B. E. Part IV (7th Semester, Metallurgy and Materials Engineering) Examination 2011-12
Subject: Composites and Ceramic Materials
(MT- 701)

Time: 3 hours   Full Marks: 70

Use single answer script.
Answer **six** questions taking **three** from each group.
Use your own words as far as practicable.

Group A

1. (a) How does rule of mixture provide mechanical properties of a particulate composite?
   (b) Which is the end constituent to fail in fibre reinforced composite?
   (c) Why are aluminium alloys for engine/automobile parts reinforced?
   (d) Explain why the elastic properties of graphite are anisotropic.
   (e) Why is the use of asbestos as fibre in composite restricted?

$$3+1\frac{2}{3}+2+3+2$$

2. (a) Suggest suitable composite for the following applications? Give reasons of your choice. (i) insulation for an inert atmosphere furnace, (ii) cutting tool, (iii) snowmobiles and (iv) pressure vessels.
   (b) Explain how fine particles in dispersion strengthened composite influence its creep behaviour.
   (c) Discuss the (i) fatigue and (ii) impact behaviour of composites with suitable example.
   (d) What are the downsides of polymer matrix composites?

$$4+3+3+1\frac{2}{3}$$

3. (a) State the essential differences between open and close mould processing of composites.
   (b) What is carbon - carbon composite? Why coating is required for it?
   (c) How can you explain that CMCs have poor K_{IC} while MMCs have good K_{IC} value?
   (d) A unidirectional composite is composed by 65% by volume of carbon fibres (modulus 230 GPa) in an epoxy resin matrix (modulus 5 GPa). Calculate the longitudinal and transverse modulus of the composite.

$$3+3+2\frac{2}{3}+3$$

4. (a) State the factors influencing the performance of ZTA composite in service. Point out the influence of environment on it.
   (b) Elucidate the fatigue crack growth rate in PMC with the help of Paris – Erdogan equation.
   (c) Draw a schematic sketch for production of metallic fibers by Taylor's process.
   (d) Why are self healing composites considered to be as smart materials?

$$3+3\frac{2}{3}+3+2$$

Group B

5. (a) What is an advanced ceramic? Enlist some of its properties that make them indispensable for many engineering applications.

(b) What is the vitrification process? In what type of ceramic materials does it take place?

(c) What is an NTC thermistor? How do you control its electrical conductivity?

(d) Which ceramic material is used for chip capacitor and why?

$$3+3+3+2\frac{2}{3}$$

6. (a) What changes occur in the unit cell of $BaTiO_3$ when it is cooled below its curie temperature? How does the electric field affect it?

(b) What kind of structural defects cause the failure of ceramic materials?

(c) What are piezoelectric ceramics? Mention numerous industrial applications that utilise the piezoelectric effect.

(d) State the alleged mechanism for electrical conduction in Fe_3O_4.

$$3++3+3+2\frac{2}{3}$$

7. (a) What is the difference between flocculation and deflocculation?

(b) What is electrical porcelain? Mention its major disadvantage as electrical insulative material?

(c) What is porous ceramic? Where do you use it?

(d) Why is machining of ceramic pricey?

(e) The maximum – sized internal flaw in a hot pressed silicon carbide is 25 μm. If this material has a fracture toughness of 4.8 MPa $\sqrt{m}$, what is the maximum stress that this material can support? (Use $Y = \sqrt{\pi}$)

$$3+2\frac{2}{3}+2+2+2$$

8. (a) What is glass? Mention the rationale of (i) PbO and (ii) Al_2O_3 additions to glass?

(b) What are glass network modifiers? Why are they added to silica glass?

(c) A soda lime glass has a viscosity of $10^{14.3}$ P at 570°C. At what temperature will its viscosity be $10^{9.9}$ P if the activation energy for the process is 430 kJ/mol?

(d) What is glass-ceramic? Why does it exhibit superior mechanical properties to its parent glass?

(e) In what sense chemically strengthened glass is superior to annealed glass?

$$3+2\frac{2}{3}+3+2+1$$