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# UNIVERSITI SAINS MALAYSIA

First Semester Examination  
Academic Session 2010/2011

November 2010

## EBB 523/3 - Ceramic Processing

Duration : 3 hours

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Please ensure that this examination paper contains FOUR printed pages before you begin the examination.

This paper consists of SEVEN questions.

**Instruction:** Answer **FIVE** questions. If candidate answers more than five questions only the first five questions answered in the answer script would be examined.

The answers to all questions must start on a new page.

All questions must be answered in English.

1. [a] Cite two main difficulties must be overcome in any joining process of a metal and ceramic?  
(20 marks)
- [b] What are the difference between friction welding and ultrasonic welding?  
(20 marks)
- [c] Ceramic joining technologies can broadly be classified by material types such as glass/metal sealing, glass-ceramic/metal joining, ceramic/ceramic joining, ceramic/metal joining and non-oxide ceramic joining. Explain briefly on glass/metal seals and ceramic/metal joining. Also cite the advantages and limitation for both joining technologies.  
(60 marks)
2. [a] Why is it so important to control the rate of drying of a ceramic body that has been hydroplastically formed or slip cast?  
(20 marks)
- [b] Cite three factors that influence the rate of drying of ceramics and explain how each affects the rate.  
(30 marks)
- [c] Is grain growth during sintering beneficial for ceramics? Discuss.  
(20 marks)
- [d] Compare the sintering of a powder compact with a broad particles size distribution with a narrow size distribution if the average particle size of the powders is the same.  
(30 marks)

3. [a] Define glass and ceramic materials? In term of processing and properties, give a significant different between ceramic, glass and glass ceramic.

(30 marks)

- [b] One of the most important ceramic processing techniques in the ceramic industry is extrusion. This technique is not only widely used in clay-based ceramics but also for advanced ceramics. Discuss in detail about the raw materials preparation requirements for this technique. What are the advantages and disadvantages of this technique?

(70 marks)

4. Briefly describe the following ceramic materials processing techniques:-

- (i) Gelcasting of advanced ceramic products
- (ii) Ceramic Foam Manufacturing Using Sponge Replication
- (iii) Ceramic injection moulding
- (iv) Advantages of the tape casting technique

(100 marks)

5. [a] Elaborate and describe ceramic materials by their definition and common properties.

(40 marks)

- [b] Compare the differences between dry milling and wet milling as well as elaborate their advantages and disadvantages.

(30 marks)

- [c] Justify why a die compaction or also commonly known as uniaxial pressing is preferred in a ceramic production compared to other forming processes. Judge also their limitation and what is the minimum expectation for this process.

(30 marks)

6. [a] Elaborate on precipitation phenomenon and parameters that influence its chemical equilibria. Then suggest 2 techniques that can be applied to minimize ceramic powder size during a powder synthesis by coprecipitation.

(60 marks)

- [b] (i) Elaborate the latest and commonly used definition of hydrothermal process and the conditions needed in a hydrothermal process.

(20 marks)

- (ii) Distinguish the limitation of homogeneity in a solid mixing and a liquid mixing, and explain each mixing mechanism.

(20 marks)

7. [a] Discuss sol-gel processing in brief.

(15 marks)

- [b] Compare the advantages and disadvantages of a sol-gel process.

(25 marks)

- [c] How do you make a distinction to obtain different forms of ceramic i.e. dense film, dense bulk ceramic, ceramic aerogel and fiber in a sol-gel process? Construct a schematic diagram to assist you in the explanation.

(60 marks)