

B. E. (Met) 7th Semester Final Examination 2013

**Nanostructured and Functionally graded materials.
(MT – 705/1)**

Full marks: 70

Time 3hrs

(Use separate answer script for different sections)

SECTION A

(All questions in this section carry equal marks. Answer any seven questions from this section.)

(7 X 5=35)

- Q1. What are nanocrystalline materials and in which respect they are different from the conventional materials.
- Q2. Explain the underlying principle associated with the synthesis of inorganic nanomaterials through the solvo-thermal route.
- Q3. Why does the photoluminescence property of direct band gap semi conducting material changes with decrease in grain size in the nanometric regime.
- Q4. With the aid of suitable example, explain why nanocrystalline materials becomes structurally and chemically unstable with the decrease in their grain size.
- Q5. Write briefly on any particular nanolithographic technique employed for fabricating nanodimensional patterns on a material surface.
- Q6. Explain why the specific heat capacity and thermal conductivity of nanocrystalline materials is different from their coarse grained counterparts
- Q7. Explain why grain growth is insignificant in nanocrystalline metals up to a reasonably high temperature.
- Q8. Explain why the electrical conductivity of diamond like structures changes with decreasing grain size.
- Q9. Explain why Hall and Petch relationship may not remain valid for nanocrystalline materials.
- Q10. Highlight the role of nanoparticles used in high definition television and elimination of pollutants from automobile exhaust gases.
- Q11. Why does melting point of nanocrystalline metals decreases with decrease in grain size.
- Q12. Explain how the principle of sol-gel technique can be used to prepare nanocrystalline heat insulation coating material.

SECTION B

Answer any one (Q No-13 ^{OR} and Q No-14)

- 13 (a) Schematically describe the structure of amorphous material in terms of Voronoi's polyhedron and Bernell hole. 5
- (b) Enumerate the variation of entropy versus temperature for crystalline alloy, supercooled liquid and glass indicating the glass transition temperature. 5
- 14 (a) Describe the variation of viscosity of supercooled liquid and glass. 5
- (b) What do you understand by strong and fragile glass? 5

Answer any one (Q No-15 ^{OR} and Q No-16)

- 15 (a) Show the occurrence of glass forming composition range in the phase diagram in terms of the nature of the T₀ line corresponding to the stability of the liquid and the terminal phases. 5
- (b) Explain the underlying mechanism of atomic mobility leading to the break down of Stoke-Einstein equation for super-cooled liquid. 5
- 16 (a) Enumerate the conditions concerning the glass forming ability of metallic alloys as envisaged in terms of the ratio of T_g/T_m 5
- (b) Furnish the popular groups of glass forming alloys in view of the position of the constituent metals in the periodic table. 5

- 17 Write short notes (**any three**): 5×3
- (a) Kauzman's Paradox
- (b) VTF equation
- (c) Suppressed eutectic
- (d) Toughness of bulk metallic glass