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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, HYDERABAD

B. Tech III Year I Semester Examinations, November/December-2013

ANTENNAS AND WAVE PROPAGATION

(Common to ECE, ETM)

Time: 3 hours

Max. Marks: 75

**Answer any five questions
All questions carry equal marks**

- 1.a) Describe and explain the significance of the terms: Radiation Resistance and Aperture Efficiency, as applicable to antennas.
- b) For a constant current distribution on a short vertical dipole, obtain an expression for the magnetic field. Hence calculate the distance at which the radiation and induction field terms have equal amplitudes. [15]
- 2.a) A 50 cm. long vertical dipole operating at 30 MHz radiates a maximum electric field of 15 mV/m at 5 km distance. Find its power radiated, input current and maximum magnetic field at the same distance.
- b) Give the far-field expressions for a $\lambda/2$ vertical dipole and hence evaluate its radiation resistance. List out the expression and sketch its current distribution along the length. [15]
- 3.a) Find the array factor and sketch the pattern of a 2-element array having equal amplitudes and phases, and having a spacing of $d = \lambda$.
- b) For a 16 element Broadside Array with $\lambda/2$ spacing, derive the array factor, and hence calculate its FNBW, First Side lobe Level, Directivity and Effective Area. [15]
- 4.a) With neat illustrations, explain the geometry and requirements for a helical antenna radiating into axial mode, and give the relevant design relations.
- b) For a parabolic reflector of 7.5 m diameter, at 4 GHz, find the BWFN, HPBW, Directivity and effective aperture. What are off-set feeds? [15]
- 5.a) With neat schematics, describe the radiation characteristics of a rectangular microstrip patch antenna, using basic transmission line model. What are the effects of ϵ_r on its characteristics?
- b) Explain the characteristic features and applications of a square corner reflector. Sketch its typical patterns. [15]
- 6.a) With a neat block diagram, explain the method of measurement of radiation pattern of an antenna. Identify the components to be measured and the principal planes, if it is a vertical dipole.
- b) Explain the need for non-uniform amplitude distribution in a linear array, and hence sketch the pattern of a 4 element Binomial Array. [15]

- 7.a) Account for the propagation characteristics of Medium Wave Broadcast Signals.
- b) Derive an expression for the variation of field strength of a space wave, with antenna heights and distance involved. What happens when the distance is large? [15]
- 8.a) Explain the effects of D and F layers of the ionosphere on propagation, and estimate the critical frequency and MUF for a layer with $10^{11}/\text{m}^3$ electron density, and incident angle of 60° . What are LUF and Optimum Frequencies?
- b) Compute the free space path loss for a link distance of 30 km at a frequency of 10 GHz. Also calculate the received power, if the transmitting and receiving antennas have equal gains of 20 dB, and the transmitter power is 500 W. [15]

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