Question 4: (14-marks)

(a) For the array of two infinitesimal horizontal dipoles positioned along the z-axis, as seen in Fig.2, assuming phase difference β between the two elements, derive the normalized array factor. (8-marks)

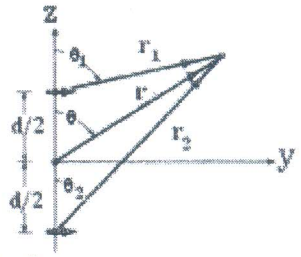


Fig. 2 Two infinitesimal dipoles

Note that: The radiated field from a single element positioned at the center is

$$E_\theta = \frac{jZ_o k_o I_o d\ell}{4\pi r}\cos\theta\, e^{-jk_o r}$$

(b) For the array given above (problem 4(a)) if the total normalized radiated electric field is given by;

$$E_{tn} = \cos\theta\cos\left[\frac{1}{2}(kd\cos\theta+\beta)\right]$$

find the nulls of the total field when $d=\lambda/2$ and a. $\beta=0$ b. $\beta=+\pi/2$ c. $\beta=-\pi/2$. (6-marks)

Question 5: True or False: (10-marks) (Model D) **لاحظ أن:** ترتيب الأسئلة مختلف فى كل نموذج

1. Inductive or capacitive loading for short dipoles (or monopoles) improve the current distribution.
2. In many applications it is necessary to design antennas with very directive characteristics. This can only be accomplished by decreasing the electrical size of the antenna.
3. The maximum magnitude for the major lobe of N-element uniform linear array is equal to N.
4. In uniform linear array; the range corresponding to the visible region is $-(2\pi d/\lambda) \le kd\cos\theta \le +2\pi d\lambda$.
5. The function $[\sin(N\psi/2)/\sin(\psi/2)]$ behaves typically like the well-known function $[\sin\psi/\psi]$.
6. In Yagi-Uda array the distance between the director elements is 0.15λ.
7. Long-wire antennas can be operated as traveling wave antennas by terminating the far end with a matched load.
8. Traveling wave antennas are characterizes by narrow frequency band of operation.
9. Log-periodic antennas are truly broadband devices and can be built to operate over essentially any frequency band desired.
10. For quarter-wave antennas mounted above the earth the poor conductivity of the soil results in excessive radiation power gain due to the induced currents in the soil.

Note that: $\mu_o = 4\pi\times10^{-7}$ H/m

P.T.O

University	: **Menoufia**		*Date*	: **26/12/2019**
Faculty	: **Electronic Engineering**		*Time*	: **From:10 AM to 1 PM**
Program	: **Communications**		*No. of pages*	: **2**
Academic level	: **Fourth year**	First Semester	*Full Mark*	: **90**
Course Name	: **Antenna Engineering**		*Exam*	: **Final Exam**
Course Code	: **ECE 411**		*Examiner*	: **Dr. Abdelmageed Sharshar**

Answer the following questions:

Question 1: (25-marks)

(a) For a half-wavelength dipole antenna located along z-axis, start with;

$$\bar{E}(r) = \frac{jk_o Z_o}{4\pi r} e^{-jk_o r} \int_{\ell} [(\bar{a}_r \cdot \bar{a})\bar{a}_r - \bar{a}] I(\ell') e^{jk_o \bar{a}_r \cdot \bar{r}'} d\ell'$$

to derive the far field electric and magnetic field components, and then;

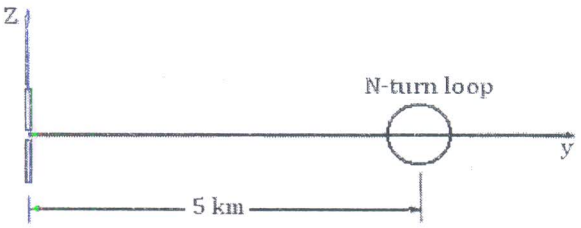
(i) Deduce the radiation power density, radiation power intensity and beamwidth.

(ii) Given that the total radiated power $P_{rad} = 36.565\, I_o^2$ watt, find out the directivity, and the maximum gain.

(iii) Find out the radiation resistance. (20-marks)

(b) A small coil of radius r_o = 10 cm and with N = 100 turns is used as a receiving antenna. This antenna is located 5 km away from a half-wave dipole and oriented for maximum magnetic flux penetration, as shown in Fig. 1. Find the induced open-circuit voltage $-j\omega B_\emptyset N(\pi r_o^2)$ in the loop when the input power to the half-wave dipole antenna is 150 W. The frequency of operation is 3 MHz. (5-marks)

Fig. 1



Question 2:

(a) Derive the input impedance for a two-element folded dipole of length l, and then show that the input impedance of a two-element folded dipole of $l = \lambda/2$ is four times greater than that of an isolated element of the same length. (10-marks)

(b) With aid of sketch, explain the construction, and function of T.L-TV balun which is used to connect a 75 Ω coaxial cable to a folded dipole of 300 Ω. Show how to increase the bandwidth. (10-marks)

Question 3: (21-marks)

(a) Compare between the Broadside and End-fire array to show the difference between them in
(i) the direction of maximum lobe. (ii) The current phase progression.
(iii) the distance between elements to get only one major lobe in the visible space. (6½ marks)

(b) Derive the array factor for two-element **parasitic** array using two port network analysis. Discuss the required conditions to work as an End-fire array with one maximum in one direction and minimum or null in the backward direction. Generally for parasitic arrays, how much the resultant bandwidth, gain and radiation resistance? (10-marks)

(c) Demonstrate the effect of ground for horizontal long wire antennas. (5-Marks)

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