BENGAL ENGINEERING AND SCIENCE UNIVERSITY, SHIBPUR
M. E. (Met. E.) Physical Metallurgy, 2nd Semester Examination, April/May 2013

ADVANCED METALLIC MATERIALS (MET-1008)

(Elective)

Full Marks: 70 **Time: 3 hrs**

Answer any SEVEN questions.

Use *single answer-script* for answering of all questions.

Figures on the right-hand side indicate full marks.

1. (a) Explain how nanostructured materials are classified into different categories.
   (b) Explain why materials with crystal size greater than 100 nm are normally not considered as nanostructured materials.
   [6+4]

2. (a) Explain why HRTEM images of nanostructured materials should be interpreted carefully.
   (b) *Below a critical grain size the hardness of nanocrystalline metals may decrease with decreasing grain size* – justify.
   [5+5]

3. (a) Explain how the tensile and fatigue properties of the metal matrix composites are affected by the size and distribution of the reinforcements in the metal matrix.
   (b) State the advantages of fabricating metal matrix composites by the in-situ technique over the ex-situ technique with reference to the reactive gas injection process.
   [5+5]

4. (a) On the basis of carrier confinement, define the following terms:
   (i) Qunatum wells, (ii) Quantum wires and (iii) Quantum dots
   (b) Highlight the potential uses of nanoparticles in the biomedical fields.
   [6+4]

5. (a) What are metal matrix nanocomposites? What is the size of the reinforcements?
   (b) Highlight the difficulties associated with the fabrication of metal matrix nano composites through melting and casting route.

(c) With reference to the strengthening mechanism, explain why metal matrix nanocomposites exhibit better properties than metal matrix composites.

[3+4+3]

6. (a) Define creep property.

(b) Discuss different stages of a typical creep curve with the help of a proper diagram.

(c) Discuss the effect of stress and temperature on creep behavior with relevant relationships.

[2+4+4]

7. (a) With the help of schematic diagram, define the following transition temperatures: NDT, FTP and FATT.

(b) State the influence of the following on DBTT:

(i) Crystal structure, (ii) level of C, (iii) level of Mn and (iv) grain size.

[4+6]

8. (a) Briefly discuss the design of materials for (a) high temperature and (b) low temperature applications.

(b) Name one material each for high temperature and low temperature applications with justifications.

[(4+3)+3]

9. (a) Differentiate between *ductile fracture* and *brittle fracture*.

(b) What is *boundary lubrication*?

(c) Define R_a and R_q terms related to the surface roughness.

[5+3+2]

10. (a) Define the term *tribology*.

(b) Discuss *abrasive*, *adhesive*, fretting and *erosive* wear with the help of schematic diagrams

(c) State the *Archard Law of Wear*.

[2+6+2]