



**PANJAB UNIVERSITY
OF SCIENCE AND TECHNOLOGY**

FACULTY OF HEALTH, NATURAL RESOURCES AND APPLIED SCIENCES

DEPARTMENT OF NATURAL AND APPLIED SCIENCES

QUALIFICATION : BACHELOR OF SCIENCE HONOURS	
QUALIFICATION CODE: 08BOSH	LEVEL: 8
COURSE CODE: MAP821S	COURSE NAME: MATERIALS PHYSICS
SESSION: JANUARY 2023	PAPER: THEORY
DURATION: 3 HOURS	MARKS: 100

SUPPLEMENTARY/SECOND OPPORTUNITY EXAMINATION QUESTION PAPER	
EXAMINER(S)	Prof Dipti R. Sahu
MODERATOR:	Dr Zivayi Chiguvare

INSTRUCTIONS
<ol style="list-style-type: none">1. Answer all five questions.2. Write clearly and neatly.3. Number the answers clearly.

PERMISSIBLE MATERIALS

Non-programmable Calculators

THIS QUESTION PAPER CONSISTS OF 3 PAGES (Including this front page)

Question 1 [10]

- 1.1 What is hardness? Mention any two types of hardness measurements? (2)
- 1.2 Consider a cylindrical nickel wire 2.0 mm in diameter and 3×10^4 mm long. Calculate its elongation when a load of 300 N is applied. Assume that the deformation is totally elastic for Ni, $E = 207$ GPa. (4)
- 1.3 What is the classification of the engineering materials? Explain the materials in brief. (4)

Question 2 [10]

- 2.1 Explain photoconductivity process in a semiconductor. (2)
- 2.2 Determine the penetration depth of the primary electrons in ZnS for an incident beam of energy of 10 keV. Given that $K = 1.2 \times 10^{-4}$ and $b = 0.0175$ (4)
- 2.3 What is the meaning of optical materials? How you classify optical materials into different categories, Mention the categories and explain. (4)

Question 3 [10]

- 3.1 The thermal conductivity of a plain carbon steel is greater than for a stainless steel. Why is this so? (2)
- 3.2 A cuboid room is perfectly isolated on all sides, except one. This side, 6m long and 2m high, is 25cm thick and shows a heat conductivity of 0.8 W/(Km) . The wall has no windows. The temperature of the inner wall surface is 10°C , the temperature of the outer wall surface is -10°C . Calculate the heat flow through the wall? (4)
- 3.3 What is thermal shock resistance? Thermal shock behaviour is affected by which factors? (4)

Question 4 [10]

- 4.1 What do you mean by dielectric constant of a materials (2)
- 4.2 A solid contains 5×10^{28} atoms/ m^3 each with a polarisability of $2 \times 10^{-40} \text{ F m}^2$. Assuming that the internal field is given by Lorentz formula. Calculate the ratio of internal field to the external field. $\epsilon_0 = 8.854 \times 10^{-12} \text{ Fm}^{-1}$. (4)
- 4.3 What is Piezoelectricity? Give an example of piezoelectric materials and its applications. (4)

Question 5 [10]

- 5.1 Explain the terms polymer and monomer (2)
- 5.2 How are Polymer classified based on structure? Give representation of each polymer (4)
- 5.3 What are thermosetting and thermoplastic polymer? Give example for each. (4)

- Question 6** [10]
- 6.1 Mention what is the primary mineral in glass products? What is fused silica glass? (2)
- 6.2 Calculate the density in grams per cubic centimetre of SrSnO_3 ceramic, which has the perovskite structure. Ionic radii are $\text{Sr}^{2+} = 0.127 \text{ nm}$, $\text{Sn}^{4+} = 0.074 \text{ nm}$, and $\text{O}^{2-} = 0.132 \text{ nm}$. Assume the lattice constant $a = 2(r_{\text{Sn}^{4+}} + r_{\text{O}^{2-}})$ (4)
- 6.3 What are some of the properties common to most ceramic materials? Distinguish between traditional and engineering ceramic materials and give examples of each. (4)
- Question 7** [10]
- 7.1 What is Domain wall energy (or) Bloch wall energy? (2)
- 7.2 The saturation magnetic induction of Nickel is 0.65 Wb m^{-2} . If the density of Nickel is 8906 kg m^{-3} and its atomic weight is 58.7, calculate the magnetic moment of the Nickel atom in Bohr magnetron. (4)
- 7.3 Explain different types of magnetic materials in brief? (4)
- Question 8** [10]
- 8.1 What is a composite ? (2)
- 8.2 A continuous and aligned glass fiber-reinforced composite consists of 40 vol% of glass fibers having a modulus of elasticity of 69 GPa and 60 vol% of a polyester resin that, when hardened, displays a modulus of 3.4 GPa. Compute the modulus of elasticity of this composite in the longitudinal direction (4)
- 8.3 What are the functions of a reinforcement in a composite? (4)
- Question 9** [10]
- 9.1 Justify, is compound semiconductor can be an intrinsic semiconductor? (2)
- 9.2 In a P-type Si sample the hole concentration is $2.25 \times 10^{15}/\text{cm}^3$. The intrinsic carrier Concentration is $1.5 \times 10^{10}/\text{cm}^3$. Calculate the electron concentration (4)
- 9.3 Compare silicon and gallium arsenide semiconductors relative to properties and applications? (4)
- Question 10** [10]
- 10.1 What do you mean by linear and planar densities (2)
- 10.2 Calculate the equilibrium number of vacancies per cubic meter for copper at 1000°C . The energy for vacancy formation is 0.9 eV/atom: the atomic weight and density (at 1000°C) for copper are 63.5 g/mol and 8.4 g/cm^3 , respectively (4)
- 10.3 Explain the difference in electrical conductivity for metals, semiconductors, and insulators in terms of their electron energy band structures. (4)

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