Seat No. : _____

DC-119

December-2018

M.Sc., Sem.-I

403 : Physics

Electrodynamics and Programming in C

(New Course)

Time : 2.30 Hours] **[Max. Marks : 70**

Instructions : (1) **All** symbols carry their usual meanings.

(2) Attempt **all** questions.

(3) Scientific calculators are allowed.

1. (A) (i) Explain the concept of reflection from the surface of metal and obtain the equation for reflection **7**

$R = 1 - 2\sqrt{\frac{2\omega\epsilon_1}{\sigma}}$. Use propagation vector K_T for conducting medium as

$K_T^2 = \epsilon_2 \mu_2 \omega^2 \left[1 + \frac{i\sigma}{\omega\epsilon_2}\right] = (\alpha + i\beta)^2$.

(ii) Calculate the exact reflection and transmission co-efficients at normal incidence without assuming $\mu_0 = \mu_1 = \mu_2$. Confirm that R + T = 1. **7**

OR

(i) (1) Express all equations for wave propagation through linear media. **3**

(2) Write boundary conditions at oblique incidence and use it to obtain the Fresnel's equation. **4**

(ii) Silver is an excellent conductor, but it's very expensive. Suppose you are 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, $\varepsilon_0 = 8.85 \times 10^{-12}$ Farad/m, $\omega = 2\pi f$ and $\mu_0 = 4\pi \times 10^{-7}$ Henry/m] **7**

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(B) Answer any **four** from the following : (**one** mark each) **4**

(i) If $n_1 = 1.11$ and $n_2 = 1.46$, then what will be the values of reflection co-efficient and transmission co-efficient ? (Assume, $\mu_1 = \mu_2 = \mu_0$)

(ii) What is Brewster's angle ?

(iii) Consider a wave propagates from glass to air. The refractive index of glass is 1.5, the critical angle for glass is $\theta_C = 42°$. If the light is incident internally from the glass at an angle of 45°, then find out it's skin depth.

(iv) What are Dispersion and Dispersive ?

(v) What is plane of incidence ?

(vi) Under which of the following conditions the α diverges ?

(a) normal incidence (b) oblique incidence

(c) grazing incidence (d) None of the above

2. (A) (i) Obtain the wave equation (E_{0T}) for waves in guides of arbitrary cross-section. Discuss the conditions of wave number and cut-off frequency for TEM waves. **7**

(ii) 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

(i) Discuss the Resonant cavities when a perfect conductor is placed at half infinite space in the direction of propagating wave. Explain Q-factor and write some applications of cavities in waveguide. **7**

(ii) Find the modes of 3 cm wavelength radar waves that would be propagated in a waveguide of rectangular cross. section with a = 1 cm, b = 2 cm. Find also the group velocity of the waves. **7**

(B) Answer any **three** from the following : (**one** mark each) **3**

(i) Write the principal or dominant mode rectangular waveguides ?

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

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(iii) In the case of dielectric waveguide, $\tan (k\,d) = k\,(\gamma + \delta) / (k^2 - \gamma\,\delta)$. Which condition is responsible for the loss of total internal reflection at the lower boundary condition (means the mode will no longer be guided) ?

(a) $\gamma = 1$, (b) $\delta = 1$, (c) $k^2 = 1$, (d) $\gamma = 0$

(iv) Find the shortest length of a simplest cavity resonator to be made from a rectangular waveguide with a =10.16 mm and b =22.86 mm which will resonate at 10 GHz.

[Take $C = 3 \times 10^8$ m/s, m & n = 1]

(v) Write an expression for cut-off frequency in case of rectangular waveguide.

3. (A) (i) With examples discuss various data types and different categories of operators available in C language. **7**

(ii) Write a program to read a positive integer number, generate a number which should be in the reversed order of the given number and then check the reversed and the original numbers are same or not. Program should print proper message. **7**

OR

(i) Write a single program to read a number n and then calculate and print the following :

(1) sum of the squares of all even numbers upto n.

(2) product of all numbers upto n, which are divisible by 5.

(3) factorial of that number. **7**

(ii) For a number, if the sum of the cubes of its all individual digits is equal to that number itself, then that number is known as Armstrong number (Eg. 153). Write a program to check the given number is an Armstrong number or not. **7**

(B) Answer any **four** from the following : **4**

(i) Write down the output of the following program segment

```
printf("%d %d", 5*4/3+2, 2*3%4+5);
```

(ii) Write any four header files used in C language.

(iii) Draw block diagram of do while loop.

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(iv) Write output of the following program segment

```
int x 100;
if (x)
        printf("AAA");
else
        printf ("BBB");
```

(v) How can we come out of a nested loop ?

