KING FAHD UNIVERSITY OF PETROLEUM & MINERALS
DEPARTMENT OF ELECTRICAL ENGINEERING

EE 422 ANTENNA THEORY

EXAMINATION II

18 May, 2010

NAME :	
I.D. # :	

PROBLEM #	SCORE	MAXIMUM
1.		30
2.		30
3.		40
TOTAL		100

Instructor : Dr. Mahmoud M. Dawoud

Q.1

a. An ideal short dipole has an electrical length of 0.0625 λ, situated along the z axis and carries an RF uniform current of 2.5 A. Calculate the electric field intensity at a point located 40 km from the short dipole and at an angle of 45^{o} from the z axis.
b. The far zone field intensity (array factor) of an endfire two-element array antenna placed along the z axis is given by:

$$E = \cos\left[\frac{\pi}{4}(\cos\theta - 1)\right]\frac{e^{-jkr}}{r} \quad 0 \leq \theta \leq \pi$$

Calculate:

1. The exact directivity
2. The HPBW in two perpendicular planes
3. The approximate directivity according to Kraus's formula and the percentage error in the directivity

$$\left[\boldsymbol{Kraus's\ formula}:\ \boldsymbol{D_o \cong \frac{4\pi}{\theta_{1r}\theta_{2r}}}\right]$$

Q.2 A thin linear dipole is 2.5 λ long and carries sinusoidal current distribution.

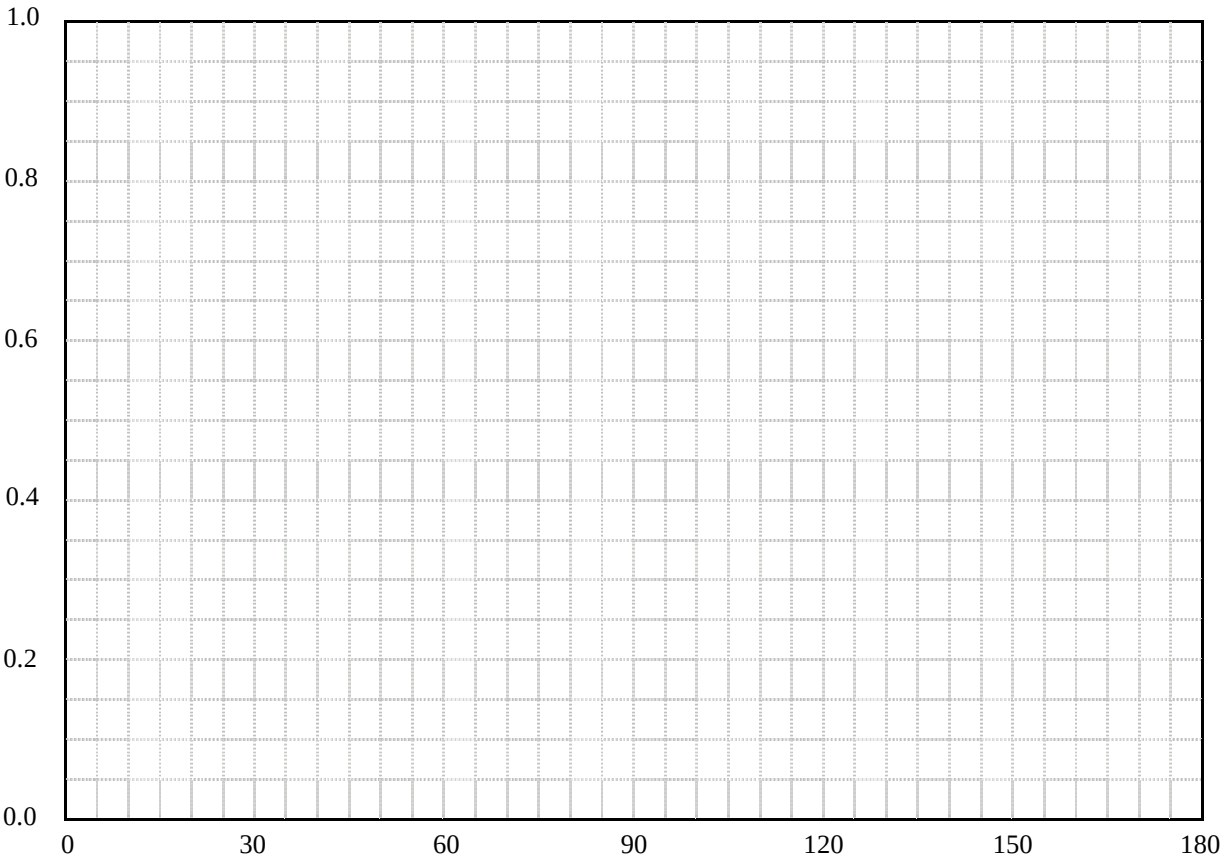
a. Derive an expression for the far zone electric and magnetic fields. Plot the E field pattern.
b. Calculate the radiation resistance of this dipole
c. Calculate the input resistance

