 Kg. Find the Pressure, Mass, Specific Volume, Specific
Entropy , Specific Enthalpy, Specific Internal Energy.

Or

(b) A Steam boiler generate 30 bar and 300^0 C at the rate of 2Kg/s. The   CO4- App   (16)
steam is expanded isentropic in turbine to a condenser in a Pressure
of 0.05 bar condense at a constant pressure and pumb back to the
boiler. Find the Efficiency of the cycle , heat supplied in the boiler,
quality of steam after the expansion.

19. (a) A vessel of volume 0.3m^3 contains 15 kg of air at 303K. Determine   CO3- App   (16)
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.

Or

(b) Derive the Maxwell relations and explain their importance in   CO3- App   (16)
thermodynamics.

20. (a) Atmospheric air with barometric pressure of 1.0132 bar has 38^0C   CO4- App   (16)
dry bulb temperature and 28^0C wet bulb temperature without aid of
psychometic chart, determine humidity and relative humidity and
dew point temperature.

Or

(b) An air conditioning system has the following conditions 1)outdoor   CO4- App   (16)
conditions 15^0C dry bulb temperature and 10^0C wet bulb
temperature 2)required conditions 20^0C DBTand 50% relative
humidity, amount of pre air circulated 0.25 m^3/min per person 3)
seating capacity 50 person to requied conditons is achieved first by
heating and then by adaibatic humidification . determine the
following 1) capacity of heating coil 2)capacity of humidifier.