UNIVERSITY OF GHANA

BSC. (Eng) SECOND SEMESTER EXAMINATIONS: 2015/2016
DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING
MTEN 326: ENGINEERING CERAMICS (2 CREDITS)

INSTRUCTIONS:
ANSWER ALL QUESTIONS **TIME ALLOWED: TWO (2) HOURS**

1.

a) Briefly discuss the energy band theory associated with engineering ceramics. **(2 marks)**
b) State and explain four (4) physical properties of ceramics. **(4 marks)**
c) Explain the term sintering and state three (3) characteristics of sintered ceramics. **(5 marks)**
d) Briefly describe the three (3) main chemical bonding types in materials. **(6 marks)**
e) Briefly explain the term polar covalent bond and state three (3) properties of covalent bonds related to ceramic materials. **(4 marks)**
f) State the molecular orbital theory. Give three (3) major draw backs and advantages of the theory. **(4 marks)**

2.

a) State 4 differences between metals and ceramics. **(4 marks)**
b) State and Explain the three basic categories of Ceramic materials **(6 marks)**
c) Discuss grain boundaries in terms of crystal structure, electrical and thermal conductivity and corrosion in engineering ceramics. **(5 marks)**
d) Discuss Hall–Petch strengthening from the grain boundary engineering point of view. **(2 marks)**
e) Explain the term glass and describe the three common types of glasses with some examples of glasses. **(4 marks)**
f) B_2O_3 is usually introduced into silica to produce good chemical resistance in a glass. To obtain good glass-forming tendencies, a client wishes that the O:Si ratio of his glass to be no more than 2.5, but also wants the glassware to have a low-melting temperature in order to make the glass-forming process easier and more economical. How will you design such a glass as a materials engineer? Take atomic weight of B_2O_3 as 69.62 g/mol and that of SiO_2 as 60.08 g/mol. **(4 marks)**

3.

a) Discuss the four (4) major steps in processing engineering ceramics. **(8 marks)**

b) State five (5) factors affecting engineering ceramic processing and two (2) common errors in processing of engineering ceramic bodies. (

c) **7 marks)**

d) In a grain size measurement of an aluminium sample, it was found that there were 56 full grains in the area, and 48 grains were cut by the circumference of the circle of area 1 in^2. Calculate the ASTM grain size number **n** for this sample. **(10 marks)**

4.

a) Define the term glass ceramic and give some of its properties, advantages and applications. **(10 marks)**

b) Tempered glasses tend to possess very high strengths. Briefly describe the two (2) hardening processes in tempered glass. **(5 marks)**

c) Silicon carbide (SiC) particles are compacted and fired at a high temperature to produce a strong ceramic shape. The specific gravity of SiC is 3.2 g/cm^3. The ceramic shape subsequently is weighed when dry to be 360 g, after soaking in water is 385 g, and while suspended in water is 224 g. Calculate the **apparent porosity**, the **true porosity**, and the **fraction of the pore volume** that is closed. **(10 marks)**