$$\int_0^{\pi} \frac{\left[\cos\left(\frac{kl}{2}\cos\theta\right) - \cos\left(\frac{kl}{2}\right)\right]^2}{\sin\theta}\, d\theta$$

$$= C + ln(kl) - C_i(kl) + \frac{1}{2}\sin(kl)[S_i(2kl) - 2S_i(kl)] + \frac{1}{2}\cos(kl)\left[C + ln\left(\frac{kl}{2}\right) + C_i(2kl) - 2SC_i(kl)\right]$$

Q.3 A uniform linear array of 5 equally spaced isotropic elements is placed along the z-axis with separation $d = 0.4\,\lambda$ between them. Assuming equal amplitudes and progressive phase shift $\beta = 0^{o}$, find the following:

a. The array factor.
b. The angles where the nulls of the array pattern occur.
c. The angles where the maxima of the array pattern occur.
d. Calculate the half-power beamwidth (HPBW) and The first null beamwidth (FNBW).
e. Sketch the array pattern on the provided linear rectangular graph.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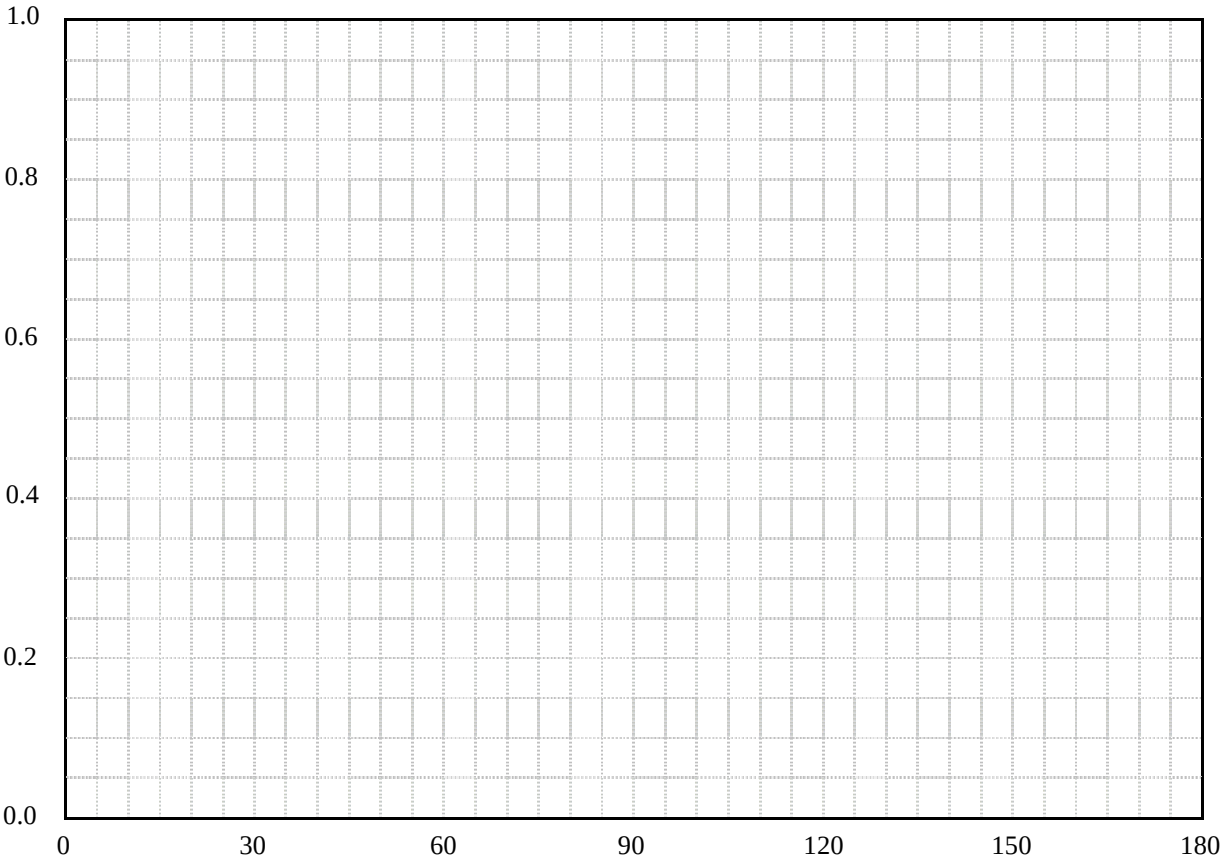
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