Uva Wellassa University, Sri Lanka
Faculty of Science and Technology
Science and Technology Degree program
1st Semester Examination – March/April 2013

Uva Wellassa University

SCT 441-2 Ceramic Technology

Instructions to candidates
Answer Four (04) questions only
Number of questions: Five (05)
Time allocation: Two (02) hours
Total marks allocated: 100

1. a. What is the general nature of *atomic bonding* in an ordinary ceramic?

   b. What determines the *degree of ionic character* of such ceramic material? Among CaF_2 and ZnS ceramics, which should show the highest *degree of the ionic character*?

   c. Make a rough sketch to illustrate the *basic building block* of silicate ceramics. What is the general formula of it?

   d. In FCC rock salt crystal structure of MgO, the ionic radii of Mg^{2+} and O^{2-} are 0.086 nm and 0.140 nm, respectively. Determine the corresponding coordination number of this stable geometry.

   e. On the basis of that, compute the theoretical density of MgO. Atomic weights of Mg and O are 24.3 a.m.u. and 16.0 a.m.u., respectively. Avagadro's number is 6.023×10^{23} mol^{-1}.

(25 marks)

2. a. With the help of schematic representation, show the characteristic *mirror, mist* and *hackle* features observed on the fracture surface of a brittle ceramic.

   b. What is *fracture toughness*?

   c. A ceramic rod with circular cross section is loaded using a three-point bending mode. Determine the minimum possible radius of the specimen without fracture, given that the *applied load, flexural strength* and *separation between load points* are 6×10^3 N, 1×10^6 Pa and 10^{-2} m, respectively.

d. What could be the reason for the fracture strength of a ceramic measured in a three-point bending test to be greater than that measured in a tensile test?

e. Explain why the existence of porosity in a ceramic body is so detrimental to its flexural strength.

(25 marks)

3. a. Make a very brief comparison between *traditional ceramics* and *advanced ceramics*, considering their *resultant microstructure* and *mechanical properties*.

b. List three main advantages of using ceramics over metals in space shuttle applications.

c. State three main difficulties faced in ceramic processing due to *strong bonding character* of ceramics.

d. What is the typical size of powder particles used in traditional ceramic industry?

e. With the use of an appropriate flow chart, briefly explain the *key steps* in manufacturing a ceramic body using a powder feedstock.

(25 marks)

4. a. Explain the role of each of three major raw material components used in traditional ceramic manufacturing.

b. Apart from those mentioned above, name two other minor material components used in this industry.

c. With the help of a schematic representation, very briefly explain the formation of a ceramic body by solid casting.

d. What is the most common mold material used in slip casting of traditional ceramics? State three main advantages of this mould material.

e. Cite the main limitations associated with the hot un-uniaxial pressing (HP) technique used in fabricating dense ceramic objects.

(25 marks)

5. a. Why it is compulsory for a ceramic green object to undergo a high-temperature firing before use in the intended application?

b. Define the term *vitrification*. State the main factors that determine the *degree of vitrification*.

c. What is *sintering*?

d. With the help of schematic representation, explain the three most effective mechanisms and their paths for transporting matter in sintering.

e. Briefly explain how a *sintering* aids in speeding up the process.

(25 marks)