Uva Wellassa University, Sri Lanka
End Semester Examination – July 2010
CHE 454-2 Composites and Bio Materials
Time: Two (02) hours

Total 05 Questions
Answer **two (02)** questions from **PART A** and **all** questions from **PART B**

PART A (Composites): Answer <u>two (02)</u> questions only

1). i. Define the term *composites*.

ii. Briefly explain the limitations of using concrete as a structural material and the techniques available to strengthen concrete by reinforcement.

iii. Express the *rule of mixtures* equations (*upper bound* and *lower bound*) to predict the elastic modulus of a composite.

iv. Mechanical properties of a metal can be improved by incorporating fine particles of a hard carbide ceramic. Compute the modulus of elasticity of the composite prepared with 65 vol% of the carbide ceramic particles in the metal matrix. The moduli of elasticity of the metal and carbide ceramic are 180 GPa and 650 GPa, respectively.

(25 marks)

2). i. Cite two main factors on which the mechanical characteristics of a fiber-reinforced composite depend.

ii. Name the three main groups of fibers categorized based on their diameter and character.

iii. Briefly discuss the need of a strong bonding between the fiber and the matrix at their interface.

iv. Make a rough sketch to show 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.

(25 marks)

3). i. What is fiberglass?

ii. Very briefly discuss why glass fibers are most commonly used for reinforcement.

iii. Cite four advantages of carbon fibers as reinforcing medium in composites.

iv. Briefly explain the term *transformation toughening* with the example of ZrO_2 particles in a ceramic matrix composite.

(25 marks)

PART B (Biomaterials): Answer all questions

4). i. What are Biomaterials? (10 marks)

ii. Discuss in detail the essential properties to be considered when selecting a biomaterial for an application. You may select your own example.

(15 marks)

5). For each of the following products that are to be implanted in mouth, select the best raw material from the list of available materials given in the table.

For each product, explain why the selected material is suitable and why other material(s) are not suitable.

Product	Raw materials available for the product		
i. Orthodontic dental archwire	TiNi alloy	SS316	SS316L
ii. Artificial tooth roots	Apatite	Tricalcium Phosphate	Zirconia
iii. Dental amalgam	Liquid Hg	Tricalcium Phosphate	Apatite
iv. Dental crowns	Pyrolitic carbons	Calcium aluminates	Hydroxyapatites
v. Filling for anterior teeth	Silver	Barium glass	Acrylic resin

(25 marks)