**Elements of Mechanical Engineering**
**(ME-101, Dec-2007)**

**Note:** Section A is compulsory. Attempt any five questions from section B & C taking at least two questions from each part.

## Section-A

1. a) Write steady flow energy equation for a steam turbine.
   b) Represent isothermal and adiabatic processes on p-v chart.
   c) Define thermodynamic state, path, process and cycle.
   d) How zeroth law of thermodynamics is applied in thermometry?
   e) How do you state flow and non flow work mathematically?
   f) What is air standard efficiency? Write its expression for diesel cycle.
   g) Define link, kinematic chain with example.
   h) State the law of lifting machine.
   i) Differentiate between creep and fatigue.
   j) Draw differential wheel and axle arrangement.

## Section-B

2. A mass of 10 kg at room temperature is dropped from a height of 10m into a bucket at room temperature containing 200 kg of water. Calculate the change in internal, potential and kinetic energies, heat and work transfer for following two cases:
   (a) Stone is just about to strike the water.
   (b) Stone just stopped at bottom of bucket.
3. (a) During a non flow frictional less compression process the volume changes from 0.12 $m^3$ to 0.04$m^3$ and system rejects 40 KJ of heat. Determine the change in internal energy, heat loss and enthalpy if pressure varies with volume as p(bar) = 4.5 (v) + 2; where v in $m^3$ and internal energy is given by the equation U = 40 – p(bar).v ($m^3$)
   (b) A steady operating pneumatic motor develops a shaft power of 0.1 kw when supplied with dry air at a pressure of 10 bar and at a temperature of 300 K and exhausting at 1 bar. The motor is adiabatic and the isentropic efficiency (i.e. the ratio of the actual enthalpy drop to the isentropic drop from the same initial state to the final pressure) is 0.7. the chance in specific KE between supply and exhaust is negligible. Determine the temperature of the air leaving the motor (°C) and mass flow rate.
4. An engine has a compression ratio of 5. The bore and stroke are 150 mm and 250mm respectively. At the beginning of compression the air is at 1 bar and 27°C, compression then occur according to the law $pv^{1.2}$ = constant. Calculate:
   (a) The temperature at the end of compression.
   (b) the work done during compression.
   (c) the interchange of heat between the air and the cylinder walls during compression.
   For air take $c_v$ = 0.717 kj/kg K and $c_p$ = .004 kj/kg K

5. Calculate the change in entropy of the universe owing to each of the following processes.
   (a) 0.5 kg of copper block at 100°C is placed in water reservoir at 10°C.
   (b) Same block at 100°C is dropped from height of 100mm into the reservoir and comes to rest without any of temperature of the block.
   (c) Two blocks at 100°C and 0°C joined together.
   $c_{cu}$ = 0.393 kj/kg K at 100°C and 0.381 kj/kg at 0°C.

**Section-C**

6. (a) Explain the working of four stroke IC engine with neat sketches.
   (b) derive the expression for the air standard efficiency for dual cycle.
7. (a) Explain the working of Oldham coupling.
   (b) A weight of 48 N is to be raised by means of a wheel and axle. the axle is 100mm diameter and wheel is 400mm diameter. If the force of 16 N has to be applied to the wheel, find;
   (i) Mechanical advantage
   (ii) Velocity ratio
   (iii) Efficiency of the machine.
8. (a) Define the following:
   (i) Lateral strain
   (ii) Stress
   (iii) Strength
   (iv) Resilience
   (v) Poisson's ratio
   (vi) Bulk modulus
   (b) Derive the expression for stress developed in any prismatic bar under thermal loading.
9. (a) Write a note on mechanical behaviour of engineering material.
   (b) What do you understand by slider straight line mechanism? Explain the working of pantograph.