(vi) Write a statement to assign largest of a and b to c using conditional operator.

4. (A) (i) Write a program to read 50 values, find out and print values greater than average. The program also should find out and print the highest value in the series. **7**

(ii) Write a program to accept a string from user and check whether it is a palindrome or not. A word is said to palindrome, if it spells same forward and backward. **7**

OR

(i) Accept roll numbers of 50 students and their marks obtained in 6 different subjects out of 100 each. Find out and print percentage marks of all individual students and average marks for all individual papers. Program should print results with original data. **7**

(ii) Write a program to read a string and a character, generate a new string by deleting the specified character from the string. Print both strings. Program also should print length of both strings. **7**

(B) Answer any **three** from the following : **3**

(i) Declare a two dimensional array which can store 10 values.

(ii) What will be output of the following program segment

```
double x[10];
printf("%d", sizeof(x));
```

(iii) What is a string in C language ?

(iv) Write C language functions (1) to get square root of 25.6 (2) to read a string containing two words.

(v) Write a statement to store PHYSICS in a variable.

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1. (A) (i) Derive expressions for electric field and magnetic field of the electric dipole radiation ? **7**

(ii) Find the radiation resistance of the oscillating magnetic dipole where d = 5 cm and a = radius of loop of wire. Express the answer in terms of λ and a, and compare it with the radiation resistance of the electric dipole (R(ele) = $790\left(\frac{d}{\lambda}\right)^2$ Ω) **7**

OR

(i) Derive expressions for electric field and magnetic field of the radiation from an arbitrary distribution of charges and currents. **7**

(ii) Prove that radiation resistance of a wire joining the two ends of an electric dipole is R(ele) = $790\left(\frac{d}{\lambda}\right)^2$ Ω (where d is distance between two ends of a dipole). **7**

(B) Answer any **four** from the following : (**one** mark each) **4**

(i) What is advance time in retarded potential theory ?

(ii) Write inhomogeneous wave equations for retarded potential.

(iii) What is radiation zone ?

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(iv) Find the ratio of total radiated power (p_{mag} / p_{ele}) ? Which one is greater for configuration with comparable dimensions ? [Assume, $m_o = \pi a^2 I_0$ and $p_0 = q_0 s$, & the amplitude of the current in the electrical case is $I_0 = q_0 \omega$ at $s = \pi a$.]

(v) Write the Poisson equations ?

(vi) Write equation of pointing vector in terms of electric field and magnetic field.

2. (A) (i) Discuss the Abraham-Lorentz formula in detail. **7**

(ii) Show that the electric field of a point charge in motion can be expressed as,

$$E = \frac{q}{4\pi\epsilon_0}\frac{1}{(R \,.\, u)}\frac{\partial}{\partial t_r}\left(\frac{Ru}{R.u}\right)$$ [NOTE : r and t are treated as constant] . **7**

OR

(i) Explain " theory of Lienard-Wiechert potentials" with appropriate example. **7**

(ii) Consider a particle of charge q moves in a circle of radius R at constant angular velocity ω (assume the circle lies in the xy plane at time t=0, the charge is at (R, 0) on the +x axis). Find out the Lienard-Wiechert potentials for point on the Z-axis. **7**

(B) Answer any **three** from the following : (**one** mark each) **3**

(i) The current density of a rigid object for radiation from a point charge is ____.

(i) ρν, (ii) ρε, (iii) ρμ, (iv) μν

(ii) Distinguish between Radiation reaction and Field reaction.

(iii) For the moving point charge, the retarded potentials V(r, t_r) and A(r, t_r) are depends upon the ____ at the time t_r. (a) field, (b) motion of charge, (c) high acceleration, (d) recoil force.

(iv) The power radiated by a point charge, $P = \frac{1}{4\pi\epsilon_0}\frac{2}{3}\frac{q^2}{c^2}\gamma^6\left[a^2 - \left(\frac{v}{c} \times a\right)^2\right]$

This is Lienard's generalization of Larmor formula (to which it reduces when v = 0). The factor γ^6 indicates that

(a) the radiated power increases enormously as the particle velocity approaches the speed of light.

(b) the radiated power decreases enormously as the particle velocity approaches the speed of light.

(c) the radiated power increases enormously as the particle charge greater then γ.

(d) None of above

(v) For the caboose train, the observer watching the leaving train looks like little longer then the real train by the factor of _____ .

(i) $(1 - v / c)^{-1}$ (iii) $(1 + v / c)^{-1}$

(iii) $(1 - v^2 / c^2)^{-1}$ (iv) $(1 + v^2 / c^2)^{-1}$

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(v) What is the difference between a global variable and a static variable ?

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