MS – 268

VI Semester B.Sc. Examination, May/June 2014
(NS) (2013-14 and Onwards)
PHYSICS – VII
Atomic and Molecular Physics, Nuclear Physics and Material Science

Time : 3 Hours Max. Marks : 70

Instruction : *Answer* ***five*** *questions from* ***each*** *Part.*

PART – A

Answer **any five** of the following, **each** question carries **eight** marks. **(5×8=40)**

1. a) Give the qualitative account of effect of finite nuclear mass in Rydberg constant.
   b) Explain the concept of elliptical orbits of Sommerfeld relativistic atom model with associated quantum numbers. **(3+5)**
2. a) Give the quantum mechanical theory of normal Zeeman effect.
   b) Distinguish between normal and anomalous Zeeman effect. **(6+2)**
3. a) Write a note on Rayleigh scattering of light.
   b) What is Raman effect ? Discuss the quantum theory of Raman effect. **(3+5)**
4. a) What are the assumptions of Rutherford's theory of alpha scattering ?
   b) Assuming the relation between impact parameter and scattering angle arrive at the Rutherford's scattering formula. **(2+6)**
5. a) What are the different types of beta-decay ?
   b) What are the salient features of beta-ray spectrum and how are they accounted for by neutrino hypothesis. **(3+5)**
6. a) Describe with theory the construction and working of cyclotron.
   b) What are the limitations of cyclotron ? **(6+2)**
7. a) Write a note on bottom up method of synthesis of nanomaterials.
   b) Write a note on graphene, fullerene and carbon nanotubes. **(2+6)**
8. a) Write a note on cholesteric and smectic liquid crystals with necessary diagram.
   b) What are the different types of liquid crystals ? **(6+2)**

P.T.O.

PART – B

Answer **any five** of the following, **each** problem carries **four** marks. **(5×4=20)**

9. $h = 6.6625 \times 10^{-34}$ J-S, $m_e = 9.1 \times 10^{-31}$ Kg, $e = 1.6 \times 10^{-19}$ C, 1 amu $= 1.67 \times 10^{-27}$ Kg, $\varepsilon_0 = 8.854 \times 10^{-12}$ Fm^{-1}.

   Calculate the value of Bohr magneton.

10. In a Stern-Gerlach experiment silver atoms traverse a distance of 0.1 m through non-uniform magnetic field of gradient 55 Tm^{-1}. If the separation between the two traces on the collector plate is 0.13 mm, find the velocity of silver atoms. Mass of silver atom is 1.79×10^{-25} Kg and Bohr magneton = 9.27×10^{-24} JT^{-1}.

11. The force constant of CO bond is 150 Nm^{-1}. Find the frequency of vibration CO molecule and spacing between vibrational levels. Mass of ^{12}C = 12 amu and $^{16}0$ = 16 amu.

12. The kinetic energy of alpha particle is 8.02 MeV. Calculate the impact parameter when it is bombarded on gold nucleus (z = 79) so that it gets scattered through 90° or more.

13. Thorium-228 emits alpha particles of energy 5.42 MeV. Calculate alpha-disintegration energy.

14. The Q-value of the reaction $^{23}Na(p, n)^{23}Mg$ is – 4.85 MeV. Calculate its threshold energy. Given mass of ^{23}Na = 22.989773 amu and proton = 1.007825 amu.

15. A parallel plate capacitor of capacitance 1.14 nF has its plates separated by 4 mm and a potential of 30 V applied across them. If a material of dielectric constant 8 is introduced between the plates, calculate the charge stored and the polarization.

16. The atomic weight and density of silicon are 28 and 1.98×10^3 Kgm^{-3} respectively. The electronic polarizability of the atom is 3.18×10^{-40} Fm^2. If the silicon has cubic structure, calculate the dielectric constant.

PART – C

Answer **any five** of the following, **each** question carries **two** marks. **(5×2=10)**

17. a) Can the principal quantum number take zero in hydrogen atom ? Explain.
    b) The alkali metals have hydrogen-like spectra, why ?
    c) Do the spectral lines in pure rotational spectra equally spaced ? Explain.
    d) What is the significance of distance of closest approach in Rutherford's alpha scattering ?
    e) Are most energetic alpha emitters are long lived ? Explain.
    f) Can G. M. counter be used to detect neutron ? Justify.
    g) Is the field experienced by an atom in a dielectric same as applied electric field ?
    h) Can discotic liquid crystals have chiral nematic type ?
