UNIVERSITY INSTITUTE OF ENGINEERING & TECHNOLOGY
CHHATRAPATI SHAHU JI MAHARAJ UNIVERSITY, KANPUR – 208024
Department of Chemical Engineering
(End semester Examination, **ESC-S202 Thermodynamics**)
CSE department, Second year

Time: 3 hours MM:50

Note: Attempt all questions

This paper has two pages, Section C is on page 2

Section A (1×10=10)

Q1) Second Law of thermodynamics defines_____.

Q2) For a reversible adiabatic process the change in entropy is_____.

Q3) The processes of a Carnot cycle are_____.

Q4) If the temperature of the source is increased, the efficiency of the Carnot engine_____

Q5) The efficiency of a Carnot engine using an ideal gas as the working substance is_____

Q6) An isentropic process is always_____.

Q7) Should the automobile radiator be analyzed as a closed system or as an open system?

Q8) Can entropy of universe ever decreases? Why?

Q9) Define triple point for pure substance.

Q10) What is meant by steam power cycles?

Section B (4×5=20)

NOTE: Give diagrams and equations to support the explanation

Write Short notes on (any 5)

a) Rankine Cycle
b) PMM1
c) Kelvin Planck Statement of second Law
d) Entropy
e) Otto Cycle
f) Carnot cycle
g) COP of heat pump/refrigerator

Section C (10×2=20)

Q1.

a) Prove the equivalence of Kelvin Planck and Clausius statements of Second Law.

b) Prove the statements of Carnot theorem.

Q2.

a) Find the co-efficient of performance and heat transfer rate in the condenser of a refrigerator in kJ/h which has a refrigeration capacity of 12000 kJ/h when power input is 0.75 kW.

b) 0.2 m^3 of air at 4 bar and 130°C is contained in a system. A reversible adiabatic expansion takes place till the pressure falls to 1.02 bar. The gas is then heated at constant pressure till enthalpy increases by 72.5 kJ. Calculate:
(i) The work done;
(ii) The index of expansion, if the above processes are replaced by a single reversible polytropic process giving the same work between the same initial and final states.
Take cp = 1 kJ/kg K, cv = 0.714 kJ/kg K.

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CSE department, Second year

Time: 1.5 hours

MM:30

DATE : 24/08 Shift II

Section A (1×9=9)

Q1) What is meant by Thermodynamics?

Q2) Give few applications of thermodynamic laws and principles.

Q3) What is meant by the thermodynamic system?

Q4) What are the various types of open system?

Q5) Explain homogeneous and heterogeneous system.

Q6) What is meant by thermodynamic property?

Q7) Define thermodynamic equilibrium.

Q8) Define the term thermodynamic Cycle.

Q9) Differentiate Path function and Point function.

Section B (3×3=9)

Q1. Compare microscopic and macroscopic approaches.

Q2. Explain constant pressure and constant volume gas thermometers with the help of suitable diagrams and equations.

Q3. Explain Zeroth Law of thermodynamics. Give a table of thermometers and thermometric properties.

Section C (6×2=12)

Q1. Solve the following equation if exact, $dP = \frac{RdT}{v-b} - \left\{\frac{RT}{(v-b)^2} - \frac{2a}{v^3}\right\} dv$

Where P is pressure, T is temperature, v is volume and a, b, R are constants.

Q2. A U-tube mercury manometer with one arm open to atmosphere is used to measure pressure in a steam pipe. The level of mercury in open arm is 97.5 mm greater than that in the arm connected to the pipe. Some of steam in the pipe condenses in the manometer arm connected to the pipe. The height of this column is 34 mm. The atmospheric pressure is 760 mm of Hg. Find the absolute pressure of steam. The diagram of manometer is on next page.

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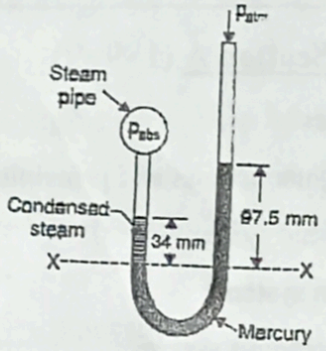

Fig. 2.26

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Section A (1×9=9)

Q1) Define internal energy.

Q2) Define gauge pressure and absolute pressure. Give units of pressure.

Q3) A container filled with a sample of an ideal gas at the pressure of 1.5 atm. The gas is compressed isothermally to one-fourth of its original volume. What is the new pressure of the gas?

Q4) Give sign convention for work (*OLD & NEW*).

Q5) During all adiabatic process, the change in internal energy is equal to work done.

(***True/False***)

Q6) What is meant by reversible process.

Q7) Define free expansion process.

Q8) What are the limitations of the first law of thermodynamics?

Q9) What are the conditions for steady flow process?

Section B (3×3=9)

Q1. Derive the steady flow energy equation. (SFEE) , *first law for open system.*

Q2. Define and give equations for: Shaft work, Flow work, magnetic work.

Q3. Derive the equations of enthalpy. Define enthalpy.

Section C (6×2=12)

Q1. The properties of a certain fluid are related as follows:

$u=196+0.718t$

$pv=0.287(t+273)$ · ·

where u is the specific internal energy (Kj/kg), t is in °C , p is the pressure (kN/m^2), and v is the specific volume (m^3/kg) .For this fluid find c_v and c_p.

Q2. A system composed of 2Kg of the above fluid expands in a frictionless piston and cylinder machine from an initial state of 1MPa , 100°C to a final temperature of 30°C.If there is no heat transfer find the net work for the process.