UNIVERSITI SAINS MALAYSIA

First Semester Examination
Academic Session 2009/2010

November 2009

EBB 332/4 - Whitewares and Glasses
[Tembikar & Kaca]

Duration : 3 hours
[Masa : 3 jam]

Please ensure that this examination paper contains EIGHT printed pages and ONE page APPENDIX before you begin the examination.
[Sila pastikan bahawa kertas peperiksaan ini mengandungi LAPAN muka surat beserta SATU muka surat LAMPIRAN yang bercetak sebelum anda memulakan peperiksaan ini.]

This paper consists of SEVEN questions. THREE questions in PART A and FOUR questions in PART B.
[Kertas soalan ini mengandungi TUJUH soalan. TIGA soalan di BAHAGIAN A dan EMPAT soalan di BAHAGIAN B.]

Instruction: Answer **FIVE** questions. Answer **TWO** questions from PART A, **TWO** questions from PART B and **ONE** question from any parts. If candidate answers more than five questions only the first five questions answered in the answer script would be examined.
*[**Arahan**: Jawab **LIMA** soalan. Jawab **DUA** soalan dari BAHAGIAN A, **DUA** soalan dari BAHAGIAN B dan **SATU** soalan dari mana-mana bahagian. Jika calon menjawab lebih daripada lima soalan hanya lima soalan pertama mengikut susunan dalam skrip jawapan akan diberi markah.]*

The answers to all questions must start on a new page.
[Mulakan jawapan anda untuk semua soalan pada muka surat yang baru.]

You may answer a question either in Bahasa Malaysia or in English.
[Anda dibenarkan menjawab soalan sama ada dalam Bahasa Malaysia atau Bahasa Inggeris.]

In the event of any discrepancies, the English version shall be used.
[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah diguna pakai.]

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PART A

BAHAGIAN A

1. [a] Describe the RAM process in plastic making. Discuss the advantages and disadvantages of this process.

Perihalkan proses RAM dalam penghasilan kaedah plastik. Bincangkan kelebihan dan kekurangan kaedah RAM ini.

(30 marks/*markah*)

[b] Explain the humper and whirler defects as well as the stretched–face fault. To your knowledge, how can these defects be overcomed?

Terangkan kecacatan cekung dan cembung serta kecacatan permukaan cekang. Pada pengetahuan anda, bagaimanakah kecacatan-kecacatan ini dapat diatasi?

(70 marks/*markah*)

2. [a] Explain the criteria necessary for slip casting. How can a good slip for castings be produced when based on the criteria discussed? Why is it important not to produce slip that is with the minimum viscosity or maximum fluidity.

Jelaskan kriteria yang diperlukan dalam tuangan slip. Bagaimanakah suatu slip yang baik untuk tuangan dapat dihasilkan berdasarkan kriteria yang dibincangkan tersebut. Mengapakah sesuatu slip itu mesti tidak mempunyai kelikatan minimum ataupun kebendaliran maksimum?

(50 marks/*markah*)

[b] Typically, sanitary products are glazed although they are fully-vitrified. One glaze formulation that was analyzed for a sanitaryware company is given below.

0.314 MgO	1.12 Al_2O_3	10.300 SiO_2
0.140 CaO		
0.167 K_2O		
0.379 Na_2O		

Determine the recipe for the glaze, based on the following raw materials:

	Molecular weights
Kaolin ($Al_2O_3.2SiO_2.2H_20$)	258
Potash feldspar ($K_2O.3Al_2O_3.6SiO_2$)	566
Soda Feldspar ($K_2O.3Al_2O_3.6SiO_2$)	525
Flin (SiO_2)	60
Wollastonite ($CaO.SiO_2$)	116
Mg carbonate ($MgCO_3$)	84
Whitening ($CaCO_3$)	100
Alumina (Al_2O_3)	102

Lazimnya, produk sanitari adalah dilicaukan walaupun ianya vitrus sepenuhnya. Satu formulasi licau yang dianalisa daripada satu kilang sanitari diberikan seperti berikut:

0.314 MgO	*1.12 Al_2O_3*	*10.300 SiO_2*
0.140 CaO		
0.167 K_2O		
0.379 Na_2O		

Tentukan resipi licau tersebut, berdasarkan bahan mentah berikut:

	JMR
Kaolin ($Al_2O_3.2SiO_2.2H_20$)	*258*
Feldspar Potasy ($K_2O.3Al_2O_3.6SiO_2$)	*566*
Feldspar Soda ($K_2O.3Al_2O_3.6SiO_2$)	*525*
Flin (SiO_2)	*60*
Wollastonit ($CaO.SiO_2$)	*116*
Mg Karbonat ($MgCO_3$)	*84*
Pemutih ($CaCO_3$)	*100*
Alumina (Al_2O_3)	*102*

(50 marks/*markah*)

3. [a] Sketch a firing schedule in typical whiteware product. Explain the different stages and the possible reaction in the firing schedule.

