Roll Number

Thapar University

School of Physics and Material Science

***B. Tech.* (*III* Semester) MST, September 2016** **UES012: Engineering Materials**

Time: 02 Hours, MM: 50 **Name of faculty: KUS, PNS, CBN, BCM, LKB, DBD, RBP**

Note: 1. Attempt all questions in **sequence**. Attempt all parts of questions together.
2. Answers should be precise and to the point.
3. Assume any missing data suitably.

Q.1 (a) Differentiate between
(i) Substructure and microstructure.
(ii) Alloys and composites.
(b) Discuss the structure-processing-properties relationship in materials engineering.
(c) Discuss the dependence of the following properties on the bonding character with proper reasoning.
(a) Modulus (b) Mechanical strength (c) Melting point (d) Resistivity.
(d) List two each of structure-sensitive and structure-insensitive properties of materials.

(6+2+4+2)

Q.2 (a) Show the atomic configuration in (111) plane and [111] direction for Fe (BCC) and Cu (FCC). Also calculate their planar and linear density. The lattice parameter for Fe and Cu is 2.87 Å and 3.63 Å, respectively.
(b) Draw $(1\bar{1}00)$, $(\bar{1}2\bar{1}2)$ planes and $[2\bar{1}\bar{1}1]$, [0001] directions in a hexagonal unit cell.
(c) Derive Bragg's condition for X-ray diffraction from a monoatomic crystal.
An X-ray diffractometer record diffraction peaks at following 2θ angle: 36.191^0, 51.974^0, 64.982^0, and 76.663^0. If the wavelength of radiation was 1.54 Å, then determine:
i. The crystal structure of the element.
ii. The Miller indices of diffracting planes.
iii. The lattice constant of element.
(d) Draw the common direction in (111) and (110) planes.

(6+4+6+2)

Q.3 (a) Explain why? Limit your answers within 30-40 words.
i. Water molecule is covalently bonded, but remains in liquid state at room temperature.
ii. Ionic radii of Fe^{2+} is larger than Fe^{3+}.
iii. Inert gases form bonds at low temperature.
iv. K_β radiation is not used for crystal structure determination.
v. (100) reflection does not exist in X-ray diffraction pattern of the BCC crystal.
vi. FCT does not exist in Bravais lattice.
(b) Draw potential energy *vs* distance curve for covalently bonded and metallic bonded atoms and discuss their distinct feature(s).
(c) The Coulomb attractive force between the Mg^{+2} and S^{-2} that just touch each other is 1.49×10^{-8} N. Determine the radius of the Mg^{+2} ion. (Radius of S^{-2} is 0.184 nm).

((2x6)+3+3)