



COLLEGE OF ENGINEERING & TECHNOLOGY

Department: Electronics and Communications

Lecturer: Dr. Mohab Mangoud

Course: Wave Propagation and Antennas I

Course Code: EC 443

Marks: 40

Time: 2 hours

Final exam

Date : 15/1/2004

Answer the first four following questions: (each for 10 marks)

Q1) I. Write down expressions for the electric and magnetic field components in a rectangular waveguide of dimensions $(0.8 \times 1.2) \text{ cm}^2$ at the dominant mode and then write down expressions for the next higher mode.

II. For a circular waveguide, considering field equations on the form: $B \cos(m\phi) J_m(k_c \rho) e^{-j\beta z}$ with diameter 1 cm is plated with perfectly conductor material and filled with dielectric material has $\epsilon_r = 2.25$

(a) Write Down Expressions for the **first two modes** (either TE or TM)

(b) Find the cut off frequencies for **the first five** TE and TM modes for circular waveguide. (10 marks)

Order 0	2.40	5.25	8.65
Order 1	3.83	7.02	10.17

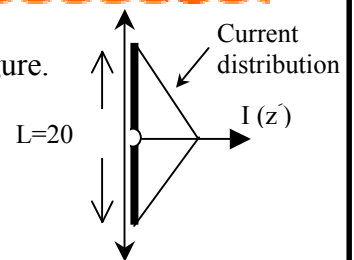
Zeros of the Bessel function of 1st kind

Order 1	1.84	5.33	8.54
Order 2	3.05	6.71	9.97

Extrema of Bessel function of 1st kind.

Q2) Consider the current distributions $I(z')$ over the antenna as shown on the figure.

- Find the operating frequency range of this antenna.
- Write down expressions for the spherical electrical and magnetic fields.
- Drive an expression for the power radiated from antenna



- II. a)** Compare using neat sketches the azimuth and the elevation radiation pattern of the electric field in the far zone for the following dipole wire antennas with the following lengths:

$\lambda/50, \lambda/12, \lambda/2, \lambda, 2\lambda, 2.5\lambda, 3.5\lambda, 4\lambda, 7\lambda, 10\lambda.$

(10 marks)

Q3) I. The current distribution on a Quarter wavelength monopole antenna operating at frequency = 900 MHz and positioned along the z-axis and fed against the ground.

- Find the monopole length.
- Write down expressions for spherical electrical and magnetic field components.
- Drive the radiated power in (w) and the radiation Resistance of this antenna.
- Find the directivity in (dB) and the effective length in (cm).
- If the same antenna has input impedance equals the radiation resistance and it is connected to a coaxial cable with characteristic impedance of 50Ω , find the overall gain of this antenna. (10 marks)

Q4) I. Derive an expression for the array factor of a linear uniform array of 10 elements. Then evaluate the limit of the peak sidelobe level for large number of elements.

II. For 5-element ULESA, Draw the array factor (AF) with the vertical angle (θ) in polar plot for Broadside array and the spacing between each two elements. $=2\lambda/5$. (10 marks)

(Q5) Bonus Question (-:-) Design 9 elements linear electronic-scanning array with the main beam directed at 45° , such that no grating lobes appear in the array factor. plot the array factor of the array. Plot the total pattern of the array in the 3 principles assuming the array line to be along the Z-axis and the elements to be 2λ dipoles oriented toward the Y-direction. (10 marks)

Have a good luck
Dr. Mohab Mangoud