Seat No. : _____

FC-139

February-2025

M.Sc., Sem.-I

403 : Physics

(Nuclear Physics-1 and Electrodynamics)

(New)

Time : 2:30 Hours] **[Max. Marks : 70**

1. (A) Discuss Molecular beam experiment in detail and explain D_2 experiment in detail. Make your comment. **7**

   (B) Write the types of excitations and derive the expression $\frac{N_{Ortho}}{N_{Para}} = \frac{I+1}{I}$ from molecular band spectra. **7**

OR

1. (A) Derive an expression for electric quadrupole moment of a nucleus. Show that the nucleus can have non-zero electric quadrupole moment only if its spin $I \geq 1$. **7**

   (B) Discuss estimation of nuclear shape and derive the electric quadrupole in terms of I, $Q_{ij} = \frac{3Q}{2I(2I-1)}\left\{I_iI_j + I_jI_i - \frac{2}{3}I(I+1)\delta_{ij}\right\}$. **7**

2. (A) In case of n-p scattering at low energy, derive the differential scattering cross section $\sigma_{sc} = 4\pi\lambda^2 \sin^2 \delta_0$. **7**

   (B) Write short note on Yukawa's meson theory of nuclear forces. **7**

OR

2. (A) Write the types of saturation of nuclear forces and discuss the exchange nuclear forces in detail. **7**

   (B) Prove that the relation of the depth potential V_0 and well range r_0 in the case of ground state of deuteron. **7**

3. (A) Explain briefly and obtain the equations related for surface impedance. **7**

(B) Explain the reflection from the surface of perfect conductor at oblique incidence. Also obtain equations for (i) E $\perp$ plane of incidence and (ii) E $\parallel$ plane of incidence. **7**

OR

3. (A) Obtain the equation for power flow at any point using Poynting's theorem, and discuss the relationship between P to E & H. **7**

(B) Obtain the equation $Q' = \frac{n}{4} \cdot \frac{\lambda}{\delta}$ for power loss in a plane conductor. **7**

4. (A) Obtain the equation for capacitance C and Inductance L per unit length wire-geometry with help of ordinary circuit that represents the parallel-plane transmission line. **7**

(B) Write the complete theory of *transmission-line theory*. **7**

OR

4. (A) Obtain the equation of resistance and reactance of terminating impedance at low-loss radio frequency and UHF transmission lines (where, $\alpha \neq 0$). **7**

(B) Write the complete theory of transmission-line charts. **7**

5. Short answers : (Any **Seven**) **14**

(1) A negative nuclear quadrupole moment indicates the nucleus is _____.

(2) Which of the following statement is incorrect for the nuclear force between two nucleons ?

(a) Its charge dependent (b) It is spin independent

(c) It is velocity independent (d) It has a non-central component

(3) Bartlett exchange force arises from _____.

(4) Spin angular momentum is given as :

(a) $\sqrt{s(s+1)}\,\frac{h}{2\pi}$ (b) $\sqrt{s(s+1)}/2$

(c) $\sqrt{s(s+1)}/2\pi$ (d) None of these

(5) Which is correct ? 1 a.m.u. = :

(a) 1.67×10^{-27} kg (b) 1.66×10^{-31} kg

(c) 1.66×10^{-33} kg (d) None of above

(6) The electrical radii can be measured by _____ technique.

(a) Mesonic X-rays (b) Electron Scattering

(c) Coulomb energies of mirror nuclei (d) Alpha- scattering

(7) Define the wave propagation through media using function of wave motion.

(8) Describe the power dissipation using the generalization of Jule's law for power flow in conductor.

(9) Prove equation of Brewster's angle and write its importance.

(10) Determine the inductance and capacitance parallel planes when a wave propagating along the line which has the dimension about (4 × 3) meter ?

(11) What are skin effects of the fields ?

(12) What is the importance of $\frac{\Delta f}{2}$ frequency in the case of a series resonant circuit of UHF frequency ?

