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Total No. of Questions : 09

B.Tech. (Sem.–1,2)
ELEMENTS OF MECHANICAL ENGINEERING
Subject Code : ME-101 (2004-2010 Batch)
Paper ID : [A0123]

Time : 3 Hrs. **Max. Marks : 60**

INSTRUCTION TO CANDIDATES :

1. **SECTION-A is COMPULSORY.**
2. **Attempt any FIVE questions from SECTION - B & C.**
3. **Selecting at least TWO questions from SECTION - B & C each.**

SECTION-A (2 marks each)

1. (a) Define the terms state, property, process and cycle.
   (b) Why does entropy remains constant in a reversible adiabatic process?
   (c) List the conditions for which $\delta Q - \delta W = dU$?
   (d) Show that enthalpy of a fluid before throttling is equal to after throttling.
   (e) What is a heat pump? How it is different from refrigerator?
   (f) Define following terms in relation to internal combustion engines :
   i) Dead centre ii) Stroke iii) Piston speed iv) Compression ratio.
   (g) How the internal combustion engines are classified?
   (h) What are kinematic links? How they are classified?
   (i) What is law of machine?
   (j) Define resilience, proof resilience and modulus of resilience.

SECTION-B (8 marks each)

2. (i) Show that polytropic specific heat is given by the expression

$$c_n = C_v\left(\frac{\gamma - n}{n - 1}\right)$$

   (ii) A tank containing air is stirred by paddle wheel. The work input to the paddle wheel is 6000 *kJ* and the heat transfer to the surroundings from the tank is 200 *kJ*. Determine the change in internal energy of the system and the work done.

3. A steam turbine delivers 20 *kW* by receiving steam at 14 *bar* with u_1 = 2730 *kJ/kg*, v_{S_1} = 0.166 m^3/kg and V_1 = 120 *m/s*. Steam comes out of the turbine with u_2 = 2340 *kJ/kg*, v_{S_2} = 18.6 m^3/kg and V_1 = 330 *m/s*. The heat lost from the turbine is 20 *kJ/kg*. Neglecting the changes in potential energy, determine the work done per *kg* of steam flow through the turbine and steam flow through the turbine-in *kg per minute*.
4. Derive the expression for change in entropy for the following processes:
   (a) Constant volume process
   (b) Constant pressure process
   (c) Adiabatic process
   (d) Polytropic process
5. Air undergoes a cyclic process in a cylinder and piston arrangement. First the atmospheric air at 1 *bar* and 27°C is compressed adiabatically to 10 *bar* then expanded isothermally to initial pressure , then brought to initial conditions under constant pressure. Find out, (i) change in internal energy, (ii) change in enthalpy, (iii) heat transfer, (iv) work transfer.

SECTION-C **(8 marks each)**

6. An engine working on Otto cycle has a volume of 0.5m^3, pressure 1 *bar* and temperature 27°C at the beginning of the compression stroke. At the end of the compression stroke, the pressure is 10 *bar,* 210 *kJ* of heat is added during the constant volume heating process. Calculate the pressures, temperatures and volumes at the salient points of the cycle. Also find the percentage clearance, efficiency, network done per cycle and mean effective pressure.
7. (i) Describe the working principle of a two stroke petrol engine with a neat diagram.
   (ii) Sketch and describe a four bar chain mechanism.
8. Describe with a neat diagram the following lifting machines, (i) Wheel and differential axle (ii) Worm and worm wheel (iii) Third system of pulleys.
9. A bar 100 *cm* in length is subjected to an axial pull, such that the maximum stress is equal to *150 MN/m^2*. It's area of cross section is 2 *cm^2* over a length of 95 *cm* and for the middle 5 *cm* length it is only 1 *cm^2*. If *E* = 200 *GN/m^2,* calculate the strain energy stored in bar.