Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech/CT(NEW)/SEM-6/CT-603/2013

2013

CERAMIC COATING AND PROCESS CALCULATIONS

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Use separate answer sheets for Group-A and Group-B.

GROUP – A

(Answer Q. No. 1 and any *three* from Q. Nos. 2, 3, 4 and 5.
Also answer any *three* from Q. Nos. 6, 7, 8 and 9.)

1. Choose the correct alternatives for the following : $5 \times 1 = 5$

   i) Which of the following is not a bounding oxide in enamel ?

   a) CoO b) NiO
   c) MbO_2 d) ZrO_2

   ii) To decrease the α value of enamel coating we decrease Na_2O content and substitute it with

   a) CaO b) K_2O
   c) ZnO d) B_2O_3

   iii) Acid consumptions for pickling process for metal preparation can be reduced by using inhibitors to the extent

   a) 0·1 % to 0·2% b) 1% to 2%
   c) 10% to 20% d) 30% to 40%.

iv) Excimer Laser wavelength is 248 nm of

a) KrCl b) KrF

c) XeCl d) XeF.

v) Which instrument is used for surface composition analysis ?

a) XPS b) TEM

c) XRD d) AFM.

2. State some important properties imparted by any *two* of the following oxides in enamel : 2½

i) Al_2O_3

ii) PbO

iii) ZrO_2

3. Which acid (amongst HCl and H_2SO_4) do you prefer for pickling process and why ? Why do we use inhibitors in pickling process ? 1½ + 1

4. What are the differences between Spin Coating and Dip Coating ? 2½

5. Make a comparative analysis of APCVD, LPCVD and PECVD. 2½

6. Why are opacifiers used in enamel coating ? State the differences between Sheet Glass and Enamel Glass. Why do we use electrolyte in enamel ? Give an example. What is neutralization process in metal preparation before enamel coating ? 2 + 2 + 2 + 1½

7. What is Fish Scaling in enamel coating ? What is vitreous coating ? Give an example. Explain in brief Degreasing process for metal preparation. What is Direct-on-Enameling ? 2 + 1½ + 3 + 1

8. What are nucleation and growth ? What are the factors that influence the film growth ? Explain the effects of various factors on the growth of grain size in thin film. 1½ + 1½ + 3 + 1½

9. What is sputtering ? Enumerate various characteristics of sputtering process and sputtering yield. Discuss the advantages and disadvantages of sputter deposition.

1 + 2½ + 2 + 2

GROUP – B

(Answer any *one* from Q. Nos. 1 and 2 and any *three* from the rest.)

1. A natural gas has the following composition :
   CH_4 — 82·5%, C_2H_6 — 13% & N_2 — 4·5%.
   Calculate the density of the gas mixture at S.T.P. in kg/m^3.

5

2. Calculate the standard heat of reaction of the following, using Hess's law :

$$C_5H_{12}(l) + 8O_2(g) \rightarrow 5CO_2(g) + 6H_2O(l)$$

Given, component	ΔH_f° cal/gm.mole
C_5H_{12} (l)	– 41370
CO_2 (g)	– 94051
H_2O (l)	– 68315

5

3. A hydrocarbon gas is burnt in a furnace with 15% excess air. It gives out flue gas of composition CO_2 — 10·9%, CO — 2·5%, H_2 — 1·8%, O_2 — 4·2% and rest N_2. Check whether the combustion is complete or not. Is the amount of reported excess air correct or not. 10

4. a) Given the formula of a glaze
   0·65 PbO 1·8 SiO_2
   0·35 Na_2O 0·25 Al_2O_3 0·5 B_2O_3
   Calculate the formula weight and the % composition of the glaze.

   b) A glaze has the formula PbO, 0·23 Al_2O_3, 2·7 SiO_2. Calculate a recipe if China Clay (Al_2O_3, $2SiO_2$, $2H_2O$), flint (SiO_2) and lead bisilicate are used as raw material.

6 + 4

5. The formula of a glaze is

$$\left.\begin{matrix} 0{\cdot}082\ K_2O \\ 0{\cdot}027\ Na_2O \\ 0{\cdot}294\ CaO \\ 0{\cdot}597\ PbO \end{matrix}\right\} \quad 0{\cdot}231\ Al_2O_3\ ,\ 4{\cdot}064\ SiO_2$$

Using flint, China clay, lead bisilicate, whiting and stone calculate the recipe. The stone has the following formula :

$$\left.\begin{matrix} 0{\cdot}414\ K_2O \\ 0{\cdot}146\ Na_2O \\ 0{\cdot}180\ CaO \end{matrix}\right\} \quad 1{\cdot}0\ Al_2O_3\ ,\ 7{\cdot}1\ SiO_2$$

10

6. Calculate the batch composition of the glass from the following oxide composition :

SiO_2 — 71%, Na_2O — 17%, CaO — 9·5% and Al_2O_3 — 2·5%

The raw materials used are sand, lime-stone, soda-felspar, anhydrous soda ash. 25% cullet is added whose composition is as follows : SiO_2 — 74%, Na_2O — 16%, CaO — 9%, Al_2O_3 — 1%. 10

7. Calculate the oxide composition of the glass from the given batch :

Sand — 1000 parts, limestone — 184 parts, red lead — 1287 parts, As_2O_3 — 5 parts, soda ash (with 2% moisture) — 121 parts, salt-cake — 14 parts and KNO_3 (with 7% moisture) — 80 parts.

[Red lead — Pb_3O_4, Salt-cake — Na_2SO_4] 10

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