Week 5 Assignment 5

The due date for submitting this assignment has passed. As per our records you have not submitted this assignment.

1) A parasitic array is represented in the figure here. Determine the driving point impedance of the driving element 1 which is fed by an external time-varying source. $Z_{22} = |Z_{22}|e^{j\gamma_2}$ is the self impedance of element 2 and $Z_{12} = |Z_{12}|e^{j\gamma_m}$ is the mutual impedance between 1 and 2 and $Z_{11} = |Z_{11}|e^{j\gamma_1}$ is the self impedance of element 1.

a. $Z_1 = Z_{11} - \frac{|Z_{22}|^2}{|Z_{22}|} e^{2j\gamma_m} - \gamma_2$

b. $Z_1 = Z_{11} + \frac{|Z_{22}|^2}{|Z_{22}|} e^{2j\gamma_m} - \gamma_2$

c. $Z_1 = Z_{11} - \frac{|Z_{12}|^2}{|Z_{22}|} e^{2j\gamma_m} + \gamma_2$

d. $Z_1 = Z_{11} + \frac{|Z_{12}|^2}{|Z_{22}|} e^{2j\gamma_m} + \gamma_2$

No, the answer is incorrect.

Score: 0

Accepted Answers:
a.

2)
For the Yagi-Uda array shown in the right, element 2 has length of $\frac{\lambda}{2}$. The element 1 and 3 are reflector and director of the array respectively. Then, comment on the reactive nature of the director and reflector.

a. Reflector is Capacitive and Director is Inductive
b. Both the reflector and director are inductive
c. Reflector is Inductive and Director is Capacitive
d. Both the reflector and director are capacitive

No, the answer is incorrect.
Score: 0
Accepted Answers:
c.

3) If $F(k_x, k_y) = \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} f(x, y)e^{+j(k_x x + k_y y)}dx dy$ represents the spatial Fourier Transform of a wave $f(x, y)$. Then, the value of $\int_{-\infty}^{\infty} \int_{-\infty}^{\infty} F(k_x, k_y)G^*(k_x, k_y)dk_x dk_y$ will be

a. $\int_{-\infty}^{\infty} \int_{-\infty}^{\infty} f(x, y)g^*(x, y)dxdy$
b. $2\pi \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} f(x, y)g(x, y)dxdy$
c. $4\pi^2 \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} f(x, y)g(x, y)dxdy$
d. $4\pi^2 \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} f(x, y)g^*(x, y)dxdy$

No, the answer is incorrect.
Score: 0
Accepted Answers:
d.
5. Determine the $E_\theta$ component of the radiated electric field from a rectangular aperture shown in the right, if the electric field in the aperture is uniform with amplitude $E_0$ and x-polarized.

\[
\begin{align*}
 a. & \quad E_\theta(r, \theta, \phi) = j \frac{E_0 a b}{2\pi r} \frac{\sin \theta \cos \phi}{\sin \theta} \cdot \frac{\sin \theta \sin \phi}{\sin \theta} \sin \phi \\
 b. & \quad E_\theta(r, \theta, \phi) = j \frac{E_0 a b}{2\pi r} \frac{\sin \theta \cos \phi}{\sin \theta} \cdot \frac{\sin \theta \sin \phi}{\sin \theta} \cos \phi \\
 c. & \quad E_\theta(r, \theta, \phi) = j \frac{E_0 a b}{2\pi r} \frac{\sin \theta \cos \phi}{\sin \theta} \cdot \frac{\sin \theta \sin \phi}{\sin \theta} \cos \phi \\
 d. & \quad E_\theta(r, \theta, \phi) = j \frac{E_0 a b}{2\pi r} \frac{\sin \theta \cos \phi}{\sin \theta} \cdot \frac{\sin \theta \sin \phi}{\sin \theta} \sin \phi
\end{align*}
\]

No, the answer is incorrect.
Score: 0

Accepted Answers:

b.

5) Determine the complex power transmitted by the aperture shown in the right. The aperture is infinitely long along the x-z plane. The electric field at the aperture is given as $E_a = a_y \cdot E_0 \quad -\frac{b}{2} \leq y' \leq \frac{b}{2}$.

\[
\begin{align*}
 a. & \quad \frac{(b\delta_1)^2}{4\pi \eta} \int_{-\infty}^{\infty} \frac{1}{k_1^2} \left| \frac{\sin(k_1 \frac{b}{2})}{k_1} \right|^2 dk_1 \\
 b. & \quad \frac{(b\delta_1)^2}{4\pi \eta} \int_{-\infty}^{\infty} \frac{1}{k_1^2} \left| \frac{\sin(k_1 \frac{b}{2})}{k_1} \right|^2 dk_1 \\
 c. & \quad \frac{(b\delta_1)^2}{8\pi \eta} \int_{-\infty}^{\infty} \frac{1}{k_1^2} \left| \frac{\sin(k_1 \frac{b}{2})}{k_1} \right|^2 dk_1 \\
 d. & \quad \text{none of these}
\end{align*}
\]
A rectangular waveguide of dimensions \( a = 7.21 \text{cm} \) and \( b = 3.41 \text{cm} \) is operating at 3 GHz in dominant mode. Determine the directivity of the aperture.

a. 2.5  
b. 4.5  
c. 3.5  
d. 0.5

No, the answer is incorrect.  
Score: 0  
Accepted Answers:  
a.  
b.  
c.  
d.

Determine the flare angle of an H-plane sectoral horn antenna, operating at 11 GHz. The horn antenna has a directivity of 12.12 dB and fed by a rectangular waveguide having dimensions \( a = 2.286 \text{ cm} \) and \( b = 1.016 \text{ cm} \).

a. 13.75\(^0\)  
b. 15.75\(^0\)  
c. 6.875\(^0\)  
d. 7.875\(^0\)

No, the answer is incorrect.  
Score: 0  
Accepted Answers:  
a.  
b.  
c.  
d.
Determine the distance of the center of the aperture from the apex of the E-plane sectoral horn such that the maximum phase deviation at the aperture of the horn is 45°. The dimension of the aperture is \( b' = 2.5\lambda_0 \).

a. \( 12.5\lambda_0 \)
b. \( 9.1\lambda_0 \)
c. \( 10.3\lambda_0 \)
d. \( 6.25\lambda_0 \)

No, the answer is incorrect.
Score: 0
Accepted Answers:
d.

9) A standard gain X-band pyramidal horn antenna has the dimensions of \( r_1 = 34.29 \text{ cm}, \ r_2 = 36.07, \ a' = 19.43\text{ cm}, \ b' = 14.35 \text{ cm}, \ a = 2.286 \text{ cm} \) and \( b = 1.016 \text{ cm} \). Determine the value of \( \rho_e \) and \( \rho_h \) and comment on the feasibility of realization.

a. \( \rho_h = 35.03, \rho_e = 37.35 \) and Realisable
b. \( \rho_h = 35.03, \rho_e = 37.35 \) and not Realisable
c. \( \rho_e = 35.03, \rho_h = 37.35 \) and Realisable
d. \( \rho_e = 35.03, \rho_h = 37.35 \) and not Realisable

No, the answer is incorrect.
Score: 0
Accepted Answers:
c.

10) A pyramidal horn antenna is designed for optimum gain at frequency of 10 GHz. The overall length of the antenna from the apex of the horn to the center of the aperture is \( 10\lambda \) and is nearly same in both the planes. Determine the Gain of the Antenna in dB.

a. 21.03
b. 12.87
c. 31.64
d. 13.64

a.
b.  
c.  
d.

No, the answer is incorrect.  
Score: 0  
Accepted Answers:  
a.