18129

BRAINWARE UNIVERSITY

Term End Examination 2025-2026
Programme – B.Tech.(ME)-2024
Course Name – Thermodynamics
Course Code - BTM30101
(Semester III)

Full Marks : 60 **Time : 2:30 Hours**

[The figure in the margin indicates full marks. Candidates are required to give their answers in their own words as far as practicable.]

Group-A

(Multiple Choice Type Question) 1 x 15=15

1. *Choose the correct alternative from the following :*

(i) Identify the law used to define thermal equilibrium.

a) First Law b) Second Law
c) Zeroth Law d) Third Law

(ii) Identify the diagram used to find work done.

a) T-s b) h-s
c) P-V d) P-T

(iii) Identify the Clausius statement of the second law.

a) Heat moves spontaneously from hot to cold b) Heat moves from cold to hot without work is impossible.
c) Heat always converts to work d) Heat flow is adiabatic

(iv) Identify the thermodynamic term representing disorder.

a) Enthalpy b) Work
c) Entropy d) Internal energy

(v) Select the correct formula for Carnot efficiency.

a) $\eta = T2/T1$ b) $\eta = 1 - T2/T1$
c) $\eta = 1 + T2/T1$ d) $\eta = T1 - T2$

(vi) Identify the cause of irreversibility.

a) Adiabatic process b) Slow expansion
c) Ideal conditions d) Friction and unrestrained expansion

(vii) Identify the correct formula for enthalpy.

a) h = u + Pv b) h = u - Pv
c) h = Pv - u d) h = u / Pv

(viii) Identify the system that allows mass and energy transfer.

a) Closed b) Isolated

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c) Open | d) Rigid

(ix) Identify the property constant in a throttling process.

a) Enthalpy constant | b) Pressure constant
c) Temperature constant | d) Internal energy constant

(x) Identify the phase region where water exists in vapor-liquid equilibrium.

a) Superheated | b) Saturated
c) Compressed | d) Subcooled

(xi) Choose the condition that defines the triple point.

a) P = 0, T = 0 | b) Solid, liquid, vapor coexist
c) High pressure only | d) Maximum entropy

(xii) Choose the correct definition of dryness fraction.

a) Ratio of gas to total mass | b) Ratio of vapor mass to total mass
c) Ratio of liquid to vapor | d) Temperature ratio

(xiii) Identify the meaning of hf in steam tables.

a) Enthalpy of saturated liquid | b) Enthalpy of vapor
c) Enthalpy of fusion | d) Enthalpy of reaction

(xiv) Identify what Mollier chart is primarily used for.

a) Work calculation | b) Turbine analysis
c) Steam properties | d) Temperature prediction

(xv) Identify where maximum entropy exists in Rankine cycle.

a) Before turbine | b) After turbine
c) Before condenser | d) After pump

Group-B

(Short Answer Type Questions) 3 x 5=15

2. State the Zeroth Law of Thermodynamics. (3)
3. Explain the difference between intensive and extensive properties. (3)
4. Solve the energy balance for a nozzle using SFEE. (3)
5. In a Rankine cycle, turbine work = 1200 kJ/kg, pump work = 100 kJ/kg. Calculate the net work. (3)
6. Explain the effect of reduced condenser pressure on the thermal efficiency of a Rankine cycle. (3)

OR

Differentiate between simple and regenerative Rankine cycles. (3)

Group-C

(Long Answer Type Questions) 5 x 6=30

7. A gas expands in a cylinder from an initial volume of 0.02 m³ to a final volume of 0.08 m³ following the law PV=C. The initial pressure is 300 kPa. Estimate the work done during the expansion. (5)
8. A rigid tank of volume 0.5 m³ contains air at 300 kPa and 27°C. Heat is added until the pressure reaches 500 kPa. Assuming ideal gas behavior, calculate the heat added. (5)
9. A Carnot engine operates between 600 K and 300 K. If it absorbs 900 kJ of heat from the high-temperature reservoir, calculate the work done and heat rejected. (5)
10. A Carnot refrigerator removes 1000 kJ of heat from a cold space at 260 K and rejects it to surroundings at 300 K. Estimate work input and COP. (5)
11. A reheat Rankine cycle receives steam at 15 MPa, 500°C, reheated at 2 MPa to 500°C, and exits at 0.1 MPa. Calculate the thermal efficiency assuming ideal processes. (5)
12. At 2 MPa, saturated steam enters a throttling valve and exits at 0.1 MPa. Estimate the exit temperature if the enthalpy remains constant. (5)

OR

Steam enters a turbine at 10 MPa, 500°C and leaves at 20 kPa with quality of 0.9. Estimate the (5)
work output per kg of steam assuming adiabatic expansion. Use steam tables.

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