MANSOURA UNIVERSITY
FACULTY OF ENGINEERING
DEPARTMENT OF ELECTRONICS & ELECTRICAL COMMUNICATIONS

ANTENNAS & WAVE PROPAGATION
B Sc EXAM
JAN 2013

Attempt all questions.
Full Mark: 100 All five questions carry equal marks **Time: 3 hours**

1- a) Define the terms: directivity, effective aperture area, radiation efficievcy and gain of an antenna
b- In target-search ground-mapping radars it is desirable to have echo power received from a target, of constant cross-section, to be independent of its range. For one such application, the desirable radiation intensity (power pattern) of the antenna is given by:

$$U(\theta, \varphi) = \begin{cases} 1 & 0^\circ \le \theta \le 30^\circ \\ 0.50 \csc(\theta) & 30^\circ \le \theta \le 60^\circ \\ 0 & 60^\circ \le \theta \le 180^\circ \end{cases} \qquad 0^\circ \le \varphi \le 360^\circ$$

Find the directivity of the antenna relative to isotropic in dBi.

2- The radiation field of a small single turn circular loop antenna of radius **a** and uniform current of rms value **I** amperes in free space is given by: $\mathbf{E_\varphi = 30\, k^2\, a^2\, I \sin(\theta)\, e^{-jkr}/r}$. ($E_r = 0$, $E_\theta = 0$.)
a) Derive expression for the radiation resistance $\mathbf{R_r}$ of the antenna. What would be $\mathbf{R_r}$ if the loop is made of **N** turns?
b) What is meant by: Polarization, linear Polarization, and Circular polarization?
c) What type of polarization do the very short dipole and the small loop have?
d) What is one way to produce circular polarization when using two linearly polarized antennas?

3- **a)** Compare between the folded dipole and the ordinary half-wavelength dipole with regard to gain and input impedance.
b) Give, aided with neat sketches, four examples of broadband wire antennas and outline their principal of operation.
c) Differentiate broadside and endfire arrays.
d) A uniform linear array is made of four isotropic radiators placed on the z-axis. The main beam is in the direction $\theta = 45^\circ$. The distance between the elements is $\lambda/2$. Find the progressive phase shift between the element currents and the number of side lobes.

4- **a)** Estimate the directivity of a parabolic-reflector antenna, if the diameter of the dish is 2 m and the frequency is 4.5 GHz.
b) What factors do degrade the performance of parabolic-reflector antennas? Outline some techniques to mitigate this degradation.
c) Write short notes on : i- Ground wave propagation. Ii- Sky waves. iii- Plasma frequency. Iv- Maximum usable frequency.

5- **a)** Explain briefly the basic sources of signal degradation for line-of sight communication.
b) A cellular telephone base station transmitter at 1800 MHz delivers 20 W into a 16-dB gain collinear array antenna. Compute the power in watts available from a 5-dB gain microstrip receiving antenna 2 km away. Consider only free space path loss.
c) What are the main advantages and limitations of microstrip patch antennas. What are the effects of substrate thickness and dielectric constant on the impedance bandwidth of the antenna? How can you design a patch antenna to be circularly polarized?

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