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**PRESIDENCY UNIVERSITY
BENGALURU**

SCHOOL OF ENGINEERING

MAKEUP EXAMINATION-JAN 2023

Course Code : PET 409

Course Name: Material Science and Engineering (OE-II)

Program : B.Tech (Petroleum Engineering)

Date: 20-JAN-2023

Time: 01:00 PM to 04:00 PM

Max Marks: 100

Weightage: 50%

Instructions:

- (i) ***Read the question carefully and answer all the questions***
 - (ii) ***Scientific calculator is allowed***
-

Part A [Memory Recall Questions]

Answer all the Questions. Each Question carries FIVE marks

(5Qx5M=25 Marks)

Q.NO.1. Fill in the blanks

(C.O.NO 1) [Knowledge]

- a. Stress required during plastic deformation is _____ than that required during elastic deformation.
- b. In body centered cubic structure the center atom is shared by _____ adjacent unit cells.
- c. In simple cubic crystal structure, the average number of atoms per unit cell is _____
- d. BCC structure have _____ Average no. of atoms per unit cell
- e. Circular brackets symbolically represents crystallographic _____

Q.NO.2 Select the correct options for the following

(C.O.NO 1) [Knowledge]

i). Indexing or designation in a unit cell can be done for a particular

- A. point location
- B. direction
- C. plane
- D. all of the above

ii). A non-crystalline material is characterized as having _____

- A. repetitive arrangement of atoms in all direction
- B. repetitive arrangement of atoms in any one direction
- C. non- repetitive arrangement of atoms in all three directions
- D. none of the above

iii). A higher value of average number of atoms per unit cell indicates

- A. bigger size of materials
- B. higher density of materials
- C. lower density of materials
- D. none of the above

iv). A material having repetitive arrangement of atoms over larger atomic distances is called

- A. crystalline material
- B. non- crystalline material
- C. solid material
- D. liquid material

v). _____ is defined as fraction of volume occupied by atoms in unit cell

- A. ligancy number
- B. average number of atoms per unit cell
- C. atomic packing factor
- D. none of the above

Q.NO.3 Match the following (C.O.NO 2) [Knowledge]

| | |
|-----------------|---|
| A. Conductivity | 1. Resistance of a material to localized plastic deformation |
| B. Ductility | 2. Ability to conduct electricity and heat |
| C. Brittleness | 3. Ability of material to absorb a certain amount of energy without failure |
| D. Hardness | 4. A little tendency to deform before rupture |
| E. Toughness | 5. Ability of material to drawn into wire |

Q.NO.4 Define the following with example (C.O.NO 2) [Knowledge]

- a. Elastic material
- b. Plastic material

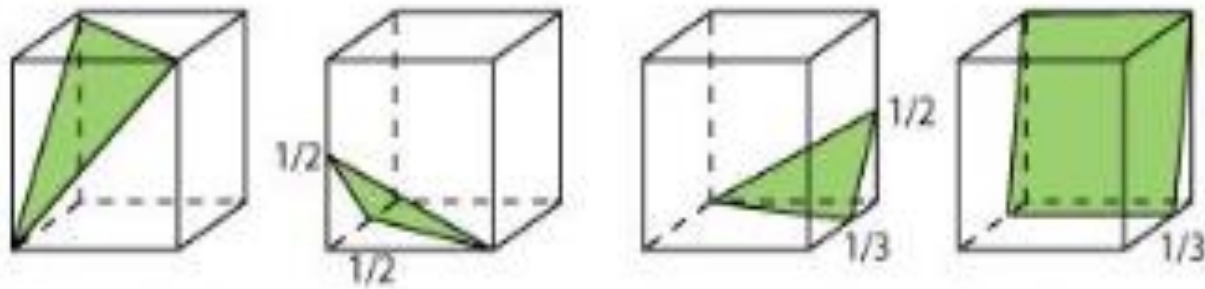
Q.NO.5 What do you mean by Geometric and Magnetic length? Why magnetic length is always less than geometric length. What is the relation between these lengths? (C.O.NO 4) [Knowledge]

Part B [Thought Provoking Questions]

Answer all the Questions. Each Question carries TWELVE marks. (3Qx12M=36 Marks)

Q.NO.6. Miller indices are used to specify directions and planes. These directions and planes could be in lattices or in crystals. The number of indices will match with the dimension of the lattice or the crystal. In the given figure, 4 planes are shown. How you can find the Miller indices for the given planes?

(C.O.NO 2) [Comprehension]



Q.NO.7. A unit cell is the smallest portion of a crystal lattice that shows the three-dimensional pattern of the entire crystal. The properties of metal depends on the number of atoms per unit cell. How can you find the effective atoms per unit cell for BCC, FCC, HCP and Simple cubic unit cell? If the edge length of a cubic cell is "a" and the radius of atoms is "R", find the relation between "a" and "R" for BCC and FCC structure. (C.O.NO 2) [Comprehension]

Q.NO.8. Classify the metals based on their magnetic properties with example. What do you mean by magnetic flux density and magnetic field intensity? Explain the magnetic hysteresis with the help of hysteresis loop. (C.O.NO 4) [Comprehension]

Part C [Problem Solving Questions]

Answer all the Questions. Each Question carries THIRTEEN marks. (3Qx13M=39 Marks)

Q.NO.9 Define Poison's ratio for isotropic and anisotropic material. Find the relation between poison's ratio, young's modulus and shear modulus. A tensile stress is to be applied along the long axis of a cylindrical brass rod that has a diameter of 15 mm. How you can change the diameter of the rod by 3×10^{-3} mm? If the deformation is entirely elastic. Poison's ratio for brass is 0.34 and Young's modulus is 100 GPa (C.O.NO 2) [Application]

Q.NO.10

a. Let the magnetic moment of a bar magnet is P_m whose magnetic length is $d=2l$ and pole strength is q_m . Compute the magnetic moment of the bar magnet when it is cut into equal three pieces

- i. Along the length of the magnet
- ii. Along the perpendicular to its length

b. The repulsive force between two magnetic poles in air is 12×10^{-3} N. If the two poles are equal in strength and separated by a distance of 20 cm. Which law will you use to determine the pole strength of each pole also find the pole strength. The value of magnetic permeability K is 10^{-7} Hm⁻¹.

(C.O.NO 4) [Application]

Q.NO.11 Structure of metal with respect to temperature can be studied by phase diagram. Draw the phase diagram for iron- carbon and explain the different structures with respect to composition and temperature. Show the eutectic, eutectoid and peritectic reactions and find the degree of freedom for these points. (C.O.NO 3) [Application]