



Uva Wellassa University, Sri Lanka
End Semester Examination - March 2011



SCT 454-2 Composites and Bio Materials

Time: Two (02) hours

Total 04 Questions
Answer all questions

- 1). i. Explain the term *principle of combined action* in the composite terminology.
- ii. Name the two main types of particle reinforced composites. Differentiate these two types by considering the *particle-matrix interactions*.
- iii. What are *pre-stressed concretes*? State two main important mechanical properties, which enhance the durability of pre-stressed concretes in structural applications.
- iv. State the two main factors, on which the *dispersion strengthen mechanism* in composites depends.
- v. A composite prepared with hard titanium carbide fine particles can improve the mechanical properties of a soft nickel metal matrix. The moduli of elasticity of nickel and titanium carbide are 187.5×10^9 Pa and 689.3×10^9 Pa, respectively. Compute the modulus of elasticity of this composite prepared by replacing half of the matrix volume with the particles.

(25 marks)

- 2). i. List three common types of *Polymer-Matrix Composites (PMC)*
- ii. With a rough sketch, explain the main stages of the typical *stress-strain behavior for an aligned fiber-reinforced composite* that is exposed to a uni-axial stress applied in the direction of alignment.
- iii. List two main functions of the matrix phase expected to perform in a *fiber-reinforced composite*.
- iv. Give two strong reasons for considering *failure of a fiber-reinforced composite as not catastrophic*.
- v. What are *hybrid composites*? Explain briefly the advantages of using both *carbon fibers* and *glass fibers* for preparing a hybrid composite.

(25 marks)

3). i. Dental Implants should be able to withstand drastic temperature and pH changes. Discuss this statement.

ii. Consider a 3 mm diameter hole which is 5 mm in length in a molar tooth. The thermal variation (ΔT) of the oral cavity is 60°C . Show (with necessary calculations) that Resin is a better choice than Amalgam to fill this cavity in the molar tooth.

Volumetric expansion of a solid is given by $\Delta V = V_0 \times 3\alpha \times \Delta T$

Where V is the volume of the material, and dV / dT is the rate of change of that volume with temperature

$$\alpha_{\text{amalgam}} = 25 \times 10^{-6} / \text{C} \quad \alpha_{\text{resin}} = 81 \times 10^{-6} / \text{C}$$

iii. Discuss advantages and disadvantages of resin and amalgam in tooth fillings. (25 marks)

4). i. Briefly discuss the main material attributes for biomedical applications.

ii. Describe how Ceramic-on-Ceramic total hip arthroplasty could be a better choice than Metal-on-Metal total hip arthroplasty.

iii. Discuss the merits and demerits of Ceramic Biomaterials (Bioceramics). (25 marks)