Q.P. Code – 42632

Sixth Semester B.Sc. Degree Examination, September 2020

(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 questions. Each question carries **8** marks : **(5 × 8 = 40)**

1. (a) Explain the similarities between a nucleus and a liquid drop.

   (b) Explain the merits and limitations of liquid drop model. **(4 + 4)**

2. Discuss the Fermi gas model of nucleus and obtain the value of depth of potential well for protons. **(8)**

3. (a) What is α - decay?

   (b) Obtain an expression for disintegration energy during α - decay. **(1 + 7)**

4. (a) What is γ - decay?

   (b) Explain kinematics of γ - rays through matter. **(1 + 7)**

5. (a) What is meant by scintillation and scintillators?

   (b) Describe with neat diagram, the construction and working of a photomultiplier tube. **(2 + 6)**

6. (a) State and explain Moseley's law.

   (b) Explain characteristic X-ray spectra. **(4 + 4)**

7. What is Fermi energy? Derive an expression for fermi energy. **(1 + 7)**

8. Explain rotational spectrum of a diatomic molecule and show that spectrum of diatomic molecule consists of equally spaced lines. **(8)**

PART – B

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

9. Calculate assymetric energy and coloumb energy for $_7N^{15}$

Given $K_a = 19$ MeV, $K_C = 0.6$ MeV

10. Calculate binding energy per nucleon of $_{82}Pb^{208}$ nucleus by using semi empirical mass formula.

Given :

$a_v = 15.5$ MeV, $a_s = 16.8$ MeV, $a_c = 0.72$ MeV, $a_{sym} = 23$ MeV, $a_p = 34$ MeV.

11. Assign ground state spin and parity of $_8O^{15}$ nucleus according to shell model.

12. A free electron decay into a proton by emission of β^- particles of maximum kinetic energy 0.782 MeV. If the rest masses of the electron and neutron are 0.000549 amu and 1.008665 amu respectively, find the mass of proton.

13. A self quenched GM counter operates at 1000 volt and has a wire of diameter of 0.2 mm. The radius of the cathode is 2×10^{-2} m and the tube has a guaranteed life time of 10^9 counts. What is the maximum radial field and how long will the counter last if it is used on an average for 30 hours per week at 3000 counts per minute? Assume 52 weeks per year.

14. Monochromatic X-rays of wavelength 0.15 A° undergoes Compton effect from a aluminium block. Calculate the wavelength of scattered X-rays through an angle of 45° and 180°.

15. Calculate the electrical conductivity of copper. Given atomic weight as 63.5, the density of copper is 8940 kgm^{-3} and the relaxation time of electrons is 2.48×10^{-14} S.

[Given mass of the electron $m = 9.1 \times 10^{-31}$ kg, $N_A = 6.023 \times 10^{23}$ atoms per mol]

16. In an experiment, in the study of Raman effect using mercury green radiation of $\lambda = 546.1$ nm, a Stokes line of wavelength 554.3 nm was observed. Find Raman shift and wavelength corresponding to Anti stokes line.

PART – C

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

17. (a) Does the surface energy of the nucleus depends on the mass number? Justify.

(b) Name two conditions for nuclear stability.

(c) Is even-even nuclei most stable? Explain.

(d) Write any two basic assumptions of Nuclear shell model.

(e) Does nuclear force depend on the nuclear charge? Explain.

(f) In what way radioactive change is different from chemical change?

(g) How is a photon different from a neutrino?

(h) Mention any two electric detectors.

(i) Semiconductor detectors are more useful than ionization chamber for detecting nuclear radiations? Justify.

(j) Does all equally spaced parallel planes have the same index number? Explain.

(k) Can Hall coefficient depend on Hall voltage? Justify.

(l) Why sun appears red at the time of sun set and sun rise? Explain.
