Roll No. | | | | | | | | | | | | **Total No. of Pages : 02**

Total No. of Questions : 09

B.Tech. (2011 onwards) (Sem.–1,2)

ELEMENTS OF MECHANICAL ENGINEERING

Subject Code : BTME-101

Paper ID : [A1107]

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

1. Write briefly :

a) Explain, the difference between temperature, heat and internal energy.

b) State the basic assumptions of steady flow energy equation.

c) Why does the enthalpy of an ideal gas depends upon temperature only?

d) State Carnot theorem for an engine and a refrigerator.

e) How the Second law of thermodynamics overcomes the limitation of First law?

f) What is function of crank shaft and flywheel in an IC engine?

g) What is air standard efficiency? Write its expression for diesel cycle.

h) What is mild steel? How is it different from cast iron and wrought iron?

i) How does stainless steel become stainless?

j) Define centre of gravity and centroid.

SECTION-B

2. a) A mass of 1.5 kg of air is compressed in a quasi-static process from 1.1 bar to 10 bar according to the law $pV^{1.25} = Constant$. The initial density of air is 1.2 kg/m^3. Find the work involved in the compression process. 4

   b) What is the concept of continuum? How density and pressure are defined using this concept? 4

3. Steam enters a nozzle at a pressure of 7 bar and 205°C (*i.e.* initial enthalpy 2850 kJ/kg) leaves at a pressure of 1.5 bar. The initial velocity of steam at the entrance is 40m/s and exit velocity from the nozzle is 700 m/s. The mass flow rate through the nozzle is 1400 kg/hr. The heat loss from the nozzle is 11705 kJ/hr. Determine the final enthalpy of steam and the nozzle exit area, if the specific volume is 1.24 m^3/kg. 8

4. a) Prove that the efficiency of an engine working on a reversible cycle depends only on the temperature of source and sink and is independent of the working fluid. 4

   b) Comment on the validity of the statement : All reversible engines operating between the same two thermal reservoirs have the same efficiency. 4

5. a) Define entropy and show that for an irreversible process. 4

$$\int dS > \int \frac{\delta Q}{T}$$

   b) Heat flows from a reservoir at 800 K to another reservoir at 250 K. If entropy change of the hot reservoir is –4 kJ/K, determine the entropy change of the cold reservoir. 4

SECTION-C

6. Derive an expression for efficiency and mean effective pressure of Otto cycle. 8

7. a) Find the moment of inertia of a circle about its diametrical axis. 4

   b) Find the centroid of a quarter of a circle. 4

8. a) Discuss the effect of following alloying elements in steel :

      a) Chromium

      b) Nickel

      c) Tungsten

      d) Sulphur 4

   b) What are ceramics? Explain classification of ceramics. Also write properties and application of ceramics. 4

9. a) Explain briefly, particle-reinforced, fibre-reinforced and structural composite. 4

   b) A diesel engine takes in air at 1 bar and 27°C. The compression and expansion ratios are 18 and 6 respectively. Estimate the quantity of heat energy added, rejected and the efficiency of the cycle. Take $\gamma = 1.4$, $c_p = 1.005$ kJ/kg – K, and $c_v = 0.717$ kJ/kg – K. 4