Kaferelsheikh University
Faculty of Engineering
Department of Electrical Engineering
Year: 4th comm. Subject: Antennas
Name: ECE4225

Date: 23/ 6 /2021
Time allowed: 3 h
Full Mark: 90 degree
Final Exam: 2 page
Academic Number:

- This exam measures competences no: A.1, A. 3 A. 4, A5, A.8 A20, A21, B1, B.3 B.4, B.8, B.13 and C1, C.3, C.6.

1- $\int_0^{\pi} \sin^3\theta d\theta \int_0^{2\pi} d\emptyset = \frac{8\pi}{3} sr$ 2- $e^{\frac{jkd\cos\theta}{2}} = \cos\frac{kd\cos\theta}{2}$ 3- $\int_{-\infty}^{\infty} \frac{e^{-j\beta\sqrt{b^2+t^2}}}{\sqrt{b^2+t^2}} dt = -j\pi H_o^{(2)}(\beta b)$

## 1] Question One[30degrees]:

a) With a neat diagram compare between Micro strip and dielectric resonator antennas (Structure, principle of operation, feeding mechanisms). [10 degrees]

b) What mean by parasitic array, explain about construction and operation of one type of this array. With a neat diagram. [6 degrees]

c) What are Electrically Small loop antennas? Drive an expression for power radiated and radiation resistance of Small loop antenna where max power as the following. [8degrees]

$$P_{max} = \frac{w^2\mu_o^2 I_0^2 S^2 \beta^2}{32\eta_o \pi^2 r^2}$$

d) Two elemental dipole antennas each having length $l \ll \lambda$ forms an array as shown in Fig. 1. the excitation of the array elements is equal in magnitude and phase. Find the expression for the radiated field components at a point $P(r, \theta,\varphi)$ . (Assume the antennas to be located in the free space) [6 degrees]

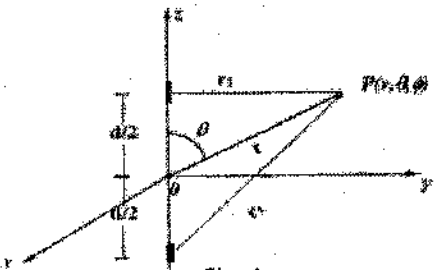


Fig. 1.

## [2] Question Two[25 degrees]:

a) Derive the electric field components as in the following equations of the infinitesimal dipole [10 degrees]

$$E_\theta = j\eta \frac{kI_o l \sin\theta}{4\pi r}\left[1 + \frac{1}{jkr} - \frac{1}{(kr)^2}\right]e^{-jkr} \quad E_r = \eta \frac{I_o l \cos\theta}{2\pi r^2}\left[1 + \frac{1}{jkr}\right]e^{-jkr} \quad E_\phi = 0$$

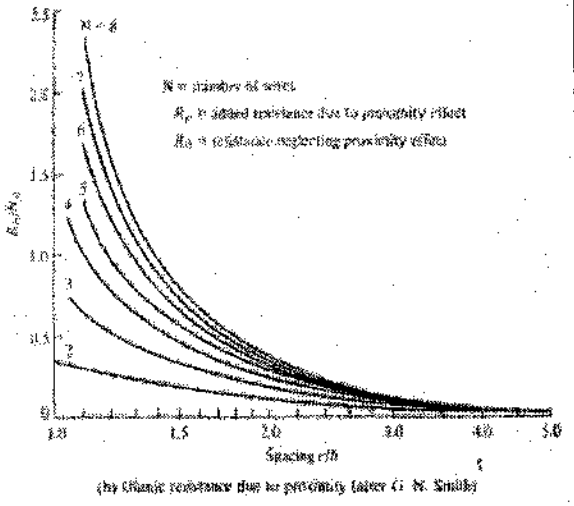
b) The maximum radiation intensity of a 90% efficiency antenna is 200mW/unit solid angle. Find the directivity and gain (dimensionless and in dB) when the: [8 degrees]

1) Input power is 125.66 mW 2) Radiated power is 125.66 mW

c) A CW circularly polarized uniform plane wave is traveling in the +z direction. Find the polarization loss factor PLF (dimensionless and in dB) assuming the receiving antenna (in its transmitting mode) is (a) CW circularly polarized (b) CCW circularly polarized [7 degrees]

## [3] Question Three[20 degrees]:

a) A resonant 6-turn loop of closely spaced turns is operating at 50 $MHz$. The radius of the loop is $\lambda/30$, and the loop is connected to a 50-ohm transmission line. The radius of the wire is $\lambda/300$, its conductivity $\sigma = 5.7 \times 10^7$ $S/m$, and the spacing between the turns is $\lambda/100$. Determine the following: [12 degrees]




1) Directivity of the antenna (in dB)
2) Radiation efficiency taking into account the proximity effects of the turns
3) Reflection efficiency
4) Gain of the antenna (in dB)

b) Determine the directivity of Hertzian monopole antenna where the radiated power is [8 degrees] $U(\theta, \emptyset) = P_{avg} r^2 = \frac{\eta}{2}(\frac{\beta I_o}{4\pi} dl \sin\Theta)^2 \ (W/rad^2)$

## [4] Question Four[15 degrees]:

a) There is a 900 MHz whip antenna of length λ/4 and of gain 2 dBi on the roof of a car. What is the capture area of the antenna? Compare this area to the physical size of the antenna. with comment [5 degrees]

b) $\lambda/2$ dipole situated with its center at the origin radiates a time-averaged power of 600 $W$ at a frequency of 300 $MHz$. A second $\lambda/2$ dipole is placed with its center at a point $P$ ($r$, $\theta$, $\varphi$), where $r = 200\ m$, $\theta = 900\varphi = 400$. It is oriented so that its axis is parallel to that of the transmitting antenna. What is the available power at the terminals of the second (receiving) dipole? [5 degrees]

c) Find the Vector potential of a line source of infinite length and constant current $I_0$ is positioned along the z-axis. [5 degrees]