UG (CBCS) Even Semester Examination, May 2025

EDUCATION
(B.Sc. B.Ed.)

6th Semester

Course No. : BSPP - 603

(Quantum mechanics, Atomic & Nuclear Physics, Crystallography & Electronics)

Full Marks : 50

Pass Marks : 20

Time : 2 hours

The figures in the margin indicate full marks for the questions

1. (a) Show that the Compton shift in wavelength is given by $\Delta\lambda = \frac{h}{m_e c}(1 - \cos\theta)$ 8

   (b) Estimate the Compton wavelength of a proton. 2

Or

2. (a) Derive the binding energy of an electron of an atom of atomic number Z using Heisenberg's uncertaintity principle. Also find the binding energy of electron of H and He atoms. 6

   (b) Show that the electron does not exist inside the nucleus using Heisenberg's uncertaintity principle. 4

3. (a) Define ionization and excitation potentials. 2

(Turn Over)

(b) Write the working of Frank-Hertz experiment to determine the excitation potential of Hg atom. 8

Or

4. (a) Show that the radius and total energy of electron in n^{th} permissible orbit for an atom of atomic number Z are $r_n = \frac{n^2 h^2 \varepsilon_0}{\pi Z e^2 m}$ and $E_n = -\frac{m e^4 Z^2}{8 {\varepsilon_0}^2 n^2 h^2}$ 6

(b) Describe the formation of fine structure of H_α- Balmer line. 4

5. (a) Consider a radioactive series A→B→C →.... X(stable). If λ_1 and λ_2 are decay constants of A and B, show that $N_2 = \frac{\lambda_1 N_0}{\lambda_2 - \lambda_1}\left[e^{-\lambda_{1t}} - e^{-\lambda_{2t}}\right]$. 6

(b) Show that the mean life of a radioactive sample is the reciprocal of the decay constant. 4

Or

6. (a) Describe briefly the construction and theory of a cyclotron. 7

(b) Derive the expression for the energy of an ion accelerated in the cyclotron. 3

7. (a) Define packing fraction of a crystal structure. 1

(b) Calculate the packing fraction of (i) simple cubic structure (ii) body centred cubic structure and (iii) face centred cubic strcuture. 9

Or

8. (a) Derive the interplanar spacing d(h k l) between

two parallel planes with Miller indices (h k l) and show that for a simple cubic lattice is 6

$$d(h\,k\,l) = \frac{a}{\sqrt{h^2 + k^2 + l^2}}$$

(b) Find the separation between two successive (110) planes of a simple cubic crystal. 1

(c) Find the Miller indices for planes which intercepts $\vec{a}, \vec{b}$ and $\vec{c}$ at (i) 2a, 3b, 6c (ii) 3a, -2b, 3c/2 3

9. (a) Describe the working of a half-wave rectifier using the two pn junction diodes. 5

(b) Show that the maximum efficiency of a full-wave rectifier is 81.2%. 5

Or

10. (a) Draw the output characteristics of a common base (CB) transistor and discuss the saturation, cut-off and active regions. 5

(b) Describe the working of CE amplifier using a n-p-n transistor. 5

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