Assignment Booklet

M.Sc. (Physics) Programme
(MSCPH)

MATERIALS SCIENCE

Valid from 1st July, 2024 to 30th June, 2025

ignou
THE PEOPLE'S UNIVERSITY

School of Sciences
Indira Gandhi National Open University
Maidan Garhi, New Delhi-110068
(2024-25)

Dear Student,

Please read the section on assignments in the Programme Guide for M.Sc. (Physics). A weightage of 30 per cent, as you are aware, has been earmarked for continuous evaluation, **which would consist of one tutor-marked assignment** for this course. The assignment is in this booklet. The total marks for this assignment is 100, of which 40 marks are needed to pass it.

Instructions for Formatting Your Assignments

Before attempting the assignment please read the following instructions carefully:

1) On top of the first page of your answer sheet, please write the details exactly in the following format:

ENROLMENT NO.: ………………………………………………

NAME: …………………………………………………

ADDRESS: …………………………………………………

COURSE CODE:…………………………..

COURSE TITLE: …………………………

ASSIGNMENT CODE: …………………..

STUDY CENTRE: ………………………..   **DATE:** ………………………………………….

PLEASE FOLLOW THE ABOVE FORMAT STRICTLY TO FACILITATE EVALUATION AND TO AVOID DELAY.

2) Use only foolscap size writing paper (but not of very thin variety) for writing your answers.

3) Leave 4 cm margin on the left, top and bottom of your answer sheet.

4) Your answers should be precise.

5) **Submit the complete assignment answer sheets containing Part A and Part B, within the due date.**

6) The assignment answer sheets are to be submitted to your Study Centre as per the schedule. **Answer sheets received after the due date shall not be accepted. We strongly suggest that you retain a copy of your answer sheets.**

7) This assignment is **valid from 1st July 2024 to 30th June 2025**. If you have failed in this assignment or fail to submit it by June 30, 2025, then you need to get the assignment for the year 2025-26, and submit it as per the instructions given in the Programme Guide.

8) **You cannot fill the examination form for this course** until you have submitted this assignment. For any queries, please contact: sgokhale@ignou.ac.in or slamba@ignou.ac.in. Please note that we do not provide answers to the questions asked in this Assignment.

We wish you a good luck.

Tutor Marked Assignment
MATERIALS SCIENCE

Course Code: MPHE-025

Assignment Code: MPHE-025/TMA/2024-25

Max. Marks: 100

Note: Attempt all questions. The marks for each question are indicated against it.

PART A

1. a) Explain with diagram, how many identical points are created by a $\bar{3}$ roto-inversion operation. Among 3-fold rotation and $\bar{3}$ roto-inversion operation, which one has higher order? Why? (3+1+1)

    b) What are glassy alloys? Discuss their mechanical properties vis-à-vis normal metal alloys and ceramic oxide materials. State any four technological applications of glassy alloys. (2+2+1)

    c) What are solid solutions? Explain the rules (Hume-Rothery) governing the formation of substitutional solid solutions. (2+3)

2. a) Explain with diagram the float zone method of crystal growth. State its advantages over the Czochralski method. (4+1)

    b) Calculate the mass of phosphorus required to make a silicon crystal with 10^{17} cm^{-3} doping density, if the initial melt load of silicon is 50 kg. The density of silicon in the melt is 2.5 g cm^{-3} and phosphorus has an atomic weight of 30.97u. Assume that the segregation coefficient $k_0 = 0.35$ is constant throughout the growth process. (5)

    c) Describe the importance and cost advantages of powder metallurgy in materials processing. (5)

    d) What is epitaxial growth? What are the advantages of MBE growth technique? State its applications. (2+2+1)

3. a) Explain with appropriate diagrams various point defects observed in solid crystals. (6)

    b) Calculate the equilibrium concentration of vacancies in a copper crystal at 1000 K. Given that melting point of copper is 1083°C and enthalpy of vacancy formation in copper is 120 kJ per mole. (4)

    c) What is dislocation defect? Discuss its role in the crystal growth. (2+3)

PART B

4. a) Based on the diffusion mechanisms involved explain why carbon atom diffusion is faster than nickel atom diffusion in iron lattice. (5)

    b) What are eutectic phase diagrams? With the help of a schematic diagram for a binary system explain the significance of eutectic point and liquidus, solidus & solvus curves. (1+4)

c) Explain the Avrami and Johnson-Mehl models of computing phase transformation rates based on their assumptions and growth mechanisms. (5)

5. a) Draw a typical stress-strain curve of a material. Define various mechanical strengths and indicate corresponding deformation regions on this plot. (5)

b) What is meant by "thermal shock" experienced by the materials? How can it be reduced? State the expression for thermal shock resistance (TRS) explaining all the terms involved. (1+2+2)

c) Define corrosion in case of materials. Discuss the five major factors affecting / promoting corrosion process. (5)

6. a) Explain the phenomena of Colossal Magnetoresistance (CMR) and Giant Magnetoresistance (GMR). Give examples of materials where these effects are observed. (2+2+1)

b) What are shape memory materials? Explain the phase transition hysteresis observed in NiTi alloy giving rise to shape memory phenomenon. Discuss any two applications of shape memory materials. (1+2+2)

c) What is graphene? Describe the bonding in graphene. Explain the band structure of graphene on *E-k* diagram. (1+2+2)

d) What is organic electronics? Explain the working of an organic diode. (1+4)

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