3E1208

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B.Tech. III Sem. (Main) Examination, April/May - 2022
Automobile Engineering
3AE4-05 Engineering Thermodynamics
AE, ME

Time : 3 Hours Maximum Marks : 70

Instructions to Candidates:

Attempt all ten questions From Part A, All five Questions from Part B and three questions out of five questions from Part C .

Schematic diagram must be shown wherever necessary. Any data missing may suitably be assumed and states clearly. Units of quantities used/calculated must be stated clearly.

Use of following supporting material is permitted during examination (As mentioned in form No. 205).

PART - A (Word limit 25) **(10×2=20)**

1. What is thermodynamic equilibrium? **(2)**
2. What is triple point of a substance? **(2)**
3. Explain clausius statement? **(2)**
4. Explain the principle of entropy increase? **(2)**
5. What is a pure substance? **(2)**
6. Explain Gibbs Dalton law. **(2)**
7. In Otto, Diesel and dual cycle, with same operating conditions which cycle has the maximum thermal efficiency? **(2)**
8. What are the thermodynamic variables? **(2)**
9. What are the properties of Ideal working fluid in vapour power cycle? **(2)**
10. What do you mean by Regeneration in a cycle. **(2)**

PART - B (Word limit 100) **(5×4=20)**

1. 0.3 Kg of nitrogen gas of 100 kpa and 40°C is contained in a cylinder. The piston is moved compressing or Nitrogen until 1 MPa. at this point the temperature is 160°C. The work done during the process is 30 KJ. Calculate the heat transfer from the Nitrogen.

   To the surroundings take C_v = 0.75 KJ/kg K. for Nitrogen. **(4)**

3. Explain the concept of Entropy and Irreversibility and prove

$$ds \geq \frac{\delta Q}{T}$$ (4)

3. A vessel of $0.03m^3$ capacity contains gas at 3.5 Bar pressure and 35°C temperature. Determine the mass of the gas in the vessel. If the pressure of this gas is increased to 10.5 Bar while the volume remain constant, What will be the temperature of the Gas? For the gas take R = 290 J/kg K (4)

4. A) Prove that the equation for enthalphy is given by: all nomenclature have usual meaning.

$$dh = C_p dT + \left\{ v - T\left(\frac{\partial v}{\partial T}\right)_p \right\} dP$$

 (2)

B) Prove that thermal efficiency of an Otto cycle is given by: $\left\{\eta = 1 - \frac{1}{r^{\gamma-1}}\right\}$.

Where all nomenclature have usual meaning. (2)

5. A) Explain vapour power cycle with a neat Diagram. (2)

B) What are the various effect of operating conditions on the efficiency of vapour power cycle? (2)

PART - C (Any three) (3×10=30)

1. A) The specific heat capacity of the system during a certain process is given by:

$$C_v = (0.4 + 0.004T)\, KJ/kg\,{}^{0}C$$

If the mass of the gas is 6 kg and its temperature changes from 25°C to 125°C find:

i) Heat transferred

ii) Mean specific heat of gas. (5)

B) Comment whether the following quantities can be called as properties or not.

i) $\int Pdv$ ii) $\int vdP$ iii) $\int Pdv + vdP$ (5)

2. Air at 20°C and 1.05 bar occupies $0.025m^3$, the air is heated at constant volume until the pressure is 4.5 Bar, and then cooled at constant pressure.

Back to original temperature. Calculate.

i) Net heat flow from the air.

ii) Net entropy change. Sketch the process on T-S diagram. (10)

3. Write short notes on

A) P-V-T Surface

B) Dryness fraction

C) Super heated Steam

D) Latent heat. (10)

4. For a perfect gas obeying Pv=RT show that C_v and C_p are independent of pressure. (10)

5. A turbine is supplied with steam at a pressure of 32 Bar and a temperature of 410°C. The steam then expands isentropically to a pressure of 0.08 Bar. Find the dryness fraction at the end of expansion and thermal efficiency of the cycle.

If the steam is reheated at 5.5 Bar to a temperature of 395°C and then expanded isentropically to a pressure of 0.08 Bar, What will be the dryness fraction and thermal efficiency of the cycle? (10)