Reg.No. \_\_\_\_\_\_\_\_\_\_\_\_



**End Semester Examination – Nov/Dec – 2018**

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| **Code :** | **17NT2004** | **Duration :** | **3hrs** |
| **Sub. Name :** | **MATERIALS SCIENCE I** | **Max. marks :** | **100** |

**ANSWER ALL QUESTIONS (5 x 20 = 100 Marks)**

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| **Q. No.** | **Sub Div.** | **Questions** | **Course**  **Outcome** | **Marks** |
| 1. | a. | List the primary classification of solid materials. | CO1 | 2 |
| b. | Sketch the following directions within a cubic unit cell  i) [1,0,0] ii) [0,0,1] iii) [0,1,0]  Sketch the following planes in a cubic unit cell  i) (1 1 1) ii) (0 0 1) iii) (2 2 2)  Calculate the coordination number of HCP unit cell, mention its atomic packing factor. | CO1 | 3 |
| c. | Describe covalent, ionic and metallic bonding with suitable sketch. Give examples. | CO1 | 15 |
| (OR) | | | | |
| 2. | a. | Define unit cell. | CO1 | 2 |
| b. | Differentiate amorphous and poly crystalline materials. | CO1 | 3 |
| c. | Sketch the different metallic crystal structures mentioning the lattice parameters. | CO2 | 3 |
| d. | Calculate the number of atoms and atomic packing factor for SC, BCC, FCC and HCP structures. | CO2 | 12 |
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| 3. | a. | Mention the steps to determine the Miller indices of planes | CO2 | 2 |
| b. | Differentiate screw and edge dislocation with suitable sketch. | CO3 | 3 |
| c. | With neat sketch, differentiate the seven different crystal systems. Mentions their lattice parameters. | CO2 | 15 |
| (OR) | | | | |
| 4. | a. | Define anisotropy. | CO2 | 2 |
| b. | Briefly discuss about line dislocations with suitable sketch. | CO3 | 3 |
| c. | Explain in detail, Czochralski’s and float zone technique to grow single crystal silicon ingots. | CO6 | 15 |
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| 5. | a. | State Fick’s first law of diffusion. | CO4 | 2 |
| b. | Explain the process of diffusion. | CO4 | 3 |
| c. | Explain in detail, the application of diffusion in sintering, doping of semiconductors and surface hardening of metals. | CO4 | 15 |
| (OR) | | | | |
| 6. | a. | Mention Fick’s second law in equation form and describe all the parameters. | CO4 | 3 |
| b. | The carbon content of a steel at the surface is 0.9%. The steel is being carburized at 927oC. The nominal C content in the steel is 0.2%. Calculate the time needed to increase the carbon content to 0.4% at 0.5 mm depth. D = 1.28 x 10-11 m2/s at 927oC.  Given  -------------------------------  z erf(z)  -------------------------------  0.70 0.6778  0.75 0.7112  0.80 0.7412 | CO4 | 3 |
| c. | Differentiate vacancy and interstitial diffusion with a suitable sketch. | CO4 | 4 |
| d. | Differentiate steady state and non-steady state diffusion and explain in detail, the various factors that affect diffusion. | CO4 | 10 |
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| 7. | a. | Define Hooke’s law. | CO5 | 2 |
| b. | Define hardness of a material and mention the different types of hardness tests. | CO5 | 3 |
| c. | Sketch a typical stress- strain curve and mention the different regions in the curve. Distinguish between elastic and plastic deformation. | CO5 | 7 |
| d. | Discuss the role of dislocations in plastic deformation with suitable sketch. | CO5 | 8 |
| (OR) | | | | |
| 8. | a. | At high temperatures, does the grain boundary cause an increase or decrease in creep strength? | CO5 | 2 |
| b. | Distinguish between brittle fracture and ductile fracture. | CO5 | 3 |
| c. | Discuss in detail about fatigue failure of materials. Explain the concept of SN curve with suitable examples. | CO5 | 7 |
| d. | Define creep. Sketch a creep curve and discuss about each stage in the curve. Mention the methods to increase creep resistance. | CO5 | 8 |
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|  | | **Compulsory**: |  |  |
| 9. | a. | Explain the lever rule in determination of each phase present in the phase diagram. | CO5 | 3 |
| b. | Sketch the single component phase diagram and mark the different phases present, also identify the critical point and triple point. | CO5 | 5 |
| c. | Schematically sketch the isomorphous phase diagram of Cu-Ni system. Label the various phase regions, solidus and liquidus lines. Discuss the different rules in determination of the following   1. Phases present 2. Phase compositions 3. Phase weight fractions | CO5 | 12 |