National Institute of Technology Delhi

End Semester Examinations –Nov.-Dec.- 2019

Roll No:

Name of Specialization – B.Tech (ECE) — Year – 3rd Semester -1st

Course Name- Antenna & Wave Propgation — **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 density of an isotropic radiator.

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

Q4: What is Rhombic antenna?

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

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

Q7: What is standing wave or resonant antenna?

Q8: What is traveling wave antenna?

Q9: What is Love's equivalence principle?

Q10: What is the expression for the radiation resistance of a circular loop antenna?

Section-B

Q-1: Derive the equation of the inhomogeneous wave from the Maxwell's equations and found out its solution in the limit by considering source is a point. **(5)**

Q-2: Consider the two-elements 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: A magnetic field strength of $5\mu A/m$ is required at a point on $\theta = \pi/2$ which is 2 km from an antenna in air. Neglecting ohmic loss, how much power must the antenna transmit if it is a 10-turn loop antenna of radius $\rho_0 = \lambda/20$? **(5)**

Q-4: A thin linear dipole of length l is placed symmetrically about z-axis. Find the far-zone spherical electric and magnetic components radiated by the dipole whose current distribution can be approximated by $I_z(z') = I_0 \cos(\frac{\pi}{l} z')$, $-l/2 \leq z' \leq l/2$. **(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]: Normalized array factor, **[b]:** Angles at which null and maxima exist, **[c]:** Largest spacing between the elements to avoid the grating lobe for broadside and end-fire radiations. **(10)**

Q-2: What do you mean by slow wave traveling antenna? By considering traveling wave current profile in the long wire, $l \gg \lambda$, oriented along z-axis, determine the following:

[a]: Far field expressions of the fields, **[b]:** Directivity, **[c]:** Radiation resistance and **[d]:** Input impedance. **(10)**

Q-3: Draw the design configuration of Yagi-Uda antenna. How many components are there and what are their roles? Derive the expression for the total far field of the entire Yagi-Uda array? **(10)**

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