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**GS-303**

VI Semester B.Sc. Examination, May/June 2019

PHYSICS-VII**ATOMIC PHYSICS, NUCLEAR PHYSICS AND MATERIAL SCIENCE**

(CBCS 2016-17 & Onwards/NS-Repeaters 2013-14 & Onwards)

Time : 3 Hours

Max. Marks : 70

Instructions : Answer **five** questions from each part.**PART - A**Answer **any five** of the following questions. Each question carries **eight** marks : **5x8=40**

1. (a) What is fine structure ? Explain. **2+6**
(b) Describe Stern-Gerlach experiment with relevant theory.
2. (a) State Paulis exclusion principle. **2+3+3**
(b) Obtain an expression for the frequency of larmar's precession with respect to Vector atom model.
(c) Obtain an expression for the maximum number of electrons that can be filled in a shell.
3. (a) Explain vibrational rotational spectra of diatomic molecule. Prove **6+2**
that spacing between the spectral lines $\Delta\gamma = \frac{h}{2\pi I}$.
(b) Distinguish between Rayleigh Scattering and Raman Scattering.
4. Assuming the relation between impact parameter and angle of scattering **8**
derive Rutherford's scattering formula.
5. Describe the construction and working of a Geiger-Muller Counter and **8**
explain the features of its characteristic curve.
6. (a) Distinguish between endoergic and exoergic nuclear reactions. **2+6**
(b) Describe with theory working of a cyclotron and mention its limitations.

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7. (a) What are nano-materials ? Write a note on quantum structures of nanotechnology. **6+2**
(b) Mention any two applications of nano-materials.
8. (a) Describe the various kinds of polarization when a dielectric material is placed in an electric field. **6+2**
(b) Write expression for electronic and orientational polarizabilities.

PART - B

Answer **any five** problems. Each problem carries **four** marks : **5x4=20**

9. Calculate the value of Bohr Magneton using $h = 6.625 \times 10^{-34}$ Js
 $e = 1.6 \times 10^{-19}$ C and $m_e = 9.1 \times 10^{-31}$ kg.
10. The Zeeman components of a 500 nm spectral lines are 0.0116 nm apart. When magnetic field is 1 T, find the specific charge of an electron.
11. With an exciting radiation of wavelength 602.24 nm a substance gave a Raman line of wavelength 620.2 nm. Calculate the frequency and the wavelength of the corresponding antistokes line.
12. Calculate the kinetic energy of the α -particles emitted by the decay of ${}_{86}\text{Rn}^{222}$. Given mass of ${}_{86}\text{Rn}^{223} = 222.017531$ amu, mass of polonium nucleus = 218.008930 amu and mass of α particle = 4.002603 amu.
13. Calculate the Q value of reaction
 ${}_{29}\text{Cu}^{63} (\text{P.n}) {}_{30}\text{Zn}^{63}$
Given mass of Cu = 62.93 amu
mass of Proton = 1.0078, amu
mass of Neutron = 1.0087 amu
and mass of Zn = 63.93 amu.
Whether it is endothermic or exothermic reaction ?
14. Thorium - 228 emits alpha particle of energy 5.42 MeV. Calculate alpha disintegration energy.



15. A solid elemental dielectric with density 3×10^{28} atoms/m³ shows an electric polarizability of 10^{-10} Fm². Assuming the internal electric field to be a Lorentz field, calculate the dielectric constant of the material.
16. Calculate the radius of the atom. If its electric polarizability is 1.85×10^{-41} Fm². Given $\epsilon_0 = 8.85 \times 10^{-12}$ Fm⁻¹.

PART - C

Answer **any five** of the following questions. Each question carries **two** marks : **5x2=10**

17. (a) Can the principal quantum number take zero in the hydrogen atom ? Explain.
- (b) Write the possible values of quantum number m_l for $l=3$.
- (c) Why are IR photographs more clear than photographs taken using visible light.
- (d) The Rutherford's Scattering formula fails to agree with the data at very small scattering angles. Give reasons.
- (e) What is the significance of negative sign of Q ?
- (f) Can a nuclear reaction take place for any energy of the projectile ? Explain.
- (g) What is meant by dielectric breakdown ? Explain.
- (h) Can Nematic liquid crystals be made conductors ? Explain.

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