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Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 10454

M.E./M.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2023.

First Semester

Communication Systems

CU 4152 – RADIATING SYSTEMS

(Common to : M.E. Electronics and Communication Engineering)

(Regulations – 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define HPBW and FNBW of an antenna.
2. A thin dipole antenna operating at 900 MHz with overall length of $\frac{\lambda}{55}$. Find the radiation resistance of the antenna.
3. Draw the functional block diagram of an adaptive array system.
4. What is phased array antenna?
5. List the applications of microstrip patch antenna.
6. State Huygens field equivalence principle.
7. Give the advantages of diversity techniques.
8. What are all the antennas used for cellular base station applications?
9. State the merits of Vivaldi antenna arrays.
10. What is the difference between traditional antenna and plasma antenna?

PART B — (5 × 13 = 65 marks)

11. (a) An infinitesimal dipole antenna of constant current I_0 and length is l symmetrically placed about the origin along z axis. Find the expressions of far field electric and magnetic fields.

Or

(b) Explain the operating principle of loop antennas. Also obtain the radiated field expressions of loop antenna.

12. (a) For an N - element uniform linear array, obtain the expressions for resultant field, normalized field, Major lobe direction, radiation null direction, Minor lobe maxima and Minor lobe minima of the Broad side array. Sketch the radiation pattern of the broadside array and mention all the above parameters.

Or

(b) Determine the array factor, amplitude coefficients of excitation elements, Half power beam width and directivity of the 10 element binomial array antenna.

13. (a) Derive the radiated field expressions due to a rectangular aperture antenna.

Or

(b) (i) Design a rectangular microstrip patch antenna using FR4 substrate with dielectric constant of 4.6, thickness of the substrate 1.6 mm and its resonance frequency is at 2.5 GHz. (6)

(ii) Illustrate the design procedure of E plane and H plane sectoral horn antennas with neat diagrams. (7)

14. (a) Explain in detail about the antenna impedance measurement technique with neat block diagrams.

Or

(b) Explain in detail about the antenna radiation pattern measurement technique with neat block diagrams.

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15. (a) Write short notes on the following.

(i) Artificial magnetic conductor antenna (7)

(ii) High impedance surface antenna (6)

Or

(b) Explain the practical usage scenarios of various antennas for millimeter wave communication.

PART C — (1 × 15 = 15 marks)

16. (a) The radiation intensity of an antenna operating at 10 GHz, is approximated by

$$u(\theta,\varphi) = \begin{cases} \cos^4\theta & 0 \le \theta \le 90^\circ \\ 0 & 90^\circ \le \theta, \le 180^\circ \\ \text{with} & 0^\circ \le \phi \le 360^\circ \end{cases}$$

Calculate (i) Directivity (dB) and (ii) Maximum effective aperture.

Or

(b) Design a five element -40 dB side lobe level Dolph-Tschebyscheff array of isotropic elements. The elements are placed along the x-axis with a spacing of $\lambda/4$ between them. Determine the normalized amplitude coefficients and array factor.