

**Elements of Mechanical Engineering**  
**(ME-101, Dec.2005)**

Time: 3 Hours

Max. Marks: 60

**Note:** Question No. 1 is compulsory. Attempt five questions from section A and B, taking at least two questions from each section.

**Section-A**

1. (a) State the Zeroth law of Thermodynamics.  
(b) Discuss whether  $(Pdv + Vdp)$  represent the system properties or not?  
(c) How enthalpy is related to the internal energy?  
(d) State the principle of entropy, draw T-S diagram for it.  
(e) A close system contains air at 1 bar, 190 K and occupies  $0.02 \text{ m}^3$  of volume. This system is heated at constant volume till pressure become 4 bar. For the problem draw P-V and T-S diagram only.  
(f) Draw P-V and T-S diagram for an engine operated by Dual cycle.  
(g) State the condition of reversibility of lifting machine.  
(h) Draw a stress-strain curve for a mild steel specimen.  
(i) What is fatigue, define?  
(j) Which of the following material has the maximum ductility?  
(a) Mild steel (b) Copper (c) Zinc (d) Aluminium

**Section-B**

2. (a) State the condition for a process to be reversible.  
(b) Classify the thermodynamic system and explain them with the help of simple diagrams.  
(c) A non flow reversible process occurs for which pressure and volume are correlated by the expression  $P=(V^2 + 6V)$ , where P is in bar and V is  $\text{m}^3$ . What amount of work will be done when volume changes from 2 to  $4 \text{ m}^3$ ?
3. (a) Explain the corollaries of first law.  
(b) A close system having a mass of 50 Kg has an initial velocity of 10 m/s. Subsequently its velocity increases to 30 m/s and its elevation also rises by 40 m. During this process the system receives 30000 J of heat and 4500 J of work. If the system delivers 0.002 KWh of electrical energy, determine the change in internal energy of the system.
4. (a) Differentiate between different polytropic process, draw common P-V diagram showing expression follow the law  $PV^n=C$  for  $n=0$ ,  $n=1$ ,  $n=n$ .  
(b) 3 Kg of air kept at an absolute pressure of 100 Kpa and temperature of 300 K is compressed polytropically until the pressure and temperature becomes 1500 KPa and 500 K respectively. Evaluate the polytropic exponent, the final volume and the work of compression. Take gas constant,  $R=287 \text{ J/Kg K}$ .
5. (a) Explain revised heat engine Carnot cycle with the help of P-V diagram.  
(b) Three real heat engines have the same thermal efficiency and are connected in series. The first engine absorbs 2400 KJ of heat from a thermal reservoir at 1250 K and the third engine rejects its waste of 300 KJ to a sink at 150 K, determine the work output from each engine.

**Section-C**

6. (a) Explain the working principle of an air standard cycle with the help of P-V and T-S diagram.  
(b) A four stroke engine working on diesel cycle has a piston diameter 25 cm, stroke of 40 cm and clearance volume of 1200 cc. The fuel injection takes place for 5% of stroke. If the induction pressure corresponding to 1 bar and engine turns 5 rev/s, find the air standard efficiency of the engine and power developed.
7. (a) Define input, output and efficiency of a simple lifting machine.  
(b) A simple lifting machine raised a load of 360 N through a distance of 200 mm. The effort a force of 60 N is moved 1.8 m during the process. Calculate velocity ratio, mechanical advantage and efficiency of the machine.
8. Write notes on the followings  
(a) Torsion and bending (b) Stress and strain (c) Sudden and impact load (d) Modulus of rigidity and Bulk modulus.
9. (a) What is creep? Explain the different stages of creep with the help of common diagram.  
(b) Differentiate between torsion and bending.