

Tribhuvan University

2081

Bachelor Level (4 Yrs.)/Science & Tech. / IV year

Nuclear Physics & Solid State Physics

PHY - 403

Full Marks: 100

Time: 3 hrs.

Candidates are required to give their answers in their own words as far as practicable.

The figures in the margin indicate full marks.

Attempt ALL the questions.

1. Discuss significance of liquid drop model in nuclear physics. [10]

OR

Describe wave function of deuteron and its solution considering square well potential (with V_0 depth of the well)

$$V(r) = -V_0 \quad \text{for } r \leq r_0 \\ = 0 \quad \text{for } r > r_0.$$

2. Discuss the Debye theory of Lattice heat capacity. [10]

OR

Describe Bloch function and its significance. Discuss Kronig - penny model and its significance.

3. Describe Meissner effect and hence define type I and type II superconductors with examples. [8]

4. Elucidate conservation theorem in nuclear reaction with examples. [8]

5. Explore idea of 'fission production' and energy released chain reactions in the nuclear reactor. [8]

6. Explain Weiss theory of ferromagnetism. [8]

7. Answer all the questions. [2×3=6]

(a) Interpret strangeness conservation.

OR

Clarify the origin of cosmic rays.

(b) Illustrate the meaning of Burgers vectors.

OR

Point out significance of Bragg's law.

8. Answer all the questions. [4×3=12]

(a) Describe bondings in crystals of inert gases.

(b) Briefly explain electric susceptibility.

- (c) Why there are three generations of quarks and leptons? Explain.
- (d) Mention the properties of neutrino.
9. The binding energy of ${}^3\text{H}$ and ${}^2\text{H}$ are 8.5 and 2.22 MeV respectively. What will be the energy released when ${}^3\text{H}$ and ${}^2\text{H}$ fused to form a stable ${}^4\text{He}$ of binding energy 28.3 MeV? [5]
10. Consider the reaction ${}^1_1\text{H} + {}^3_1\text{H} \rightarrow {}^3_2\text{He} + \eta$ which has a Q -Value - 0.7638 MeV. Calculate the threshold energy if (i) target ${}^1_1\text{H}$ is hit by ${}^3_1\text{H}$ and (ii) target ${}^3_1\text{H}$ is hit by ${}^1_1\text{H}$. (Given ${}^1_1\text{H} = 1.007825$ amu and ${}^3_1\text{H} = 3.0106049$ amu) [5]
11. In nuclear reaction $n \rightarrow p + e^- + \bar{\nu}_e$ check whether Baryon number and strangeness number conserve. [5]
12. Numbers of nearest neighbours in bcc & fcc are 8 and 12 respectively. What are the corresponding values of nearest neighbour distance? [5]
13. Calculate the fraction electrons excited into conduction band in Ge at 100 K and 300 K (given $E_g = 0.75$ eV for Ge). [5]
14. Fermi energy of certain metal is 2.5eV. Calculate the number of free electrons per m^3 of metal. [5]