Roll No. ....

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B.Tech. (Sem.–1,2)
ELEMENTS OF MECHANICAL ENGINEERING
Subject Code : BTME-101 (2011 Batch)
Paper ID : [A1107]

Time : 3 Hrs.   Max. Marks : 60

INSTRUCTION TO CANDIDATES :
1. SECTION-A is COMPULSORY.
2. Attempt any FIVE questions from SECTION - B & C.
3. Select at least TWO questions from each SECTION-B & C.

SECTION-A   (10 × 2 = 20 Marks)

l. Write short notes on :
   (a) Show that work is a path function.
   (b) What is a free expansion process? What are its characteristics?
   (c) Differentiate between a heat pump and a refrigerator.
   (d) Draw the variation of thermal efficiency against compression ratio of an Otto cycle.
   (e) What is function of piston rings in an internal combustion engine?
   (f) Differentiate between brass and bronze.
   (g) What are technological properties of materials?
   (h) What is moment of inertia and why it is called second moment of area?
   (i) Differentiate between thermoplastic and thermosetting plastic.
   (j) An inventor of heat engine claims that his engine is 75% efficient which receives heat at 100°C and rejects at 20°C. How do you rate his claim?

SECTION-B   (8 Marks each)

2. (a) A mass of gas is compressed in a quasi-static process from *80kPa, 0.1m³ to 0.4 MPa, 0.03m³*. Assume that pressure and volume are related by $pV^n = Constant$. Find the work done by the gas system. (5)

   (b) Define control volume and control surface. How does control volume differ from an open system.? (3)

3. (a) Write down the general steady flow energy equation and deduce it for a nozzle, stating the assumptions taken. (2)

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

4. (a) State and prove Clausius inequality. (4)

(b) In a refrigerator, heat is transferred from a lower temperature to higher temperature. Is this a violation of second law of thermodynamics? Explain. (4)

5. (a) Define the term entropy. Show that entropy is a property of the system. (4)

(b) Heat flows from a hot reservoir at 800 *K* to another reservoir at 250 *K*. If the entropy change of overall process is 4.25 *kJ/K*, make calculations for the heat flowing out of the high temperature reservoir. (4)

SECTION-C (8 Marks each)

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

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

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

8. (a) Discuss the composition, specific properties and main applications of the following materials:

    (i) Mild steel   (ii) High carbon steel

    (iii) High speed steel   (iv) Stainless steel (6)

(b) State Thermochromic and Photochromic effects. (2)

9. (a) A gas engine working on Otto cycle has :

cylinder bore (diameter) = 220 *mm*; stroke length = 300 *mm*, clearance volume = 1600 *cm³*. Find the air standard efficiency. Take $\gamma = 1.4$. (4)

(b) List the major factors affecting the selection of materials. (4)