Roll No.:.....

National Institute of Technology, Delhi

Name of the Examination: End Sem. Exam.

Branch	**:Electronics & communication Engineering**	**Semester**	**: V**
Title of the Course	**:Antenna and wave propagation**	**Course Code**	**: ECL 301**
Time: 3 Hours		**Maximum Marks: 50**	

---

1. Answer all the parts of this question [10 x 1 = 10]

I. What is the most fundamental source of electromagnetic wave radiation?

II. What is the general way to increase the directivity of an antenna?

III. What are the modes of a helical antenna?

IV. What is the most general purpose of an antenna array?

V. What is the HPBW of a quarter wavelength monopole antenna?

VI. What is the maximum directivity of a quarter wavelength monopole antenna?

VII. Write the most common relation between the directivity and effective aperture of an antenna.

VIII. What is the ideal value of axial ratio of a circularly polarized wave?

IX. Radiation resistance of an infinitesimal dipole antenna is?

X. What is the relation between the directivity and gain of an antenna?

Answer any four from the following questions [4 x 5 = 20]

2. A $\lambda/50$ linear dipole is placed vertically at a height of $h = 2\lambda$ above an infinite electric ground plane. Determine the angles where all the nulls of its pattern occur. [5]
3. Transmitting and receiving antennas operating at 1 GHz with gain of 20 and 15 dB, respectively, are separated by a distance of 1 km. Find the power delivered to the load when the input power is 150 W (assume polarization matched case). [5]
4. A lossless (e_{cd}) antenna is operating at 100 MHz and its maximum effective aperture is 0.7162 m^2 at this frequency. The input impedance of this antenna is 75 Ω, and it is attached to a 50 Ω transmission line. Find the directivity of the antenna if it is polarization matched? [5]

5. Design a lossless resonant circular loops operating at 10 MHz so that its single turn radiation resistance is 0.73 Ω. The resonant loop is to be connected to a matched load through a balanced 300 Ω transmission line [2+3]
   a) Determine the radius of the loop
   b) To minimize the matching reflection between the resonant loop and the 300 Ω transmission line, determine the closest number of integer turns the loop must have
6. The power radiated by a lossless antenna is 10 watts. The directional characteristics of the antenna are represented by the radiation intensity of [2.5+2.5]

$$U = B_0 \cos^3\theta \text{ (watts/solid angle)} \quad \left(0 \le \theta \le \frac{\pi}{2},\ 0 \le \phi \le 2\pi\right)$$

Find the

(a) Maximum power density at a distance of 1 Km (assume far-field distance) and specify the direction where this occurs.

(b) Maximum directivity of the antenna in dB

Answer any Two from the following questions [2 x 10 = 20]

7. A 3 cm long dipole carries a phasor current $I_0 = 10e^{-j60}$ A. Assuming that $\lambda = 5$ cm determine the E-and H-fields at 10 cm away from the dipole and at $\theta = 45^0$. [10]
8. Show that in order for a uniform array of N-elements not to have any minor lobes, the spacing and the progressive phase shift between the elements must be [5+5]
   a) $d = \lambda/N$, $\beta = 0$ for a broadside
   b) $d = \lambda/2N$, $\beta = \pm kd$ for an ordinary end-fire array
9. Design an end-fire right hand circularly polarized helix having a half-power beam width of 45^0, pitch angle of 13^0, and a circumference of 60 cm at a frequency of 500 MHz. Determine the [2.5+2.5+2.5+2.5]
   a) Turns needed
   b) Directivity
   c) Lower and upper frequencies of the bandwidth over which the required parameters remain relatively constant
   d) Input impedances at the lower, center and upper frequency of the band.