Roll No.:.....

National Institute of Technology, Delhi

Name of the Examination: B. Tech 3rd year

Branch : ECE | Semester: 5th

Title of the Course : Antenna and wave propagation | Course Code: ECL-301

Time: 3 Hours | Maximum Marks: 50

Section-A

Note: Attempt all questions **(1×10=10)**

Q.1 According to Frii's equation, the energy transfer will be highest at *lowest or highest frequency*.

Q.2 For a infinitesimal loop antenna ($l<<\lambda/10$) the reactance part is .....,whereas for infinitesimal dipole antenna of length ($l<<\lambda/10$) it is.....

Q.3 The radiation gets more and more focused in the direction of main beam if the directivity of the antenna is (increased/decreased/not affected).

Q.4 What is the total impedance of the $\lambda/2$ dipole antenna.

Q.5 An electrical component starts radiating more and more as the frequency .....

Q.6 Radiation is the phenomenon related to *time varying or none time* varying current.

Q.7 The radiation resistance of the infinitesimal dipole antenna is nearly equal to .....

Q.8 The direction in which no radiation goes i.e. in which the electrical field is zero is called as ..... of the radiation pattern.

Q.9 Draw the current distribution for dipoles of lengths $\lambda/2$, $5\lambda/4$ and λ.

Q.10 In two element array the spacing between elements controls the .....in radiation pattern.

Section-B

Note: Attempt any four questions **(4×5=20)**

Q.1 A 0.1 m long thin wire is carrying 10 A peak current at 30 MHz, and is oriented along the z-axis. Find the magnetic vector potential at a distance of (i) 1 m (ii) 10 m (iii) 100 m from the wire.

Q.2 Three isotropic elements of equal excitation phase are placed along the y-axis, as shown in figure. If the relative amplitude of element-1 is +2 and element-2 and 3 is +1, find the expression for total electric field and three dimensional unnormalized array factor.

Q.3 A two element array of isotropic antenna is to used to get maximum radiation and a null along the array axis in the opposite directions. Find the array parameters.

Q.4 The radius of a small loop of constant current is $\lambda/25$. Find the physical area of the loop and compare it with its maximum effective aperture.

Q.5 A $\lambda/2$ dipole situated with its center at the origin radiates a time-averaged power of 600 W at a frequency of 150 MHz. A second $\lambda/2$ dipole is placed with its center at a point P (r, θ, φ), where r = 200 m, $\theta = 90^{\circ}$, $\varphi = 40^{\circ}$. It is oriented so that its axis is parallel to that of the transmitting antenna. What is the available power at the terminals of the second (receiving) dipole.

Section-C

Note: Attempt all questions **(2×10=20)**

Q.1 Find the radiation efficiency of a single-turn and an eight-turn small circular loop at f = 100 MHz. The radius of the loop is $\lambda/25$, the radius of the wire is $10^{-4}\lambda$, and the turns are spaced $4 \times 10^{-4}\lambda$ apart. Assume the wire is copper with a conductivity of 5.7×10^{7}(S/m) and the antenna is radiating into free-space.

Q.2 Derive the expression for P_{rad} and radiation resistance R_r, if the complex Poynting vector (W) or P_{avg} of a infinitesimal dipole antenna is

OR

Q.2 At what frequency a wave must propagate for the D region to have an index of refraction 0.5 for N= 400 electron/c.c. for D-region.