



**RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES**

**B. Sc. (General) Degree
Third Year - Semester II Examination – September / October 2013**

PHY 3309 – STRUCTURE AND PROPERTIES OF MATERIALS

Answer SIX questions only

Time: 3 hours

The use of a non-programmable calculator is permitted.

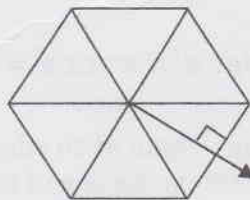
01. (a) Define the term “unit cell” and draw unit cells for simple cubic, body-centered cubic and face-centered cubic lattices.
- (b) Calculate the “packing fraction” for each of the above cubic lattices.
- (c) Distinguish between “unit cell” and “primitive cell”.
- (d) Draw a primitive cell for a simple cubic lattice.
02. (a) Define the “reciprocal lattice” and briefly discuss the importance of the reciprocal lattice concept.
- (b) Construct the reciprocal lattice of a square lattice.
- (c) Comment on the reciprocal lattice obtained in (b) above.
03. Show that the following relationship is held for dislocations in crystals.

$$\text{Energy of an edge dislocation} = \frac{3}{2} \text{Energy of a screw dislocation}$$

(The energy per unit length of an edge dislocation is $Gb^2/(1-\nu)$; where G , ν and b are the shear modulus and the poisson's ratio of the material and the Burgers vector of the dislocation respectively).

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04. (a) Discuss, with suitable examples, the importance of knowing the mechanical properties of a material, meant for a certain application.
- (b) Draw the engineering stress vs. engineering strain curves for the following.
- Brittle and lower toughness material.
 - Ductile and higher toughness material.
 - High ductile, lower strength and lower toughness material.
- (c) X-ray diffraction techniques are widely used to determine the crystal structures.
- Explain why the X-rays are used to determine the crystal structures.
 - What are the advantages and disadvantages in using X-rays over the other types of radiation?
 - Briefly explain the Laue method of crystal structure determination.
06. (a) Explain how the Miller indices of a set of planes and a direction in a crystal are determined.
- (b) What do the following indices represent? Explain with suitable examples.
- (hkl)
 - {hkl}
 - [hkl]
 - $\langle hkl \rangle$
- (c) Draw the unit cell and the following sets of planes in a simple cubic lattice.
- (100)
 - (111)
 - (200)
 - (201)
- (d) Determine the Miller-Bravais indices of the following direction in the basal plane of a hexagonal crystal.



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06. (a) Write a comprehensive note on “Kroger – Vink notation”, used to denote the point defects in crystals.
- (b) Give the Kroger – Vink notation for the following cases.
- (i) Frankel defect formation in MgO.
 - (ii) Schottky defect formation in TiO_2 .
 - (iii) Schottky defect formation in BaTiO_3 .
07. Write short notes on the following.
- (i) Crystalline materials.
 - (ii) Mohs hardness scale.
 - (iii) Percentage ionic character of a bond.
 - (iv) Graphite vs. diamond.

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