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

INSTRUCTIONS 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) Define property and mention its main characteristic in relation to a cyclic process.

   b) Define specific heat. Why there are two specific heats for gases?

   c) Name and state the property introduced by the first law of thermodynamics.

   d) Show that the work done in a steady flow process is given by – $\int v dp$.

   e) Explain the concept of Clausius Inequality.

   f) Comment on the statement, "*The entropy of the universe tends to be maximum*".

   g) Define the terms available energy and unavailable energy.

   h) How IC engines are classified?

   i) Give the position of centroid of a triangle and semicircle.

   j) Give composition and uses of high carbon steel and high speed steel.

SECTION-B

2. a) Set up an expression for the displacement work done during any arbitrary process. (3)

   b) Air initially at 75 *kPa* pressure, 1000K temperature and occupying a volume of $0.12m^3$ is compressed isothermally until the volume is halved and subsequently it undergoes further compression at constant pressure till the volume is halved again. Sketch the process on p - V diagram and make calculations for work done. (5)

3. A steady flow of water at enthalpy 250 kj/kg enters a section of the heating plant of building in which there are no pumps. The water leaves the section at enthalpy 200 kj/kg. The exit pipe is 25 m above the inlet pipe. Neglecting changes in kinetic energy, make calculations for the heat transfer from the water. (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) A reversible heat engine receives heat from two thermal reservoirs at 870 K and 580 K, and rejects 50 kW of heat two a sink at 290 K. If the engine output is 85 kW, make calculations for the engine efficiency and heat supplied by each reservoir. (4)

5. a) Show that whenever a system executes a complete cyclic process, $\phi \frac{\delta Q}{T}$ is less than zero or in the limit is equal to zero. Hence prove that entropy is a property of the system. (4)

   b) A fluid transfers 2000kJ of heat to the environment at 300 K. If the entropy change of the fluid is –5 kJ/K determine the overall entropy change and comment on the nature of the process whether possible, reversible, irreversible. (4)

SECTION-C

6. Derive an expression for efficiency and mean effective pressure for a Dual cycle. (8)

7. A vertical cylinder with diameter 30 cm and height 40 cm is topped by a right circular cone of same diameter and height 20 cm. Find the C.G. of the composite body from the apex of the cone. (8)

8. a) Differentiate between the following :

      i) Creep and fatigue

      ii) Yield stress and proof stress

      iii) Ductile and brittle fracture (6)

   b) What are the commercial alloys of aluminum? Briefly describe their composition and uses. (2)

9. A diesel engine operates on the air standard diesel cycle. The engine has six cylinders of 11 cm bore and 13 cm stroke. The engine runs at 2000 *rpm*. At the beginning of compression the air is at 1 bar and 26°C. If the clearance volume is 12.5 percent of the stroke volume, find :

   a) compression ratio.

   b) pressure and temperature of the air after compression.

   c) thermal efficiency and power output if the air is heated to 1370°C. (8)