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Total No. of Questions : 09

B.Tech. (Sem.–1,2)

ELEMENTS OF MECHANICAL ENGINEERING

Subject Code : ME-101   (2005-2010 Batches)

Paper ID : [A0123]

Time : 3 Hrs.   Max. Marks : 60

INSTRUCTION TO CANDIDATES :

1. SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.
2. SECTION - B & C have FOUR questions each.
3. Attempt any FIVE questions from SECTION B & C carrying EIGHT marks each.
4. Select atleast TWO questions from SECTION - B & C.

SECTION-A

l. Write briefly :

a) Why shape, colour and odour are irrelevant in thermodynamics?

b) Set up an expression for the displacement work done during an\ arbitrary process.

c) How does a control volume differ from a system?

d) Comment on the validity of the statement: *"All reversible engines operating between the same two thermal reservoirs have the same efficiency."*

e) Write the expression for heat transfer which is equivalent to the term *pdv* for work transfer.

f) What is cutoff ratio? How does it affect the air standard efficiency of a Diesel cycle?

g) What are the two basic types of internal combustion engines? What are the fundamental differences between the two?

h) How does a machine help to achieve gain in force?

i) State the principle of superposition and point out its utility.

j) Define direct, shear and volumetric stresses and corresponding strains.

SECTION-B

2. i) Determine the molecular weight of a gas if its specific heats are $c_p = 2.286$ $kj/kg - K$ and $c_v = 1.768$ $kj/kg - K$. (4)

   ii) One mole of an ideal gas at 10 bar and 300 K at constant pressure till the volume is doubled and then it is allowed to expand at constant temperature till the volume is doubled again, Calculate the work done by the gas. (4)

3. i) Show that when an ideal gas is compressed in a piston cylinder assembly according to polytropic law $pV^n = C$. the heat rejected, increase in internal energy and work done are in the ratio. (4)

   ii) What is the concept of continuum? How density and pressure are defined using this concept.

   $(\gamma - n) : (n - 1) : (\gamma - 1)$ (4)

4. i) Make an energy analysis of a turbine. (2)

   ii) Steam enters a steam turbine at 5m elevation, at a velocity of 30m/s. enthalpy 2950 kJ/kg. At exit the velocity is 600 m/s, enthalpy 2200 kJ/kg and elevation 2m, 75 kJ/kg of heat is lost to the surroundings. Calculate the work output of the turbine. (6)

5. A reversible engine operates between three heat reservoirs X, Y, and Z. The engine receives equal amount of heat from reservoir X and Y at temperatures T_x and T_y respectively and rejects heat to a reservoir Z at temperature T_z. If the efficiency of the engine is β times the efficiency of a reversible engine operating between two reservoirs X and Z only, show that (8)

$$\frac{T_x}{T_\gamma} = 2(1-\beta) \; \frac{T_x}{T_z} + (2\beta - 1)$$

SECTION-C

6. A six cylinder four stoke Diesel engine has compression ratio 16 to l. The bore and stroke are 200 mm and 250 mm respectively and the engine runs at 1200 rpm. Ambient conditions are 100kPa and 300 K. Calculate the power produced if the cut off is 10% of the stroke. What is the maximum temperature ? (8)

7. A substance is initially at $0.5MPa$ pressure and 0.25m^3. It is compressed by an isentropic process so that the final pressure is $3MPa$. Find,

   i) changes in enthalpy, internal energy and entropy,

   ii) heat and work interactions during the process. (8)

8. A vertical circular copper bar 20mm diameter and 3m long carries a tensile load of 200kN. Calculate the elongation, decrease in diameter and the volumetric strain. (8)

9. i) Give a neat sketch of the theoretical and actual pV diagrams for a four stroke Petrol engine. Describe briefly the factors which account for deviations between these plots. (4)

   ii) Sketch and describe the working of crank and slotted lever type quick return mechanism. (4)