# INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY

## THIRUVANANTHAPURAM

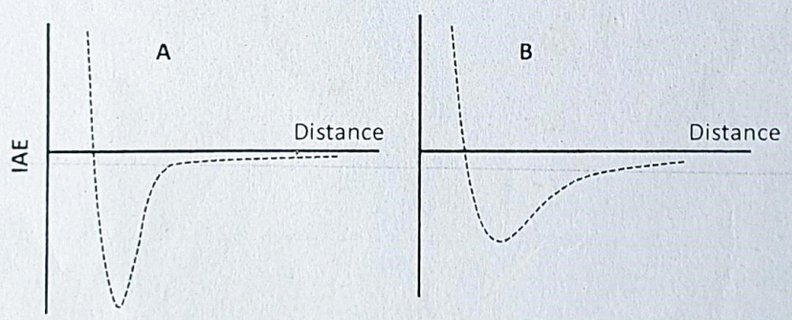
**Quiz I – May 5, 2022**

**CH 121- Materials Science and Metallurgy**

**Second Semester**

**Time: 1 h** **Max. Marks: 20**

1. You have the catalyst system $BF_3/H_2O$ and the following monomers in your laboratory. (i) $CH_2$=CHCN (ii) $CH_2$=$C(CH_3)_2$ (iii) $CH_2$=CHCl (iv) $HO(CH_2)_4COOH$ Which one of the monomers is most suitable to be subjected to polymerization with the available catalyst? Why? Write the mechanism of polymerization with the suitable monomer. (3 marks)
2. A polymer sample 'X' is prepared by mixing four mono-disperse fractions (A, B, C and D) of the polymer. If 'X' contains 2 parts by weight of A, 0.5 part by weight of B, 0.5 part by weight of C and 1 part by weight of D, calculate Mn and Mw of 'X'. Molecular weights of A, B, C and D are 40,000, 70,000 and 60,000 and 50,000 $gmol^{-1}$ respectively. (4 marks)
3. In many polymerization systems, the polymer molecular weight is observed to be lower than predicted on the basis of the experimentally observed extents of termination by coupling and disproportionation. Why? Explain. (1½ marks)
4. One would expect the rate of radical polymerization to decrease with time. However, the exact opposite behavior is observed in many polymerizations. Is this possible? If so, explain the conditions and the reason. (1½ marks)
5. The IAE-distance curve for two atoms in materials A and B is given below. Which material has a lower coefficient of thermal expansion? Explain your answer with the help of the IAE-distance curve. *(draw these curves onto your answer paper and explain with the help of these curves).* (3 marks)




6. The material $CaTiO_3$ has a perovskite crystal structure. Consider the unit cell with $Ca^{2+}$ in (½, ½, ½) position. The density of $CaTiO_3$ is 3.98 $g/cm^3$. Find out the unit cell parameter $a_0$. What is the repeat distance of [100] in nm and planar density of (100) in $atoms/nm^2$. (3 marks)
   *(Atomic mass of **Ca** = 40.0, **Ti** = 47.8, **O** = 16 g/mol, Avogadro number = 6.022 x $10^{23}$ atoms/mol)*
7. Describe the corundum structure of $Al_2O_3$ *(maximum three sentences)*. Consider the corundum structure and deduce the Miller indices of the (any) plane where $Al^{3+}$ are present. The plane should have minimum of one $Al^{3+}$, should not intercept the ***c*** axis, does not pass through the origin, and should contain $O^{2-}$. (only one plane is sufficient and you should draw it in your paper) (4 marks)