1. Consider each application below and select the most appropriate material from the following list (and explain why do you think it is the best choice) : an aluminum alloy, SiC (Ceramic), Steel (Fe-0.05%C-2%Mn)　(10%)
   a. A material for construction of a vessel designed to contain liquid nitrogen at ~77°K
   b. A material that must retain its stiffness at elevated temperature but will not experience impact loading.

2. Gives physical arguments for why steels have a definite yield point while Al and Cu do not. Based on these arguments, what type of yield behaviour would you predict for amorphous polymers? (10%)

3. List three ways in which a metal can be strengthened by hindering the motion of dislocations. Discuss these strengthening mechanisms from a physical point of view and indicate whether or not the indicated mechanism would be strongly temperature-dependent. (10%)

4. Describe how degree of polymerization, molecular weight, cross-linking and degree of crystallinity affect polymer behavior? What causes the material to shrink during the injection molding process and what to do to reduce the shrinkage? (10%)

5. Why do fatigue failure often originate from the surface? Under what conditions would you expect the fatigue failures to initiate from the interior of the component? What would you do to prevent the fatigue fracture? (10%)

6. The stress-strain curves for three materials are shown below. a) Which material has the highest modulus? b) Which material has the highest ductility? c) Which material has the highest toughness? d) Which material is more likely to be polymer? (10%)
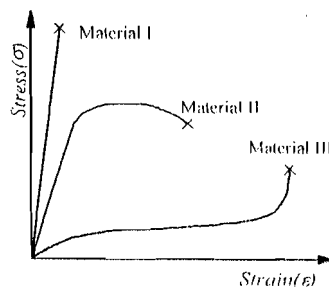
7. Briefly describe Fick's first law of diffusion and Fick's second law of diffusion (10%).

8. Why are FCC metals generally more ductile than HCP or BCC metals?(10%)

9. Briefly explain the following terms/processes (1) Eutectic reaction (2) glass transition temperature (3) Arrhenius equation (4) Endurance limit (5) Slip system (20%)