BRAINWARE UNIVERSITY

Term End Examination 2024-2025
Programme – B.Tech.(ME)-2023
Course Name – Thermodynamics
Course Code - PCC-ME302
(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 non-renewable energy source.
   a) Nuclear energy b) Bio-mass
   c) Both 1 & 2 d) None of these

(ii) Identify the reaction by which fuel cell converts chemical energy to electrical energy.
   a) Eliminates combustion of fuel. b) Requires combustion of fuel.
   c) Requires no ignition of fuel. d) Fuel is not required.

(iii) Identify the type of cell used for building a laptop battery pack.
   a) Nickel cadmium b) Lithium ion
   c) Zinc silver oxide d) Lead acid

(iv) Determine if temperature of the source is incressed, the efficiency of the Carnot engine.
   a) Increase b) Decrease
   c) Remains constant d) First increases and then becomes constant

(v) Identify the thermodynamic process where there is no flow of heat between system and surrounding.
   a) Isobaric b) Isochoric
   c) Adiabatic d) Isothermal

(vi) Heat does not spontaneously flow from a colder body to a hotter one. Identify the thermodynamics law.
   a) Zeroth law b) First law
   c) Second law (Kelvin - Plank) d) Second law (Clausius)

(vii) Quote the appropriate phenomena related to degree of super-heat.
   a) The temperature beyond the freezing point. b) The temperature beyond the boiling point.
   c) The temperature beyond 273 K. d) None of these.

(viii) Choose the correct cases provision of fins on a given heat transfer surface will be more effective.

a) Fewer but thin fins
b) Large number of thin fins
c) Large number of thick fins
d) Fewer but thick fins

(ix) Predict the imortant factors of thermal radiation.

a) Time.
b) Temperature.
c) Volume.
d) Pressure.

(x) Identify the physical phenomena which is introduced by the second law of thermodynamics.

a) Heat
b) Temperature
c) Entropy
d) Internal energy of the system

(xi) Identify the quantity upon which the enthalpy and internal energy are the function of temperature.

a) All gases.
b) Steam.
c) Water.
d) Ideal gas.

(xii) Choose the correct option for a steady flow process.

a) Mass flow rate is constant
b) Heat transfer rate is constant
c) Work transfer rate is constant
d) All of the these

(xiii) Identify the sensible heat of water.

a) greater than the latent heat of steam
b) less than the latent heat of steam
c) equal to the latent heat of steam
d) none of the these

(xiv) Identify the amount of heat supplied during super-heating of steam.

a) latent heat
b) sensible heat
c) both sensible and latent heat
d) none of the these

(xv) Identify the machine which is impossible to buid up according to first law of thermodymics.

a) PMM-I
b) PMM-II
c) PMM-III
d) PMM-IV

Group-B

(Short Answer Type Questions) 3 x 5=15

2. Determine the enthalpy, internal energy and entropy of steam per kg when (a) steam is at 14 bar and 0.75 dry, (b) steam is at 14 bar and at 300° C. (3)

3. Estimate the change in internal energy when 1 kg of steam expands from 10 bar and 300° C to 0.5 bar and 0.9 dry. Take C_p = 2.1 kJ/kg-K. (3)

4. A spherical shell of 80 cm in diameter contains saturated steam and water at 303.3° C. Estimate the mass of saturated steam and saturated water in the shell if their volumes are equal. (3)

5. Develop a relation between COP of Heat pump and COP of refrigerator (with schematic diagram). (3)

6. A drum of 0.085 m^3 contains saturated water and steam at 334° C. If the volume of each (water and steam) is equal, estimate the mass of each. (3)

OR

Steam at 10 bar and 240o C is flowing through a pipe loses 4000 kJ of heat but pressure remains constant. Estimate the quality of steam coming out of the pipe if the flow of steam is 5 kg/s. (3)

Group-C

(Long Answer Type Questions) 5 x 6=30

7. A heat engine operates between a source a 600° C and a sink at 60° C. Evaluate the least rate of heat rejection per KW net output of the engine. (5)

8. Dry and saturated steam at pressure 11 bar is supplied to a turbine and expanded isentropically to pressure 0.07 bar. Find the amount of heat supplied. (5)

9. Identify a steady flow process. State all the assumptions for steady flow process. (5)
10. Explain the limitations of 1st law of thermodynamics. (5)
11. Steam at 550 kPa and quality of 92% occupies a rigid vessel of 0.4 m^3. Evaluate the mass, internal energy and enthalpy of the system. (5)

12. A certain quantity of air has a volume of 0.028 m^3 at a pressure of 1.25 bar & 25° C. It is compressed to a volume of 0.0042 m^3 according to law $pv^{1.3}$ = constant. Evaluate the final temperature and work done during compression. Also, determine the reduction in pressure at a constant volume required to bring back the air to its original temperature. (5)

OR

A chilled water of 15 kg/s enters the system for air conditioning a tall building with a velocity of 60 m/s at an height of 40 m from the ground. The water leaves the system with a velocity of 20 m/s at an height of 70 m. The enthalpies of water entering in and leaving out are 30 KJ/kg and 50 KJ/kg respectively. The rate of workdone by a pump in the line is 40 KW. Evaluate the rate at which heat is removed from the building. (5)

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