Uva Wellassa University, Sri Lanka
End Semester Examination – June/July 2009
CHE 455-2 Ceramic Technology

Time: Two (02) hours

Total 05 Questions
Answer **four (04)** questions only

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1).

I. Cite the two main factors that determine the crystal structure of ceramics.

II. Draw a unit cell to represent the FCC (face centered cubic) rock salt crystal structure of FeO. What is the respective coordination number for this stable geometry?

III. On the basis of the above crystal structure, compute the theoretical density of FeO. Ionic radii of Fe^{2+} and O^{2-} are 0.077 nm and 0.140 nm, respectively. Atomic weights of Fe and O are 55.85 g/mol and 16.00 g/mol, respectively.

IV. What is the basic building block of silicate ceramics?

V. Draw a rough sketch to show the structure of *kaolinite clay* having the formula of $Al_2(Si_2O_5)(OH)_4$.

(25 marks)

2).

I. Define the term *fracture toughness*.

II. Very briefly explain why measured fracture strength of ceramic materials are considerably lower than that predicted by theory.

III. Why do brittle ceramic specimens show a considerable variation and scatter in the fracture strength?

IV. What is the reason for compressive strengths of ceramics to be much higher than the tensile strengths?

V. Based on the reason given under IV above, propose a mechanism to enhance the fracture strength of brittle ceramics.

(25 marks)

3).

I. What are the main difficulties encountered in performing tensile tests to ascertain stress-strain behavior of brittle ceramics?

II. With the help of a schematic representation, briefly explain how to measure the stress-strain behavior and flexural strength of brittle ceramics using the three point loading scheme.

III. Write down the mathematical expressions needed for computing flexural strengths for rectangular and circular cross sectional specimens.

IV. A three-point transverse bending test is conducted on a cylindrical specimen having a flexural strength of 400 MPa. If the specimen radius is 6.5 mm and the support point separation distance is 20.0 mm, calculate the load at fracture.

V. How does the *specimen volume* affect the measured *flexural strength*?

(25 marks)

4).

I. List four factors that influence the shrinkage of clay–based ceramic body at drying and firing stages.

II. What does the term *vitrification* mean?

III. Give a very brief account on the *degree of vitrification*, the factors that determine the *degree of vitrification* and the effect of the *degree of vitrification* on the properties of a ceramic material.

IV. What are the two main functions of organic binders that are used in powder pressing?

V. Some ceramic materials are fabricated by cold uni–axial pressing. Cite the main advantages and limitations associated with this technique.

(25 marks)

5).

I. What is the main driving force for sintering?

II. With the help of schematic representation, explain the six mechanisms (that are responsible for transporting matter in sintering) and their paths. Which is the most effective mechanism for densification?

III. What are the two major ways for speeding up sintering?

IV. Highlight the main features of the *liquid phase sintering* compared to the *solid state sintering*.

V. What is the main advantage of *reaction bonding sintering* regarding shrinkage?

(25 marks)