



GIET Main Campus (Autonomous)

Gunupur-765 022

Reg.No.:

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B.TECH. DEGREE EXAMINATION-NOV-DEC.2018
End Semester Examination
BMEPC3030-Introduction to Physical Metallurgy and Engineering Materials
(Regulations 2017)(Mechanical Engineering)

Time : 3 Hours

Maximum : 100 Marks

Question Code:351012

Answer ALL Questions

PART A - (10 X 2 = 20 Marks)

1. (a) Packing efficiency of a crystal structure is the ratio of: [CO1] [PO1]
 - a) Volume occupied by particles to total volume of unit cell
 - b) Volume occupied by particles to that by voids
 - c) Total volume of unit cell to volume occupied by particles
 - d) Volume occupied by voids to that by particles

- (b) Miller indices for Octahedral plane in cubic crystal [CO1] [PO1]
 - (a) (100)
 - (b) (110)
 - (c) (111)
 - (d) None

- (c) Stainless steel is so called because of its—— [CO1] [PO1]
 - (a) High strength
 - (b) High corrosion resistance
 - (c) High ductility
 - (d) Brittleness

- (d) Austenite phase in Iron-Carbon equilibrium diagram..... [CO2] [PO1]
 - a. is face centered cubic structure
 - b. has magnetic phase
 - c. exists below 727 degC
 - d. all of the above

- (e) Which transformation starts after the nucleation of ferrite phase? [CO2] [PO1]
 - a. Bainite transformation
 - b. Pearlite transformation
 - c. Both a. and b.
 - d. None of the above

- (f) Which one of the following is not equilibrium heat treatment [CO3] [PO1]
 - a) Austenitising
 - b) Annealing



GIET Main Campus (Autonomous)

Gunupur-765 022

- c) Normalizing
- d) Precipitation

- (g) Which one of the following is not correct [CO3] [PO1]
- a) Martensite has a BCC structure
 - b) Austenite has FCC structure
 - c) Martensite is a solid solution of carbon in BCC iron
 - d) The martensite which is formed during quenching is too brittle
- (h) Materials are softened by [CO3] [PO1]
- a) Carburizing
 - b) Normalizing
 - c) Tempering
 - d) Annealing
- (i) Multimode graded index fibers use incoherent source only. State whether the following statement is true or false. [CO4] [PO1]
- a) True
 - b) False
- (j) Refractive index of materials is approximately equal to square root of [CO4] [PO1]
- (a) electrical permittivity
 - (b) magnetic permeability
 - (c) electrical permittivity x magnetic permeability
 - (d) None

PART B - (10 X 2 = 20 Marks)

2. (a) Define Lattice. Define space lattice (or) crystal lattice [CO1] [PO1]
- (b) Obtain the relation between the cell edge and the atomic radius in the case of a BCC unit cell. [CO1] [PO1]
- (c) What is an isomorphous system? [CO2] [PO1]
- (d) What is meant by eutectoid, hypo eutectoid, hyper eutectoid steel? [CO2] [PO1]
- (e) What is the application of Lever rule? [CO2] [PO1]
- (f) What are the types of Annealing? [CO3][PO1]
- (g) What is Critical Cooling Rate (CCR)? [CO3][PO1]



GIET Main Campus (Autonomous)

Gunupur-765 022

- (h) What is Carbonitriding? [CO3][PO1]
- (i) Differentiate thermoplastics and thermosetting plastics. [CO4][PO1]
- (j) What are the factors that control the strength of ceramics? [CO4][PO1]

PART C - (4 X 15 = 60 Marks)

3. (a) (i) Define packing factor and obtain the packing factor for the Hexagonal Closed packing factor with a neat diagram. [8][CO1] PO2]
- (ii) Find the number of atoms associated in each BCC, FCC and HCP unit cells. Calculate the equilibrium number of vacancies per cubic meter for copper at 100°C . The energy for vacancy formation is 0.9 eV/atom; the atomic weight and density for copper are 63.5 g/mol and 8.45 g/cm³, respectively. Take Avogadro's number as 6.023×10^{23} atoms/mol. $k = 8.62 \times 10^{-5} \text{ eV/atom}$. [7][CO1][PO2]
- (or)
- (b) (i) Aluminum has FCC structure and its density is $2700 \frac{\text{kg}}{\text{m}^3}$. Calculate the unit cell dimension and atomic diameter. (Aw of Al = 26.98 g/mol). [7][CO1][PO2]
- (ii) What is meant by crystal defects? Describe in detail the point, line and surface defects and Burger vector. [8][CO1][PO1]
4. (a) (i) Draw neatly the phase diagram of a system in which the two components are completely soluble in the liquid state and partly soluble in the solid state having terminal solid solutions α and β . Label the phase diagram with proper labeling. Show the liquidus curve, solidus curve and solvus curves in the system. Show the eutectic temperature and the composition of eutectic alloy. [8][CO2][PO2]
- (ii) Define non-equilibrium cooling. What is the impact of this cooling? [7] [CO2][PO1]
- (or)
- (b) (i) Show and describe in details the development of microstructure on slow cooling in different regions of Pb-Sn phase diagram. [7][CO2][PO2]
- (ii) For a 0.35 wt% C plain carbon steel at a temperature just below the eutectoid temperature determine: i. Fraction of total ferrite and cementite phase.
ii. Fraction of the pro-eutectoid ferrite and pearlite.
iii. Fraction of eutectoid ferrite. [8][CO2][PO1]



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Gunupur-765 022

5. (a) (i) What is meant by Normalizing? List the objectives of normalizing. [7][CO3][PO1]
- (ii) What is yield point phenomenon? Describe it with a neat sketch of load-elongation curve of low carbon steel. [7][CO3][PO1]
- (or)
- (b) (i) The tensile stress on a single crystal of BCC iron lies along [010] direction. If the tensile stress of 52 MPa is applied, Calculate the resolved shear stress along (110) plane and in $[-1 \ 1 \ 1]$ direction. If slip occurs on (110) plane and $[-1 \ 1 \ 1]$ direction and CRSS is 30 MPa, calculate the applied tensile stress to cause yielding. [8] [CO3][PO2]
- (ii) Explain the concept of work hardening or strain hardening and illustrate with the help of stress-strain diagram. [7][CO3][PO1]
6. (a) (i) Explain the working principle of Ruby Laser with proper diagram. [8] [CO4][PO1]
- (ii) Explain fibre optic communication system with a block diagram. [7][CO4][PO1]
- (or)
- (b) (i) The fraction of the nonreflected radiation that is transmitted through 5mm thickness of a transparent material is 0.95. If the thickness is increased to 12 mm what fraction of light will be transmitted? [7][CO4][PO2]
- (ii) What are Optical fibres? And explain the structure and working principle of optical fibre with neat diagram. [8][CO4][PO1]