

Instructions: 1. All questions are compulsory

2. Write answer of every question on new page

3. Assume suitable data wherever necessary (specify them in your answers)

Q. 1 Write the answers of following questions.

[14]

1. What are the assumptions introduced by Drude-Lorentz to explain classical free electron theory of metal? Discuss the achievements and failures of this mole. [4]

OR

- ✓ Explain the variation of magnetic susceptibility with temperature in the (a) Dia (b) Para (c) Ferro (d) Antiferro and (e) Ferri magnetic materials. [4]
- ✓ Write the difference between Conductors and Superconductors. For a specimen of V_3Ga , the critical fields are respectively 1.4×10^5 and 4.2×10^5 A/m for 14 K and 13 K. Calculate the transition temperature and critical fields at 0 K and 4.2 K. [4]
- ✓ Write short note on (1) Meissner Effect and (2) Hall Effect [6]

Q. 2 Attempt any THREE of following questions.

[12]

- ✓ 1. What are carbon nano tubes (CNTs)? Explain characteristic properties of CNTs in detail.
- ✓ 2. Explain Ball-milling method for fabrication of nano-particles with appropriate schematic.
- ✓ 3. What are nano-materials? Explain why nano-materials exhibit drastically different properties than the same materials in bulk form?
- ✓ 4. Explain difference between CVD and PVD systems for fabrication of thin films.

Q. 3 Write the answers of following questions.

[12]

1. Classify seven crystal systems in 3D along with diagrams, lattice parameters and examples. [6]

OR

- ✓ Define Miller indices. How Miller indices of a plane are calculated? Calculate the volume of a monoclinic unit cell with cell parameters $a=14.84 \text{ \AA}$, $b=11.19 \text{ \AA}$, $c=16.09 \text{ \AA}$ and $\alpha=90^\circ$, $\beta=112.48^\circ$ and $\gamma=90^\circ$. [6]
- ✓ 2. Write short notes on any TWO of the following: [6]
 - (i) Intrinsic and extrinsic semiconductors, (ii) Laue method of X-ray diffraction,
 - (iii) Hexagonal closed packing (hcp)

Q. 4 Attempt any THREE of following questions.

[12]

- ✓ 1. What is meant by an ensemble? Discuss microcanonical, canonical and grand canonical ensembles. Compare these three types of ensembles.
- ✓ 2. State and prove Liouville's theorem.
- ✓ 3. What do you mean by phase space, microstates and macrostates? Explain them in detail.
- ✓ 4. Describe the fundamental forces in detail.
5. What is liquid drop model? Describe each term in detail.

S. V. NATIONAL INSTITUTE OF TECHNOLOGY, SURAT.
B.TECH-I MID SEM TEST, SEPT-OCT - 2019
PHYSICS OF MATERIALS AND NUCLEI (ALL BRANCHES)

Time : 1.5 Hours

Maximum Marks : [30]

Instructions: 1. All main questions are compulsory
 2. Figures to the right indicate marks

Q-1 (a) Discuss formation of domains in ferromagnetic materials. Explain hysteresis curve based on the domain concept.

OR

(4)

(a) State Wiedemann-Franz law. Deduce this law using the results of classical free electron theory.

(b) An iron ring of mean circumferential length 30 cm and cross-section 1 cm^2 is wound uniformly with 300 turns of wire. When a current of 0.032 amp flows in the windings, the flux in the ring is 2×10^{-6} Weber. Find the flux density in the ring (B), the magnetic intensity (H) and the permeability of iron (μ).

(3)

Q-2 (a) Define Miller indices.

Determine interplanar spacing (d) between the two parallel planes with Miller indices ($h k l$), and find d for a cubic unit cell whose side is 2.1 \AA for the $\{110\}$ family of planes.

(1+4)

OR

Explain production, spectra and applications of X-rays with relevant diagrams.

(5)

(b) Calculate the wavelength of X-rays that give third order reflection at an angle of 6° for (111) reflection from a cubic lattice of edge length 5.63 \AA .

(3)

Q-3 Answer Any Two

(2x3=6)

(a) What is quantum confinement? Explain effects of one-, two-, and three-dimensional confinements on density of states of the nano-structures.

(b) Explain the principal and working of Chemical Vapor Deposition (CVD) system for growth of nano-structured films with appropriate schematic

(c) Explain effects of substrate temperature on the crystallinity of the thin films in physical vapor deposition (PVD).

Q-4 (a) What is the need of the nuclear force? Write its properties.

(b) What is nuclear fusion? Why it is important?

(c) Draw the meson octet and write its quark combination.

(2)

(2)

(2)

Q-5 Pick the correct answer

[1x3=3]

1. A conservation law that is not universal but applies only to certain kinds of interactions is conservation of...

(a) lepton number (b) baryon number (c) spin (d) charge (e) strangeness

2. In quantum electrodynamics (QED), electromagnetic forces are mediated by...

(a) the interaction of electrons. (b) hadrons. (c) the weak nuclear interaction. (d) the exchange of virtual photons. (e) gluons

3. An isotope with a high Binding Energy per nucleon...

(a) will decay in a short period of time. (b) is very unstable (c) is very stable (d) has very few electrons (e) has more protons than neutrons.