

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



SCT 441-2 Ceramic Technology

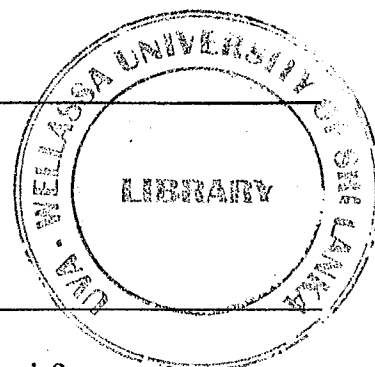
Instructions to candidates

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 $6.023 \times 10^{23} \text{ mol}^{-1}$.
(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 $6 \times 10^3 \text{ N}$, $1 \times 10^6 \text{ Pa}$ 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)