National Institute of Technology Delhi

End Semester Examinations –Dec.- 2022

Roll No:

Name of Specialization – B.Tech (ECE) | Year – 3rd , Semester -5th

Course Name- Antenna & Wave Propagation | **Maximum Marks – 50**

Course Code: ECL-301 | **Total Time: 3:00 Hours**

Note : This question paper divided into three sections A, B and C and each section must be solved with rules given as follows:
Section A: Contains Ten (10) questions of 01 mark each and all questions are compulsory.
Section B: Contains Five (05) questions of 5 marks each and any four (04) are to be attempted.
Section C: Contains Three (03) questions of ten (10) marks each and any two (02) are to be attempted.
Assume suitable data, if found missing. Used symbols have their usual meaning

Section A

Q1: What do you mean by Hertizan dipole and what is the expression of its radiation resistance?

Q2: Write down the expression for radiation intensity of an isotropic radiator.

Q3: What is expression of the loss resistance parameter of a straight wire antenna having uniform current?

Q4: Write down the expression of antenna radiation efficiency.

Q5: What do you mean by principal E & H-planes for an antenna?

Q6: Define end-fire and broadside radiation patterns of an antenna array.

Q7: How is standing wave or resonant antenna different from traveling wave antenna?

Q8: Write down the expression of power receiving by a bi-static Radar?

Q9: What is Love's equivalence principle?

Q10: In which direction do the patch antenna radiate maximally?

Section-B

Q-1: In the free space $\rho_v = 0$, $J = 0$, show that $A = \frac{\mu_0}{4\pi r}(\cos\theta\, a_r - \sin\theta\, a_\theta)\exp j\,\omega(t - r/c)$ satisfies the wave equation. Find the corresponding V. **(5)**

Q-2: For the two-element antenna array in which two infinitesimal dipoles are placed in free space along z-axis but oriented parallel to x-axis. The separation between the elements is d and they are carrying uniform current with an initial excitation phase difference of β. Sketch the normalized field pattern when currents are fed in phase $\beta = 0$ and $d = \lambda/2$. **(5)**

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Q-3: An electric field strength of 10 $\mu V/m$ is to be measured at an observational point $\theta = \pi/2$, 500 km from a half-wave (resonant) dipole antenna operating in air at 50 MHz. Calculate the current that must be fed to the antenna. **(5)**

Q-4: What is directive gain of an antenna? Determine the electric field intensity at a distance of 10 km from an antenna having a directive gain 5dB and radiating a total power 20 kW. **(5)**

Q-5: Show that directivity of a linear, broadside uniform array of N isotropic elements with a separation of d between the elements is approximately equal to $2N(d/\lambda)$, where λ is operating wavelength. **(5)**

Section-C

Q-1: For the N-elements linear array antenna, which contains identical elements and are excited by identical magnitude, but each succeeding element has a β progressive phase lead current excitation relative to the preceding one. Determine the following:

(a): Array factor, **(b):** Angles at which null and maxima exist, **(c):** Largest spacing between the elements to avoid the grating lobe for broadside radiation. **(10)**

Q-2: A rectangular aperture with a constant field distribution, with aperture dimensions $a = 3\lambda \; and \; b = 2\,\lambda$ is mounted on an infinite ground plane. Compute the **(a):** FNBW in the E-plane, **(b):** HPBW in the E plane, **(c):** total beamwidth between first side lobes (FSLBW) in the E-plane. **(10)**

Q-3: Define E –plane sectoral horn. For the E-plane sectoral horn derive the expression for the maximum phase deviation at its aperture. Formulate the expressions of the radiated fields by such E-plane sectoral horn assuming that it is dominated by TE_{10} mode. **(10)**

**********End of paper********** *****