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FC-139

February-2025

M.Sc., Sem.-I

403 : Physics

(Electrodynamics and Programming 'C')

(Old)

Time : 2:30 Hours] **[Max. Marks : 70**

1. (A) Obtain the equation for reflection co-efficient and refraction co-efficient at normal incidence. **7**

   (B) Silver is an excellent conductor, but it's very expensive. Suppose you designing a microwave experiment to operate at a frequency of 10^{10} Hz. How thick would you make the silver coatings ? [Take : $\rho_{silver} = 1.59 \times 10^{-8}$ Ωm, $\varepsilon = 8.85 \times 10^{-12}$ farad/m, $\omega = 2\pi \times 10^{10}$ s^{-1} and $\mu = 4\pi \times 10^{-7}$ henry/m]. **7**

OR

1. (A) Explain in brief the total internal reflection. **7**

   (B) The index of refraction of air and diamond are 1 and 2.42 respectively. Draw a graph of amplitudes of reflected and transmitted waves versus the angle of incidence at air/diamond interface. (Assume $\mu_1 = \mu_2 = \mu_0$). Calculate (a) the amplitudes at normal incidence, (b) Brewster's angle, and (c) cross-over angle at which reflected and transmitted amplitudes are equal. **7**

2. (A) Discuss the Resonant cavities when a perfect conductor placed at half infinite space in the direction of propagating wave. Explain Q-factor and write some application of cavities in wave guide. **7**

   (B) Consider a rectangular waveguide with dimension 2.28 × 1.01 cm. If the driving frequency is 1.70×10^{10} Hz, which TE modes will propagate in this waveguide ? What range of frequency has to be used to excite only one TE mode ? What are the corresponding wavelengths in open space ? **7**

OR

2. (A) Explain in brief the dielectric waveguides. **7**

   (B) Write the theory of waves guide in rectangular cross section. **7**

3. (A) With help of examples describe various data types used in C language. What are qualifiers (modifiers) in C language ? Write different qualifiers available in C language and mention their advantages. **7**

(B) What is the difference between while loop and do while loop ? Write a program to read a positive number, generate another number by reversing it. Print both original number and the reversed number. **7**

OR

3. (A) With help of a bock diagram describe nested if construction. Write a program to read three numbers and find out highest number among them. **7**

(B) Write a program to read a decimal number and obtain binary number corresponding to it. Print both decimal number and binary number. **7**

4. (A) Write a program to read 50 values, calculate and print mean of the series and mean of highest and lowest in the series. **7**

(B) What is a string ? How strings are initialized ? Write a program to read two strings, generate a third string by appending the second string over the first string. Program should print all three strings. **7**

OR

4. (A) Write a program to read 100 values, calculate and print standard deviation of the series using the relation $s = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(x_i - m)^2}$ Where m is the average of the series. **7**

(B) Write a program to read a string and a specific character, and check how many times the specified character is repeated in the string. **7**

5. Short answers : (Any **Seven**) **14**

(1) Choose the false statement about C language arrays.

(a) Address of an array is the address of the element with subscript 1.

(b) Array size must be declared if not initialized.

(c) Array size is the sum of sizes of all elements of the array.

(d) All are correct

(2) Which of the following statement is not true as far an array is considered ?

(a) All elements should be of same data type.

(b) Index of all array elements should be integers, may be constant or variable.

(c) Index of C arrays always start with 1.

(d) Array size must be specified in declaration of all arrays.

(3) Which of the following statement is false ?

(a) a+=b;

(b) x = a++ + ++b;

(c) a=+b;

(d) 5+= a;

(4) Which of the following is true for switch statement ?

(a) Two cases can have same value.

(b) Default block is compulsory.

(c) A block can be associated with more than one case values.

(d) Case values should be terminated in ;

(5) Which of the following is true for C language keywords ?

(a) White space is not allowed in between

(b) All keywords are lowercase

(c) Keywords are part of C language

(d) All of the above

(6) According to C language which of the following specifies that ab is between a and b

(a) a < ab < b

(b) a < ab & & ab < b

(c) a < ab || ab < b

(d) a > ab > b

(7) Consider a wave propagate from glass to air. The refractive index of glass is 1.5, the critical angle for glass is 42°. If the light is incident internally from the glass at an angle of 54°, then find out skin depth ?

(8) What is the expression of Energy Density and wave intensity equation ?

(9) What is the significance of Brewster's angle ?

(10) How is it possible that there will be no cut-off wavelength in a coaxial waveguide ?

(11) Which is the principal (dominant) mode in the waveguide ?

(12) What is the requirement for exciting a particular mode of oscillation in a resonant cavity ?