11621

Reg. No. | | | | | | | | |

# VI Semester B.Sc. Degree Examination, September/October - 2022

## PHYSICS

## Atomic, Molecular and Nuclear Physics and Nuclear Reactions

## (CBCS Scheme Fresher & Repeaters 2018-19 and Onwards)

## Paper No. VII



**Time : 3 Hours** **Maximum Marks : 70**

***Instructions to Candidates :***

1. Answer any Five questions from each Part.
2. Use of Non-Programmable scientific calculator is allowed.

### PART-A

**Answer any FIVE questions. Each question carries 8 marks.** **(5 × 8 = 40)**

**1.** a) Explain Sommerfeld's atom model.

b) Give an account of spinning electron hypothesis. **(5+3)**

**2** a) Distinguish between normal and anomalous Zeeman effect.

b) Give the Quantum theory of Normal Zeeman effect. **(2+ 6)**

**3.** a) What is Raman effect?

b) Give the Quantum theory of Raman effect. **(2+6)**

**4.** a) State any two assumptions of Rutherford's theory of $\alpha$ - ray scattering

b) Obtain the relation between impact parameter and scattering angle of $\alpha$ -particle.

**(2 +6)**

**5.** Describe the construction and working of a Geiger-Muller counter and explain the features of its characteristic curve. **(8)**

**6** a) What is beta-decay? Mention the types of beta emission.

b) Explain Pauli's neutrino hypothesis of beta decay. **(4+4)**

**[P.T.O.**

7. Define Q-value of a nuclear reaction. Derive an expression for Q-value of a nuclear reaction (8)

8. a) Explain various types of interactions between elementary particles

   b) What are quarks? Write the properties of quarks (6+2)

## PART - B

**Solve any FIVE problems. Each problem carries Four marks.** (5× 4 = 20)

9. In a Stern Gerlach experiment, silver atoms traverse a distance of 0.1m through a non-uniform magnetic field of gradient 60 $Tm^{-1}$. If the separation between two tracings on the recording plate is 0.15 mm, find the velocity of silver atoms. (Given: mass of silver atom = 1.79 $\times 10^{-25}$ kg, Bohr magneton = $9.2\times 10^{-24}$ $JT^{-1}$)

10. Calculate the Zeeman shift observed in the normal Zeeman effect when a spectral line of wavelength 680 nm is subjected to a magnetic field of flux density 1.2T. Given $\frac{e}{m} = 1.76\times 10^{11} Ckg^{-1}, c = 3\times 10^{8} ms^{-1}$

11. The force constant of CO molecule is 187 $Nm^{-1}$ . Find the frequency of vibration of CO molecule and spacing between the vibrational levels. Given : the reduced mass of CO molecule is $1.145\times 10^{-26}$ kg

12. In a given radioactive sample, the counting rate of particle is 47 per minute. After 5 minutes, the counting rate is reduced to 27 per minute. Find the decay constant & half -life of the sample.

13. 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 $90^0$.

14. A magnetic field of 4T is employed in a cyclotron to accelerate protons. Find the frequency of reversal of the electric field applied between the dees, given mass of proton = $1.67\times 10^{-27}$kg.

15. Calculate the threshold energy required to initiate the reaction $_{15}P^{31}$ $(n,p)_{14}$ $Si^{31}$. Given $m_p$ = 1.0084 amu, $m_n$ = 1.00898 amu, mass of phosphorous Mp = 30.98356 amu and $M_{si}$ = 30.98515 amu

16. Find the threshold energy for the reaction ${}_8O^{18}(p,n)\ {}_9F^{18}$, given the Q-value of the reaction is 2.742 MeV Using the following data.

Mass of ${}_8O^{18}$=17.99916 amu,

Mass of proton = 1.00783 amu,

Mass of neutron = 1.00866 amu,

Mass of ${}_9F^{18}$=18.00095 amu.

## PART - C

**Answer any FIVE questions. Each question carries 2 marks** **(5 × 2 = 10)**

17. a) The alkali metals have hydrogen like spectra. Why?

b) The path of an electron is rosette according to Sommerfeld model. Explain.

c) Why all diatomic molecules do not show rotational spectra? Explain.

d) Electrons of target atoms do not affect the scattering of $\alpha$ -particles, Justify.

e) Are most energetic $\alpha$ -emitters long lived? Explain.

f) Can GM counter detect neutrons? Explain.

g) Hyperons and K-mesons are called strange particles. Why?

h) Compound nucleus state is known as quasi-stationary state. Justify.

