Roll Number: _____

Thapar Institute of Engineering and Technology, Patiala

School of Physics and Materials Science

MID SEMESTER EXAMINATION, April 2022

B. E. (Second Year): Semester-IV (2021/22)	Course Code: **UES012**	Course Name: **Engineering Materials**
Thursday 8th April 2022, 13:30 PM	Course coordinator: **Dr. Jayant Kolte**	
Time: 2 Hours, Max. Marks: 35	Name of Faculty: Dr. Loveleen Brar and Dr. Jayant Kolte	

Note

1. *Attempt **any five** questions.*
2. *Assume missing data, if any, suitably.*
3. *Use of a scientific calculator is allowed.*

Q. 1 (a) Match the following instruments with their most appropriate magnification and resolution. (4)

Magnification	Instrument	Resolution
50000 X	Magnifying lens	0.1 nm
100000 X	Optical microscope	0.1 μm
50 X	Scanning electron microscope	0.1 Å
1500 X	Transmission electron microscope	0.01 mm

(b) Define structure-sensitive properties for materials. Categorize the following properties as structure sensitive or structure insensitive. (3)

(i) Strength (iii) Density

(ii) Hardness (iv) Ductility

Q. 2 (a) Show the following directions and planes in a unit cell. (5)

i) $(1\bar{1}\bar{1})$ ii) $[01\bar{2}]$

iii) $(11\bar{2}\bar{2})$ iv) $[\bar{1}100]$

v) (1102)

(b) List zero-dimensional defects in (2)

i) Metallic solids

ii) Ionic solids

Q. 3 (a) Explain briefly with a suitable diagram and suggest two prevention method for each (5)

i) Stress corrosion

ii) Galvanic corrosion

(b) List any two corrosions for which: (2)

i) Temperature plays a key role.

ii) Environment plays a key role.

Q. 4 For a Tungsten crystal (BCC, r = 0.141 nm) determine the following

(a) Lattice parameter (1)

(b) Planar density for (111) plane (1.5)

(c) Linear density for [111] direction (1.5)

(d) Index and position of 7th peak in XRD (Cu K_α = 0.154 nm) (3)

Q. 5 For the LiF crystal (r_{Li^+} = 0.076 nm r_{F^-} = 0.133 nm) determine the following

(a) Structure and co-ordination number (2)

(b) Lattice type (1)

(c) Ionic packing fraction for the unit cell (4)

Q. 6 (a) Differentiate between edge and screw dislocations. (Use a suitable diagram). (3)

(a) Compute the line energy of dislocations in FCC Palladium (a = 0.389 nm). The shear modulus of Palladium is 42 GNm^{-2}. (2)

(c) Define Burgers vector for a dislocation. Draw a Burgers circuit for negative edge dislocation. (2)

Q. 7 Explain briefly (7)

(a) Dislocations in ionic solids have larger burger vectors as compared to metallic solids having same lattice.

(b) Nanomaterials (size < 100 nm) cannot be seen using optical microscope.

(c) Crystals are anisotropic in nature.

(d) XRD pattern of diamond cubic structure has fewer diffraction peaks as compared to that of FCC.

(e) To increase the number of vacancies in a solid, we need to heat and quench cool it.

(f) Draw a neatly labeled unit cell of the perovskite structure.

(g) Baking of specimen prevents blistering in hydrogen embrittlement susceptible materials.
