EE381 HW 10

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```
from numpy import pi, sin, e
f = 400E6
c = 3E8
wavelength = c/f
IO = 3
r = 60
1 = 0.02*wavelength
eta0 = 120*pi
theta = pi/2
k = 2*pi/wavelength
E = 1j*I0*l*k*eta0/4/pi * (e**(-1j*k*r)/r) * sin(theta)
print(f'\setminus[|E| = {abs(E):.2f}\setminus]')
H = E/eta0
print(f'\setminus[|H| = {abs(H)*10000:.0f}\setminus 10^{{-4}})')
RRad = 80*pi**2*(1/wavelength)**2
print(f'\[R_{{rad}} = {RRad:.2f}\Omega\]')
PRad = 1/2 * I0**2 * RRad
print(f'\[P_{{rad}} = {PRad:.2f}W\]')
```

$$|E| = 0.19$$

$$|H| = 5 \cdot 10^{-4}$$

$$R_{rad} = 0.32\Omega$$

$$P_{rad} = 1.42W$$



$$I_0 = 0.331A$$



(a)

(b)

(c)

$$P_{Span} = \frac{\pi R^2}{70} \int_{\theta=60^{\circ}}^{120^{\circ}} \left(\frac{\cos 2\theta}{R}\right)^2 \sin \theta d\theta$$

$$= \frac{1}{120} \int_{60}^{120^{\circ}} \cos^2 2\theta \sin \theta d\theta$$



(a)

```
from numpy import pi, sin, e, sqrt, deg2rad, log10

B = deg2rad(4)
D = 4*pi / B**2
G = 10*log10(D)
print(f'Gain = {round(G, 2)}db')
```

```
(b)
```

```
from numpy import pi, sin, e, sqrt, deg2rad, log10, rad2deg

Bold = deg2rad(4)
Dold = 4*pi / Bold**2
Dnew = Dold * (1+0.5)
Bnew = sqrt(4*pi/Dnew)
Gnew = 10*log10(Dnew)
print(f'\[G = {round(Gnew, 2)}db\]')
print(f'\[\beta = {rad2deg(Bnew):.2f}^{{\circ}}\]')
```

$$G = 35.87db$$
$$\beta = 3.27^{\circ}$$

(c)

$$G = 40.13db$$

$$\beta = 2.00^{\circ}$$

5

(a)

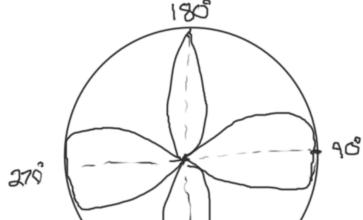
$$F_{A}(G) = \left(\frac{1}{2} \text{ at } e^{\frac{1}{2} i k d \cos \theta}\right)^{2}$$

$$= \left(1 + e^{\frac{1}{2} i k d \cos \theta}\right)^{2}$$

$$= \left(1 + e^{\frac{1}{2} (2\pi/\lambda)(\lambda)} \exp \left(\frac{1}{2} + e^{\frac{1}{2} (2\pi/\lambda)(\lambda)(\lambda)} \exp \left(\frac{1}{2} + e^{\frac{1}{2} (2\pi/\lambda)(\lambda)(\lambda)(\lambda)} \exp \left(\frac{1}{2} + e^{\frac{1}{2} (2\pi/\lambda)(\lambda)(\lambda)(\lambda)} \exp \left(\frac{1}{2} + e^{\frac{1}{2} (2\pi/\lambda)(\lambda)(\lambda)(\lambda)} \exp \left(\frac{1}{2} + e^{\frac{1}{2} (2\pi/\lambda)(\lambda)(\lambda)(\lambda)(\lambda)} \exp \left(\frac{1}{2} + e^{\frac{1}{2} (2\pi/\lambda)(\lambda)(\lambda)(\lambda)(\lambda)} \exp \left(\frac{1}{2} + e^{\frac{1}{2} (2\pi/\lambda)(\lambda)(\lambda)(\lambda)} \exp \left(\frac{1}{2} + e^{\frac{1}{2} (2\pi/\lambda)(\lambda)(\lambda)(\lambda)(\lambda)} \exp \left(\frac{1}{2} + e^{\frac{1}{2} (2\pi/\lambda)(\lambda)(\lambda)(\lambda)(\lambda)} \exp \left(\frac{1}{2} + e^{\frac{1}{2} (2\pi/\lambda)(\lambda)(\lambda)(\lambda)(\lambda)(\lambda)} \exp \left(\frac{1}{2} + e^{\frac{1}{2} (2\pi/\lambda)(\lambda)(\lambda)(\lambda)(\lambda)(\lambda)} \exp \left(\frac{1}{2} + e^{\frac{1}{2} (2\pi/\lambda)(\lambda)(\lambda)(\lambda)(\lambda)(\lambda)(\lambda)} \exp \left(\frac{1}{2} + e^{\frac{1}{2} (2\pi/\lambda)(\lambda)(\lambda)(\lambda)(\lambda$$

(d)

$$F_{A}(\Theta) = 0 = 4\cos^{2}(\pi\cos\Theta)$$
 $\pi n - \frac{\pi}{3} = \pi\cos\Theta$
 $n - \frac{1}{3} = \cos\Theta$
 $\cos^{2}(n - \frac{1}{3}) = \Theta$
 $\Theta = \{2\pi n + \frac{\pi}{3}, 2\pi n + \frac{3\pi}{3}\}$
 $\frac{\pi}{3}, 2\pi - \frac{\pi}{3}, 2\pi \frac{3\pi}{3}, \frac{3$



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