# NATIONAL INSTITUTE OF TECHNOLOGY JAMSHEDPUR

**Material Science (MM1201)**

Department of MMF, ME, PIE and ECM

B. Tech Mid Semester Examination (2nd semester)

Date of Exam: 22nd March 2024, Time: 2 Hours, Marks: 30

Course Faculty: Dr. Anushree Dutta, Dr. Jichil Majhi, and Dr. Partha Duley

**Instructions:**

Read the questions carefully and answer all of them with proper diagrams wherever it is required.

1. i. Determine the Miller Indices for Planes A and B in Fig. (a), and determine the Miller-Bravais indices for the directions in Fig. (b). [2+4]

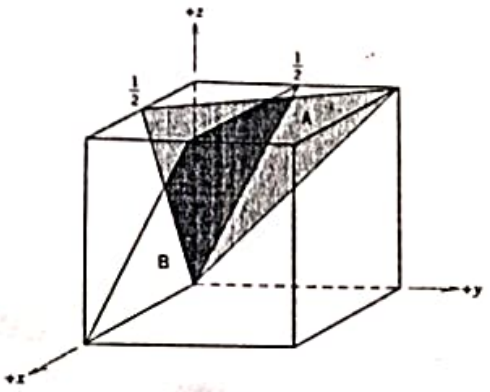


Fig. (a)

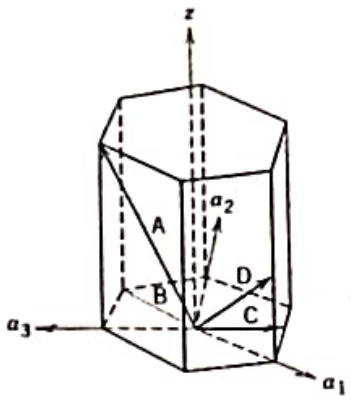


Fig. (b)

ii. Derive planar density expressions for FCC (100) and (110) planes in terms of the atomic radius *R*. [4]

2. i. What are interstitial and substitutional solid solutions? Explain why 100% solid solubility is not possible in interstitial solid solution. [3]

ii. What is elastic and plastic deformation? How do you measure resilience and toughness value from a stress-strain plot? [4]

iii. What do you mean by ductile and brittle materials? How do you measure ductility from stress-strain plot/data? [3]

3. i. What is strain hardening? Compute the strain-hardening exponent ($n$) for an alloy in which a true stress of 415 MPa produces a true strain of 0.10; assume a value of 1035 MPa for the strength coefficient. [4]

ii. A 10-mm-diameter Brinell hardness indenter produced an indentation 2.50 mm in diameter in a steel alloy when a load of 1000 kg was used at room temperature. Compute the HB of this material. And what will happen to the hardness of materials if temperature is increased? [4]

iii. Name two types of impact testing methods. Explain any one of them briefly with a diagram. [2]

---*All the best*---

NATIONAL INSTITUTE OF TECHNOLOGY JAMSHEDPUR

Materials Science (MM1101)

Department of CE/CSE/ECE/EE

End Semester Examination (1st Semester)

Time: 3 hrs., Date of Exam: 12th December 2024 Full Marks: 50

Course Faculty: Dr. Anushree Dutta, Dr. Jichil Majhi, Dr. Partha Duley & Dr. Ram Krishna

Instructions:

Answer all the questions precisely. In case of missing data, it may be assumed appropriately.

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|---|---|---|
| 1 (a) | For some metal alloys, a true stress of 415 MPa (60,175 psi) produces a plastic true strain of 0.475. How much will a specimen of this material elongate when a true stress of 325 MPa (46,125 psi) is applied if the original length is 300 mm (11.8 in.)? Assume a value of 0.25 for the strain-hardening exponent n. | [6] |
| (b) | i. Briefly discuss on dislocation climb and dislocation cross slip.<br>ii. Cite the relative Burgers vector–dislocation line orientations for edge, screw, and mixed dislocations. | [2+2] |
| 2(a) | i. What is fatigue failure? Draw the S-N curve for ferrous and non-ferrous alloys.<br>ii. A 4340-steel bar with a diameter of 30 mm is subjected to a fluctuating axial load that varies from a maximum of 330 kN tension to a minimum of 110 kN compression. Calculate the fatigue properties such as mean stress, stress range, stress amplitude and stress ratio. | [3+3] |
| (b) | How does grain size affect the creep rate of a material? Describe the different design considerations to avoid creep failure. | [2+2] |
| 3 (a) | Differentiate between conductor, semiconductor and insulator based on band theory. | [4] |
| (b) | Plot energy (E) vs. wave number (k) diagram as per free electron theory and zone theory | [3] |
| (c) | Write short notes on Ferroelectricity, Piezoelectricity and Magnetism. | [3] |
| 4 (a) | i. Write the different invariant reactions present in the Fe-Fe$_3$C phase diagram.<br>ii. 'Degree of freedom for an invariant reaction is zero'. What do you mean by that? Justify the statement by taking a suitable example. | [2+3] |
| (b) | Draw a TTT diagram of a eutectoid steel showing a eutectoid reaction. | [3] |
| (c) | Briefly explain the difference between hardness and hardenability. | [2] |
| 5(a) | What is the difference between composites and alloys? Explain with examples. | [3] |
| (b) | What is the degree of polymerization? Write the example of thermoplastic and thermosetting polymers. | [3] |
| (c) | Write the different properties of ceramic material and their usefulness. | [4] |

---------- All the Best! ----------