

Roll Number

Group

Thapar Institute of Engineering and Technology, Patiala

School of Physics and Materials Science

MID SEMESTER EXAMINATION

September 28, 2019

Saturday, 10.30 AM

B. E. Semester-III (2019/20)

Course Code: UES012

(COE/ ECE/ ENC)

Course Name: Engineering Materials

Time: 02 Hours, MM: 50

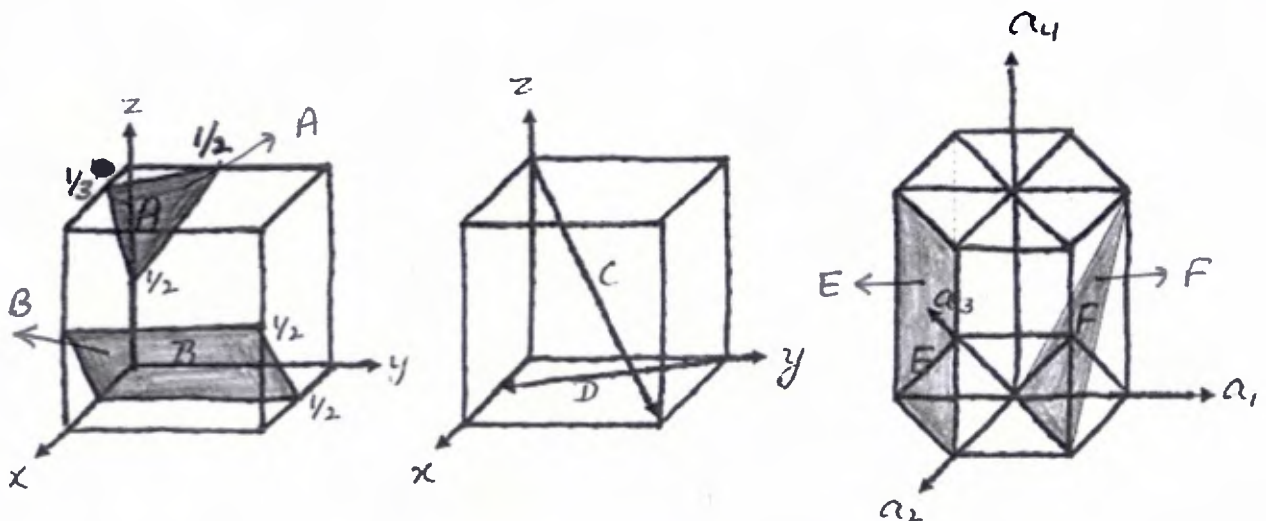
Name of faculty: OPP, KUS, PNS, CBN, BCM,
LKB, JTK, CHK, SAK, RPS

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

1. (a) Categorize the following materials into metal, alloy, ceramics, polymer and composite. (i) Brass, (ii) Boride reinforced steel, (iii) SiC, (iv) Invar, (v) Sodium, (vi) Nylon, (vii) Cement and (viii) Silica. (4)
- (b) Match the following instruments with their most appropriate magnification and resolution. (4)

Magnification	Instrument	Resolution
50,000 ×	Magnifying lens	0.1 nm
1,00,000 ×	Optical microscope	0.1 μm
50 ×	Scanning electron microscope	0.1 Å
1500 ×	Transmission electron microscope	0.01 mm

2. (a) Find out Miller Indices for the following directions and planes (A to F). (6)



- (b) Find out the planar density of FCC copper with lattice parameter of 3.61 Å along (200) and (111) plane. (4)

3. (a) Explain with suitable diagram intergranular and pitting corrosion along with two prevention methods for each. (8)
- (b) Define passivation and corrosion penetration rate. (2)
4. (a) The following 2θ values (in degrees) were observed from an experiment for a given crystal: 28.4, 47.3, 56.1, 69.1, 76.5, 88.1, 95.0 and 106.8. Copper $K\alpha$ radiation ($\lambda = 1.54 \text{ \AA}$) was used. Index all these lines; find the crystal structure. List the Bragg's angle and Miller indices for next diffraction peak. Given $a = 5.326 \text{ \AA}$. (10)
- (b) In inverse spinel NiAl_2O_4 , iron exists in two ionic states; Ni^{2+} ($R_{\text{Ni}^{2+}} = 0.078 \text{ nm}$) and Al^{3+} ($R_{\text{Al}^{3+}} = 0.057 \text{ nm}$). If the ionic radii of O^{2-} is 0.140 nm ; determine the co-ordination number for Ni^{2+} and Al^{3+} ions. (2)
5. (a) An FCC aluminum crystal has atomic radius of 0.143 nm . The sheer modulus of aluminium is 25.94 GNm^{-2} . Calculate the elastic energy of line imperfections stored in the crystal. (4)
- (b) Explain why? (6)
- (i) Graphite has low packing fraction.
- (ii) A Face centred tetragonal structure is not possible.
- (iii) Same sign dislocations existing in same plane repel each other.
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