Roll Number

Thapar Institute of Engineering and Technology
School of Physics and Materials Science
Mid Semester Examination, 7th March 2020, 10.30 AM

B. Tech. (IV Semester)	**UES012: Engineering Materials**
Time: 02 Hours, MM: 50	Name of faculty: OPP, PNS, BCM, JTK, CHK, SAK

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

Q.1 **(a)** Arrange different levels of structure in the decreasing order. Mention an appropriate technique to examine each level of structure. **5**

 (b) Categorize the following materials into metal, alloy, ceramic, polymer and composite: Alumina, Steel, Bronze, Duralumin, Lead and PVC. **3**

Q.2 Explain the followings: **6**
 (a) Passivity **(b)** Cathodic protection
 (c) Corrosion penetration rate **(d)** Hydrogen embrittlement

Q.3 **(a)** Draw the (111) plane and show atomic positions for a BCC and FCC structure. Compare the planar density of these two structures. Assume that radius of atoms in both cases is the same. **6**

 (b) Consider a hypothetical metal crystallizing in FCC structure. If each lattice point contains one atom and there are 2.3×10^{28} number of unit cells per cubic meter, calculate radius of atom. **4**

Q.4 **(a)** If a unit cell of CaF_2 consists of four molecules with Rc/Ra ratio of 0.80. Calculate the atomic packing factor. **4**

 (b) Assume the following point defects: (i) Mg^{2+} ions substitute for Yttrium in Y_2O_3 and (ii) Fe^{2+} ions replace Sodium in NaCl. Indicate for each case, what needs to be removed, added and indicate the type of point defect. **4**

Q.5 **(a)** An alkali halide has molecular weight of 74.6 g with rock-salt structure. Calculate its density if it contains 0.1% Schottky defects. Assume that the nearest distance between a cation and anion is 0.32 nm. **6**

 (b) Differentiate between spinel and inverse spinel structure. **2**

Q.6 Explain why? Limit your answer to 40 words. **10**
 i. Graphite is used as a lubricant.
 ii. A 2-D pentagonal lattice is not possible.
 iii. (100) reflection peak is absent in XRD pattern of BCC Iron.
 iv. Young's modulus is a structure insensitive property.
 v. For a cation to anion radius ratio less than 0.155 in triangular coordination, the structure becomes unstable.