EE 4382/5306 – Antenna Engineering
Test # 3

Nov. 22, 2017

Instructions:

a. **Please keep your cell phone stored in your bag or pocket. No cellphone access during the exam. If you are found using your cellphone, you will be asked to leave the room and will receive a grade of 0 in the test.**

b. **You cannot talk to your classmates during the exam. If you talk to your classmates during the exam, you will be asked to leave the room and will receive a grade of 0 in the test.**

c. **This is a closed book, closed notes, no computer exam. The formula sheet is one page, double-sided, written by you and will be handed at the end along with the test. DO NOT TEAR ANY PAGES FROM THE TEST.**

d. **Put the proper units and prefixes with your answers and use the appropriate sign conventions.**

e. **Show all work, including intermediate steps. Failure to do so will be penalized.**

f. **Write clearly the answer(s) to each question and highlight them or box them. Do all your work on the pages provided. No scrap paper is permitted. You may also use the back of the paper if you run out of space.**

g. **No bathroom breaks during the exam.**

By signing this exam, you agree that the work presented here represents only your effort.

Name: KEY _____ **Signature:** KEY _____

UTEP ID: KEY _____

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1.– Arrays, Broadband and frequency Independent Antennas – Theory (4 points each)

Circle the correct answer for the following statements.

1. The total field of an array of identical elements, neglecting coupling, is referred as

Array Factor Pattern Multiplication Element Pattern

2. The scanning of the array pattern is usually accomplished by controlling primarily

Amplitude distribution Phase Distribution Spacing between elements

3. A Hansen-Woodyard end-fire uniform array leads to a greater:

Half-Power Beamwidth Directivity Scanning Angle

4. To achieve a Hansen-Woodyard end-fire radiation, for a uniform array with large number of elements, the approximate spacing between the elements should be

λ $\lambda/2$ $\lambda/4$

5. Traveling wave antennas are those where, for example, the current travels

In one direction only In two directions only Both, one and two directions

6. In general, traveling wave antennas can be classified as

Fast wave only Slow Wave Only Both fast and slow wave

7. A dipole antenna is considered

Traveling Wave Surface Wave Standing Wave

8. For a V antenna, there is basically an optimum included angle that leads to maximum

Radiation efficiency Directivity Impedance

9. **In general**, helical antennas radiate waves that are

Linearly polarized Circularly Polarized Elliptically Polarized

10. When the pitch angle α of a helix is made 90 degrees, the helix reduces to

Linear dipole Circular Loop Exponential Spiral

11. Antennas whose dimensions are specified by _____ are usually classified as frequency independent.

Angles Length Volume

12. The following are usually classified as frequency independent

Linear dipoles Helical Antenna Spiral Antenna

13. Typically, the bandwidth of a log-periodic dipole antenna is _____ than that of a comparable Yagi-Uda array.

Greater Equal Smaller

14. The lower frequency of the bandwidth of a log-periodic dipole antenna is determined by the length of the

Smaller element Middle Element Larger Element

15. Frequency Independent Antennas usually have bandwidths of

About 2:1 Less than 5:1 More than 10:1

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2.– Linear Antenna Array (40 points)

Design and plot the array factor for an ordinary end-fire, five-element, isotropic, uniformly excited linear array with spacing $d = 0.35\lambda$. Use $\theta = 180^{\circ}$ for direction of maximum radiation.

(a) Find the phase constant β (10 points)
(b) Find the total normalized field E_n (10 points)
(c) Plot the polar pattern for the array factor (20 points)

$\beta = kd$ for $\theta = 180^{\circ}$

a) $kd = \frac{2\pi}{\lambda}(0.35\lambda) = 0.7\pi = \beta$

b) $E_n = E_{isotropic} \cdot AF = 1 \cdot \cos\left[\frac{1}{2}(kd\cos(\theta) + \beta)\right]$