Lakarkan satu jadual lazim dalam pembakaran hasilan tembikar putih. Terangkan peringkat-peringkat dalam jadual pembakaran tersebut serta tindakbalas yang mungkin berlaku.

(40 marks/*markah*)

[b] Assuming that you have the tasked to set up a new production plant for the production of figurines, i.e. for instance the production of Prince and Princess of various cartoon character. What would be your proposed plan? The answer should include among others the raw material selection, processing and type of furnace.

Diandaikan anda diberi tugas untuk mendirikan sebuah kilang untuk menghasilkan figurin, katakan penghasilan Putera dan Puteri dalam perlbagai siri watak kartun. Apakah pelan perancangan anda? Jawapan anda perlu melibatkan pilihan bahan mentah, pemprosesan dan jenis relau pembakaran.

(60 marks/*markah*)

PART B

BAHAGIAN B

4. [a] Describe the photochemical machining of glasses by referring to the design of chemical composition and the stages in machining.

Perihalkan pemesinan kaca secara fotokimia dengan merujuk kepada komposisi kaca dan tatacara pemesinan.

(40 marks/*markah*)

[b] What are the advantages of such machining as compared to conventional mechanical machining? Illustrate with examples glass products/devices that are machined as such.

Apakah kelebihan pemesinan seumpama ini berbanding pemesinan mekanikal. Ilustrasikan dengan contoh hasilan yang dimesin seperti ini.

(20 marks/*markah*)

[c] Discuss how colours in glasses can be designed by controlling the processes during glass melting.

Perihalkan bagaimana warna dihasilkan dalam kaca.

(40 marks/*markah*)

5. [a] Glasses can also be produced by a sol-gel method as opposed to conventional melting. Describe the process of producing glass by the sol-gel method.

Kaca juga boleh dihasilkan dengan kaedah sol-gel berbanding dengan kaedah peleburan biasa. Bincangkan proses penghasilan kaca menerusi kaedah sol-gel.

(40 marks/*markah*)

[b] Critically discuss the advantages and disadvantages of both glass-making processes.

Bandingkan secara kritis kelebihan dan kelemahan kedua-dua proses penghasilan kaca.

(40 marks/*markah*)

[c] Briefly describe other processes that are now available to produce glasses.

Nyatakan secara ringkas kaedah-kaedah lain yang kini wujud untuk menghasilkan bahan kaca.

(20 marks/*markah*)

6. [a] Glass-ceramics was initially designed to overcome the engineering strength of glass in practice. Critically evaluate the steps taken to produce a glass ceramic material. Your evaluation must include the design of composition, heat-treatment schedules, etc.

Bahan seramik kaca asalnya direkabentuk untuk mengatasi kekuatan bahan kaca yang rendah bila digunakan secara praktik. Huraikan secara kritis langkah-langkah yang diambil untuk menghasilkan suatu bahan seramik kaca. Huraian mesti merangkumi rekabentuk komposisi, jadual olahan haba, dan sebagainya.

(40 marks/*markah*)

[b] Based on the ternary diagram provided (Appendix 1) how would you design a product that has very high strength and good thermal shock resistance for use as catalytic converters.

Berpandukan gambarajah yang diberi (Lampiran 1), bagaimanakah suatu hasilan seramik kaca yang mempunyai kekuatan dan rintangan kejut terma yang amat tinggi dapat direkabentuk untuk menghasilkan suatu penukar pemangkin.

(40 marks/*markah*)

[c] Briefly describe the glass-ceramic used as a substrate in the latest IBM mainframe computers.

Huraikan secara ringkas mengenai bahan seramik kaca yang digunakan sebagai substrat dalam komputer rangka utama IBM yang terkini.

(20 marks/*markah*)

7. [a] JERAGLAS^{TM} is an innovative glass product invented at Universiti Sains Malaysia. Critically discuss how such glasses can be successfully produced based on the fundamentals of glass science and technology.

JERAGLAS^{TM} adalah suatu jenis kaca yang dicipta di Universiti Sains Malaysia. Bincangkan bagaimana kaca seumpama ini berjaya dihasilkan berpandukan kepada asas-asas sains dan teknologi kaca.

(40 marks/*markah*)

[b] Discuss the roles of homogenizing and refining in a glass-making process.

Bincangkan peranan penghomogenan dan penulenan dalam proses penghasilan kaca.

(40 marks/*markah*)

[c] Describe with examples the group of glasses classified as non-oxide glasses.

Huraikan dengan contoh kumpulan kaca-kaca jenis bukan oksida.

(20 marks/*markah*)

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APPENDIX 1

LAMPIRAN 1