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# VI Semester B.Sc. Degree Examination, September/October - 2022

## PHYSICS

## Electronics, Magnetic Materials, Dielectric and Quantum Mechanics - II

## (CBCS Scheme Freshers & Repeaters 2018-19 Onwards)

## Paper : VIII

**Time : 3 Hours** **Maximum Marks : 70**

***Instructions to Candidates :***

1. Answer any Five questions from each Part.
2. Use of Non-Programmable scientific calculator is allowed.

### PART - A

**Answer any FIVE questions. Each question carries 8 marks.** **(5 × 8 = 40)**

**1.** a) Write the characteristics of ideal Op-Amp.

b) Obtain an expression for voltage gain of Op-Amp in inverting mode. **(4+4)**

**2.** a) Define

i) Slew rate

ii) CMRR of Op-Amp.

b) With a neat diagram, explain the operation of first order low pass filter using Op-Amp. **(2+6)**

**3.** a) Write the circuit symbol and truth table of AND gate.

b) What is full adder? Draw the logic circuit of full adder and write its truth table. **(3+5)**

**4.** a) Define

i) Intensity of magnetization.

ii) Magnetic susceptibility.

b) Derive an expression for susceptibility of diamagnetic material. **(2+6)**

**[P.T.O.**

5. a) What is

   i) Dielectric polarization

   ii) Dielectric breakdown?

   b) Derive Clausius-Mossotti equation for a dielectric material. (2+6)

6. a) What is meant by normalized wave function?

   b) Arrive at the time dependent one-dimensional Schrodinger's wave equation. (2+6)

7. Arrive at the expressions for eigen energy values and normalized wave functions of a particle trapped in a one dimensional box. (8)

8 a) Write the linear momentum and total energy operators.

   b) Derive an expression for eigen energy values of linear harmonic oscillator and draw the energy level diagram (2+6)

## PART - B

**Solve any FIVE Problems. Each problem carries Four marks.** (5× 4 = 20)

9. A phase shift oscillator has frequency of oscillation $f_0$ = 1.5 kHz. Calculate the value of resistance R. Given C = 0.1μF.

10. Convert

    i) $(72.45)_{10}$ to binary

    ii) $(568)_{16}$ to decimal.

11. An amplifier has a gain of 800. When feedback is applied, the gain is reduced to 150. Find the feedback fraction.

12. The magnetic susceptibility of silicon is - 0.4 $\times 10^{-5}$. Calculate the flux density and magnetic moment per unit volume. Given magnetising field H = 5.25 $\times 10^5$ $Am^{-1}$.

13. Susceptibility of a paramagnetic material at 400K is $1.5\times 10^{-3}$ . At what temperature will the susceptibility increase to $8\times 10^{-3}$.

14. The dielectric constant of helium gas at NTP is 1.00007. Calculate the electronic polarizability of atoms if the gas contains $2.7\times 10^{25}$ atoms per $m^3$. Give $\varepsilon_o = 8.854\times 10^{-12}$ $Fm^{-1}$

15. The period of a linear harmonic oscillator is 1 milli second. Find its zero point energy in eV.

16. The energy of an electron in the first excited state in a one dimensional box is 151eV. Find the length of the box. Given mass of electron m = $9.1\times 10^{-31}$ kg h = $6.625\times 10^{-34}$Js.

## PART - C

**Answer any FIVE questions. Each question carries 2 marks.** **(5 × 2 = 10)**

17. a) Can an oscillator also work as amplifier? Justify.

    b) Is 8 an octal number? Explain.

    c) NAND gate is an universal gate. Explain.

    d) Does the magnetic susceptibility of diamagnetic substances depend on temperature? Explain.

    e) Is $N_2$ a polar dielectric? Explain.

    f) Why are transformer cores made of soft iron?

    g) Does a free particle have quantised energy states? Justify.

    h) Is $\psi = ax^2$ an acceptable wave function in quantum mechanics? Explain.