$E_n = \cos(0.35\pi[\cos(\theta) + 1])$

can also use summation formula or sine closed form

c) $N = 5$
$\beta = kd$
$= 0.7\pi$

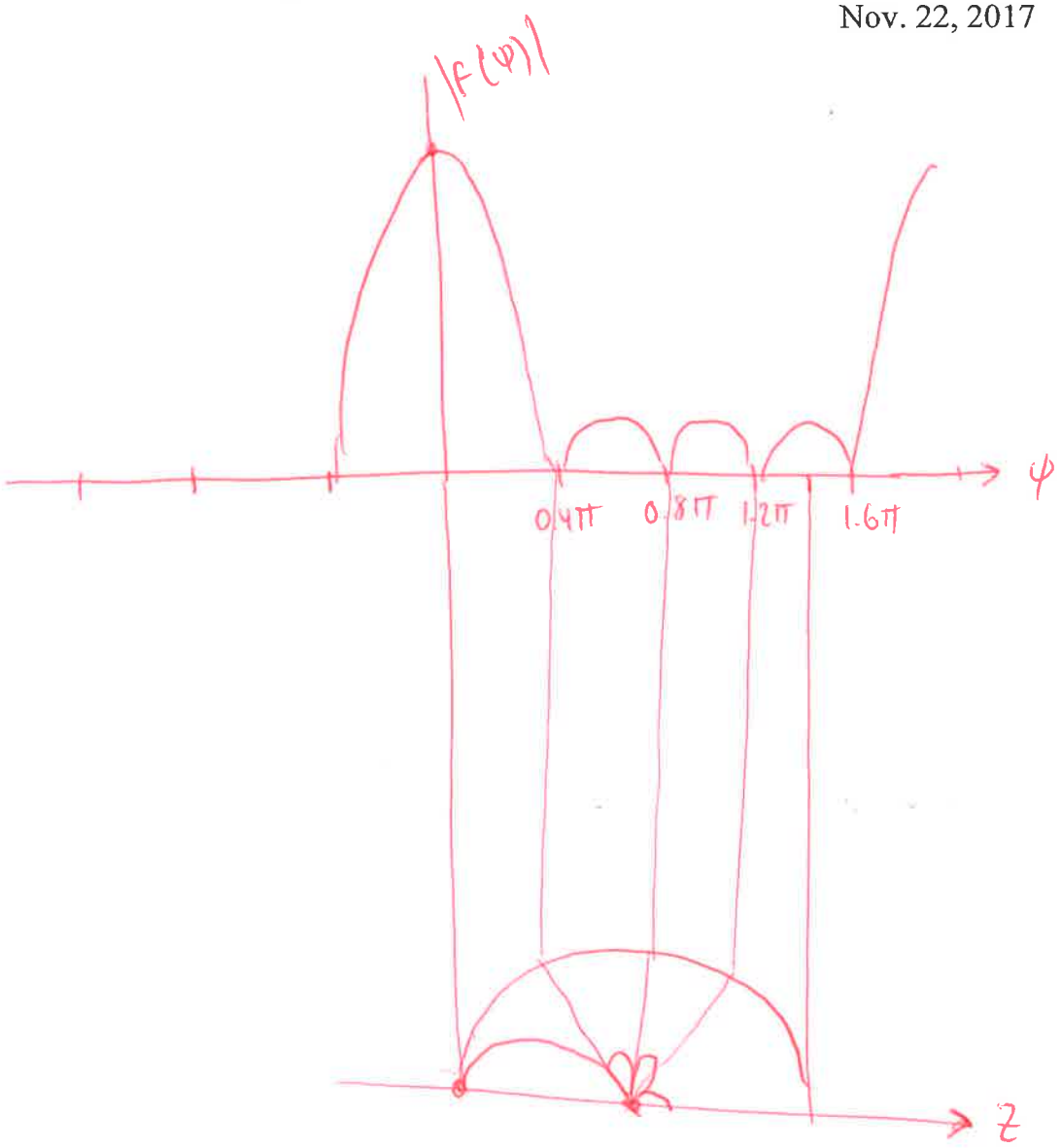
$-0.7\pi \le \psi \le 0.7\pi$

$0 \le \psi \le 1.4\pi$ visible region

minor lobes 3

$\frac{2\pi}{5} = 0.4\pi$

major lobe 0.8π


|F(ψ)|
ψ
0.4π
0.8π
1.2π
1.6π
z