Q.P. Code – 42632

Sixth Semester B.Sc. Degree Examination, April/May 2019

(CBCS Scheme)

Physics

Paper VIII — NUCLEAR AND SOLID STATE PHYSICS

Time : 3 Hours] *[Max. Marks : 90*

Instructions to Candidates : Answers should be written completely in English.

PART – A

I. Answer any **FIVE** of the following. Each question carries **8** marks. **(5 × 8 = 40)**

1. Obtain semi empirical mass formula using liquid drop model and explain the terms. **(8)**

2. (a) Give the assumptions of shell model.

   (b) Give the evidence for the existence of magic numbers **(5 + 3)**

3. (a) Explain Geiger-Nuttall law.

   (b) Outline the Gamow's theory of α -decay. **(2 + 6)**

4. What is β -decay? Explain the different types of β -decay with examples. **(8)**

5. Describe the construction and working of a GM counter. **(8)**

6. What are Miller indices? Derive an expression for the spacing between lattice planes of a cubic crystal. **(8)**

7. Obtain an expression for the electrical conductivity of metals based on the free electron theory. **(8)**

8. What is Raman effect? Describe the experimental arrangement for the study of Raman Effect. **(8)**

PART – B

II. Answer any **SIX** of the following. Each question carries **5** marks. **(6 × 5 = 30)**

9. Using the semi empirical mass formula, calculate the binding energy of $^{40}_{20}Ca$. Given that a_v = 15.75 MeV, a_S = 17.80 MeV, a_C = 0.71 MeV, a_n = 22.7 MeV and $\delta = 34$.

10. Calculate the range of α particles having energies (a) SMCV (b) 10 MeV.

11. Calculate the neutron separation energy for ^{7}Li in the reaction ${}^{7}_{3}Li_4 \rightarrow {}^{6}_{3}Li_3 + {}^{1}_{0}n_1$. Given that $m_{Li7} = 7.016003$ amu, $m_{Li6} = 6.015121$ amu, $m_n = 1.008665$ amu.

12. Given that the range in standard air of the $\alpha-$particles from radium (half life 1621 years) is 3.35 cm, whereas from polonium (half life 138 days) this range is 3.84 cm. Calculate the range of $\alpha-$particles in Rac^1 for which the half life is 2.4×10^{-9} sec.

13. $\alpha-$particles of energy 5 MeV pass through an ionization chamber at the rate of 10 per second. Assuming all the energy is used in producing an ion pairs, calculate the current produced (35 eV is required for producing an ion pair and C = 1.6 × 10^{-19}C)

14. Find the smallest glancing angle at which K_α radiation of molybdenum of $\lambda = 0.5A^0$ will be reflected from calcite crystal of spacing $3A^0$. At what angle will be the third order reflection?

15. Calculate the Fermi energy at absolute zero for sodium. Given electron density $(n) = 2.52\times10^{28}\,m^{-3}$, mass of electron $(m) = 9.1\times10^{-31}$kg, $h = 6.625\times10^{-34}$ JS.

16. The J= 0 to J = 1 absorption line in carbon monoxide (CO) occurs at a frequency 1.153×10^{11}Hz. Calculate the moment of inertia and bond length. Given that $m_c = 12$ amu, $m_o = 16$ amu, 1 amu $= 1.66\times10^{-27}$ kg.

PART – C

III. Answer any **TEN** of the following. Each question carries **2** marks. **(10 × 2 = 20)**

17. (a) Does magic nuclei have magnetic moment? Explain.

(b) What are the drawbacks of Fermi gas model?

(c) Write any two properties of nuclear force.

(d) What is binding energy and separation energy?

(e) Why $\alpha-$ particles are emitted by radio active nuclei, while protons are neutrons are not?

(f) In α-decay of similar nuclei the energies of α-particles are the same but in β-decay of similar nuclei the energies are not same. Why?

(g) GM counter cannot detect neutrons. Why?

(h) Name any two ionization detectors.

(i) X-rays are more penetrative than visible light. Why?

(j) Does the ratio of thermal to electrical conductivity of a metal depends on temperature? Explain.

(k) All the states having energy less than the Fermi energy are occupied while above the Fermi energy are empty. Explain.

(l) The colour of the sky is blue. Explain.
