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BRAINWARE UNIVERSITY

Term End Examination 2025-2026
Programme – Dip.ME-2024
Course Name – Thermal Engineering-1
Course Code - DME30103
(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 type of thermodynamic system that allows energy but not mass transfer.

a) Open system b) Closed system
c) Isolated system d) Adiabatic system

(ii) Select the intensive property from the following options.

a) Volume b) Enthalpy
c) Temperature d) Mass

(iii) Choose the process that is infinitely slow and reversible.

a) Irreversible b) Quasi-static
c) Isochoric d) Constant heat

(iv) Choose the correct statement about heat and work.

a) State functions b) Properties
c) Point functions d) Path functions

(v) Identify the process in which no heat enters or leaves.

a) Isothermal b) Isobaric
c) Isochoric d) Adiabatic

(vi) Identify the type of flow where all properties remain constant with time.

a) Steady flow b) Unsteady flow
c) Irregular flow d) Laminar flow

(vii) Identify the Clausius inequality.

a) $\oint dQ/T \geq 0$ b) $\oint dQ/T \leq 0$
c) $\oint dQ/T < 0$ d) $\oint dQ/T \geq 1$

(viii) Select the correct statement about entropy generation.

a) Positive for ideal b) Always positive

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c) Always zero
d) Negative in reality

(ix) Identify the device that violates second law.

a) Perpetual motion PMM-2
b) Carnot engine
c) Compressor
d) Boiler

(x) Select the cycle with highest efficiency for same temperature limits.

a) Diesel
b) Otto
c) Joule
d) Carnot

(xi) Identify the significance of dryness fraction in steam.

a) Indicates density
b) Indicates viscosity
c) Indicates phase quality
d) Indicates heat flow

(xii) Select the expression for enthalpy change in steam.

a) h = hf – hg
b) h = hf + xhfg
c) h = hg – xhf
d) h = hfg + xhf

(xiii) Choose the correct order of processes in Rankine cycle.

a) Boiler → Pump → Turbine → Condenser
b) Boiler → Turbine → Condenser → Pump
c) Pump → Turbine → Boiler → Condenser
d) Pump → Boiler → Condenser → Turbine

(xiv) Select the phase of water entering the boiler in ideal Rankine cycle.

a) Dry saturated liquid
b) Superheated steam
c) Saturated vapor
d) Compressed liquid

(xv) Select the state of steam at turbine inlet in reheat cycle.

a) Superheated
b) Saturated vapor
c) Wet steam
d) Compressed liquid

Group-B

(Short Answer Type Questions) 3 x 5=15

2. 2 kg of air at 300 K is heated to 600 K at constant volume. Cv = 0.718 kJ/kg·K. Estimate the heat added. (3)
3. A Carnot engine operates between 600 K and 300 K. Find efficiency. (3)
4. Classify systems into open, closed, and isolated with examples. (3)
5. Describe Carnot cycle with T-S diagram. (3)
6. 5 kg of gas is compressed isothermally at 300 K from 0.8 m^3 to 0.2 m^3. Calculate work done. R = 0.287 kJ/kg·K. (3)

OR

1 kg ideal gas (γ = 1.4) expands adiabatically from 500 kPa and 0.2 m^3 to 100 kPa. Calculate final volume and work. (3)

Group-C

(Long Answer Type Questions) 5 x 6=30

7. A gas is compressed isothermally from 0.5 m^3 to 0.2 m^3 at 300 K. Estimate the work done. (5)
8. A gas is compressed isothermally in a piston-cylinder arrangement from 0.5 m^3 to 0.2 m^3 at a constant temperature of 300 K. If the initial pressure is 200 kPa, Estimate the work done. (5)
9. Air at 25°C and 1 atm enters a compressor and leaves at 300°C and 6 atm. Calculate the work done per kg of air. Assume Cp=1.005kJ/kg, neglect KE and PE changes. (5)
10. A tank contains 5 kg of air at 500 kPa and 300 K. Estimate the total internal energy. Take Cv=0.718kJ/kg. (5)
11. Estimate the dryness fraction of steam if its enthalpy is 2400 kJ/kg at 1 MPa. Use values from steam table. (5)
12. A Carnot engine operates between 750 K and 323 K. If it absorbs 1200 kJ of heat from the high-temperature reservoir, calculate the work done and heat rejected. (5)

OR

A heat engine operates between 800 K and 400 K. If the engine absorbs 500 kJ of heat, calculate the maximum possible work. (5)

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