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

VI Semester B.Sc. Degree Examination, September - 2021

PHYSICS

Atomic, Molecular and Nuclear Physics

Paper : VII

(CBCS Scheme Fresh + Repeaters 2018-19 and onwards)

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** of the following questions. Each question carries Eight marks. **(5×8=40)**

1. Describe with a diagram Stern and Gerlach experiment. Write the importance of results of experiment. **(6+2)**

2. a. What is meant by pure rotational spectrum?

b. Derive an expression for rotational energy levels of a diatomic molecule and hence obtain the frequency of rotational spectra. **(1+7)**

3. a. Define impact parameter.

b. Assuming the relation between the impact parameter and the angle of scattering derive Rutherford's formula. **(1+7)**

4. a. Derive an expression for Q - value in α - decay.

b. Write a note on Geiger - Nuttal law. **(5+3)**

5. With the help of a diagram describe the construction and working of cyclotron. Arrive at the expression for energy of the emerging particle. **(8)**

6. a. What is nuclear cross - section? How is it determined?

b. Derive an expression for the number of particles emerging out of a slab of finite thickness **(3+5)**

7. a. Explain the formation and decay of a compound nucleus.

b. Give the properties of electrons and muons. **(4+4)**

8. Explain the various types of interactions among the elementary particles mentioning their characteristics and life time. **(8)**

P.T.O.

PART - B

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

9. Write the spectral terms and the ground state for P^4 state.

10. The value of specific charge of electron is $1.76\times10^{11}Ckg^{-1}$. Calculate the value of Bohr magneton. ($h=6.625\times10^{-34}Js$).

11. The spacing between the vibrational levels of a CO molecule is 0.08 eV. Calculate the value of force constant. Given the mass of carbon atom = 12 amu and that of oxygen = 16 amu & 1 amu = 1.67×10^{-27} kg.

12. Find the activity of 1 mg of randon - 222 whose half life is 3.8 days. [$h = 6.625\times10^{-34}Js$].

13. Potassium - 40 decays into calcium by β emission. Calculate the Q-value of the decay. Given, mass of potassium = 39.96399 amu and that of calcium = 39.96255 amu, 1 amu = 1.67×10^{-27} kg).

14. An α particle of energy 5 MeV passes through an ionisation chamber at the rate of 10 per second. Assuming all the energy is used in producing ion pairs, calculate the current produced. Given 35eV is required to produce each ion pair and e = 1.6×10^{-19} C.

15. Calculate the Q-value and threshold energy of the reaction ${}_3Li^7(p,n){}_4Be^7$ in MeV. Given the masses of ${}_3Li^7$, ${}_4Be^7$, ${}_1H^1$ and ${}_0n^1$ are 7.0160 amu, 7.0169 amu, 1.0078 amu and 1.0087 amu respectively, and 1 amu = 1.67×10^{-27}kg).

16. Verify the conservation of hyper charge, baryon number, strangeness and z - component of isospin for the reaction given below.

$p+p\rightarrow n+p+\pi^+$

PART - C

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

17. a. Can the value to principal quantum number be zero? Explain.
    b. What is meant by Larmor precession? Define the frequency of Larmor precession.
    c. What are the selection rules for rotational Rayleigh and Raman lines?
    d. Why is quenching necessary in GM counter?
    e. Why are heavy nuclei unstable and start disintegration? Explain.
    f. What happens if the Q-value of a nuclear reaction is zero? Explain.
    g. What are strange particle? Give an example.
    h. How many quarks are required to form mesons and baryons?

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VI Semester B.Sc. Degree Examination, September - 2021

PHYSICS

Electronics, Magnetic Materials, Dielectrics and Quantum Mechanics - II

(CBCS Scheme Freshers+Repeaters 2018-19 and 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 any three characteristics of an ideal Op-Amp.

b. Derive an expression for output voltage of a differential amplifier using an Op-Amp. **(3+5)**

2. a. What is Barkhausen criterion for sustained oscillations?

b. Explain the working of Phase - Shift oscillator with a neat circuit diagram. Write expression for it's frequency of oscillation. **(2+6)**

3. a. Write the symbol and truth table of NAND gate.

b. What is half adder? Draw the logic diagram of half adder and write it's truth table. **(2+6)**

4. Derive an expression for paramagnetic susceptibility on the basis of Quantum Theory. **(8)**

5. a. Explain the Weiss domain theory of Ferromagnetism.

b. What is hysteresis? Define retentivity and coercivity. **(5+3)**

6. a. Write any three comparisons between ionic polarisation and orientational polarisation.

b. Derive Clausius - Mossotti equation for a 3 - dimensional cubic lattice. **(3+5)**

7. a. Write the expressions for momentum and energy operators.

b. Set up the time independent one dimensional Schrodinger wave equation. **(2+6)**

8. Set up Schrodinger wave equation for a one dimensional linear harmonic oscillator and derive the expressions for Eigen values and represent them graphically. **(8)**

[P.T.O.

PART - B

Answer any **FIVE** problems. Each question carries **4** Marks. **(5×4=20)**

9. In an Op-Amp, $R_i = 1k\Omega$, $R_f = 1M\Omega$ and input voltage is 2 mV. Calculate voltage gain and output voltage in case of (a) inverting and (b) non - inverting amplifier.
10. For a low pass filter, Calculate R_f so that the gain is 100 for the allowed frequency. Also find the value of R to get cut - off frequency of 2 kHz. Given C = 0.02 μF, $R_i = 1k\Omega$.
11. Convert the decimal 64.2 to octal and then to binary.
12. A paramagnetic material has magnetic field intensity of $10^4 Am^{-1}$. If the susceptibility of the material at room temperature is 3.7×10^{-3}, calculate the magnetisation and flux density of the material.
13. If a sample of sulphur contains 3.76×10^{28} atoms per m^3, find the electronic polarizability of sulphur. Given, dielectric constant of sulphur = 3.5 and $\varepsilon_0 = 8.85\times10^{-12} Fm^{-1}$.
14. Determine the normalization constant of the wave function $\psi = A\sin x$
15. Find the momentum and energy of an electron in its ground state and first excited state when it is confined to a one dimensional box of side 2 nm. Given $h = 6.625\times10^{-34}$Js.
16. Calculate the probability of finding a particle in one dimensional box of length L between 0.3L and 0.5L.

PART - C

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

17. a. Why is it desirable to have a high CMRR in an operational amplifier?
    b. Is the Boolean identify AC+ABC =AC true? Justify.
    c. Does the susceptibility of a paramagnetic material depend on temperature? Explain.
    d. Why is soft iron preferred over steel for fabrication of transformer core?
    e. Can all crystals exhibit piezoelectric effect? Explain.
    f. Does a free particle have quantised energy states? Explain.
    g. Is $\psi = \alpha x^2$ an acceptable wave function? Explain.
    h. What is the probability of finding the particle at any state at x = 0 and x = L in an one dimensional box of infinite height.
