

Nanostructured and Functionally Graded Materials.  
(MT – 705/1)

Full marks: 70

Time 3hrs

***Use single answer script for answering all questions***

**(Section – A)**

Answer ***any five*** questions from this section

- Q1. Explain why the thermal properties of nanocrystalline materials differ from their coarser counterpart.
- Q2. With the help of suitable examples explain how multilayer nanocrystalline films can be prepared by electrodeposition technique.
- Q3. The nanometer sized crystallites are expected to exhibit size and/or dimensionality effects. Justify the statement.
- Q4. Explain why a nanocrystalline material becomes unstable with the decrease in crystal size.
- Q5. Explain why the hardness value in some nanocrystalline metal decreases after reduction of the grain size below a critical size.
- Q6. With reference to the rapid expansion of supercritical fluid solution explain how solvo-thermal synthesis technique is used to prepare nanostructured materials.
- Q7. What is quantum confinement? Explain how nanomaterials are classified on the basis of their dimensionality.
- Q8. Write briefly on the use of nanoparticles (***any two***) in the following area.
- (a) Cellular therapy
  - (b) Magnetic resonance imaging
  - (c) High definition television
  - (d) Abrasion resistant coatings.

(5 X 7 = 35)

**(Section-B)**

Answer *any two* questions from this section

- Q.9 ~~Q.9~~ (a) Enumerate the classification of the glass forming alloy groups and the constituent elements involved therein.  
(b) Demonstrate the possibility of glass formation as envisaged from the phase diagram with reference to the  $T_0$  line. (10)
- Q.10 ~~Q.10~~ (a) Explain the temperature dependence of viscosity for strong and fragile glass.  
(b) Explain the cooling rate dependence of glass transition temperature. (10)
- Q.11 ~~Q.11~~ (a) Enumerate the empirical rules for glass forming ability of multi component alloys.  
(b) Compare the activation energy between the diffusive jump and local atomic shear for the super-cooled liquid and glass. (10)

**(Section -C)**

Q.12. Write notes on (any three)

- (a) Reduced glass transition temperature
- (b) Kauzmann paradox
- (c) Polymorphic crystallization
- (d) Submerged eutectic
- (e) Attractive and unattractive mechanical behavior of glass. (3 X 5 = 15)