MSMF GATE CENTRE
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Sub: SIGNALS & SYSTEMS
Date: 25-12-16

1. The output of a linear system for a step input is $\frac{t^2e^{-t}}{2}$, then transfer function is

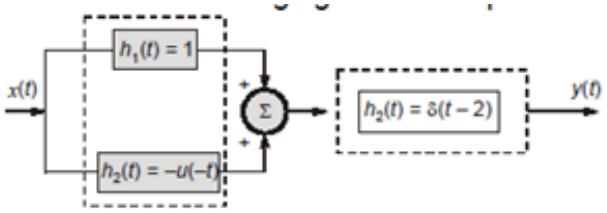
a) $\frac{s}{(s+1)^3}$ b) $\frac{2s}{(s+1)^3}$ c) $\frac{1}{s^2(s+1)}$ d) $\frac{1}{(s+1)^3}$

2. If the step response of a system is given by $A(-n)$, then the impulse response of the same system is

a) $A(-n)+A(-n+1)$ b) $A(-n)-A(-n-1)$

c) $A(-n)-A(-n+1)$ d) $A(-n)+A(-n+1)$

3. Consider the following figure. The impulse response of the entire system is



a) $u(t-2)$ b) $u(t-2)+\delta(t-2)$ c) $u(t-2)-\delta(t-2)$ d) $-u(t+2)+\delta(t-2)$

4. Consider the following relationship $y(t)=\int_{-\infty}^{t+t_0} x(t)dt$, where $t_0<0$. The system is

a) Linear but non causal b) Casual but non linear

c) Both linear and causal d) None of these

5. The Fourier transform $h(n)$ is defined as $H(e^{iw})$, where $h(n)$ is the impulse response of the system whose input is $x(n)$ and output $y(n)$. If $h(n)=3\left(\frac{1}{2}\right)^n u(n)-2\left(\frac{-1}{3}\right)^n u(n)$ then which of the following difference equations represents the system

a) $y(n)=\frac{5}{6}y(n-1)-\frac{1}{6}y(n-2)+x(n)$ b) $y(n)=\frac{1}{6}y-(n-1)-\frac{1}{6}y(n-2)+x(n)+2x(n-1)$

c) $y(n)=\frac{1}{6}y(n-1)+\frac{1}{6}y(n-2)+x(n)+2x(n-1)$ d) $y(n)=\frac{-5}{6}y(n-1)-\frac{1}{6}y(n-2)+x(n)$

6. $x(n)$ is a real and even functions of n with a period $N=8$ has exponential Fourier series coefficients as c_k. If $c_{18}=2$, then c_2 will be

a) 2j b) +2 c) -2 d) -2j

7. If $y(t)=e^{-at}u(-t)$, then $Y(s)$ is

a) $\frac{1}{s+a}$ Re(s)> -a b) $-\frac{1}{s+a}\text{Re}(s)<-a$ c) $-\frac{1}{s+a}\text{Re}(s)>-a$ d) $\frac{1}{s+a}\text{Re}(s)>a$

8. If a signal $p(t)$ is defined as $p(t)=\sum_{k=-\infty}^{\infty}\delta(t-4k)-\delta(t+1-4k)$, then the fundamental period of the signal is

a) 2 b) 4 c) 8 d) Not periodic

9. A continuous time signal $x(t)$ is given by $x(t)=\pi.\delta(t)+\frac{1}{jt}$.

Fourier transform of signal $x(t)$ is given by

a) $2\pi U(\omega)$ b) $2\pi u(-\omega)$ c) $-2\pi u(\omega)$ d) $2\pi u(-\omega)$

10. The relationship between Fourier series coefficient X_k and Y_k of signals $x(n)$ and $y(n)$ respectively is given as $Y_k=\left(1-(-1)^k\right)X_k$. Then which one of the following difference equations represents the relationship between $x(n)$ and $y(n)$.

a) $y(n)=x(n-N)-x(n)$ b) $y(n)=x(n)-x\left(n-\frac{N}{2}\right)$

c) $y(n)=x(n)-x(n-N)$ d) $y(n)=x\left(n-\frac{N}{2}\right)-x(n)$

11. The energy of the signal $x_1(t)=e^{-1}u(t)$ is E_1 and the energy of the signal $x_2(t)=e^{-(2t-1)}u(t)$ is E_2. If $E_2=AE_1$, then the value of A is _____

12. A signal $x(n)$ is defined as

$$x(n)=\begin{cases}5\ ;\ 0\le n<7\\ 0\ ;\ otherwise\end{cases}$$

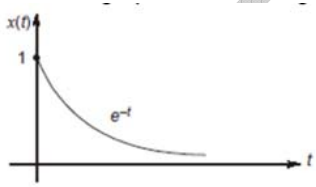
If the discrete time Fourier transform of $x(n)$ is defined as $X(e^{jw})$, then the value of $X(e^{j\pi})$ is _____

13. If Laplace transform of $x(t)$ is $X(s)$ and $X(s)=\int_{-\infty}^{s}\frac{2}{s^2+1}ds$, then $x(0)$ is _____

14. The discrete fourier transform [DFT] of a discrete sequence $x[n]$ is $x[k]=\{6,7,8,9\}$. If the DFT of the sequence $g[n]=x\{n-2\}_{\text{mod }N}+x[-n]_{\text{mod }N}$ is $G[k]$, then $G[1]$ is _____

15. If Laplace transform of $x(t)$ is $X(s)$ and Laplace transform of $e^{-2t}x(t)$ is $X(s-s_0)$, then the value of s_0 is _____

16. The average power of the signal shown below is



17. Consider the following statements for N point DFT $X(k)$ of the real valued discrete time sequence $x(n)$. Which of the statements are true ?

a) $X(0)=\sum_{n=0}^{N-1}x(n)$ b) $X\left(\frac{N}{2}\right)=\sum_{n=0}^{N-1}(-1)^n x(n)$, for N being even

c) $X(k)=X^{+}(N-K)$ d) All of the above

18. Let $(n)=4^n u(n)-b^{2n}u(-n-1)$. If the 'z' transform of $x(n)$ exists, then the condition on b is

a) $b>2$ b) $|b|>2$ c) $-2<b<2$ d) No value of 't' is possible

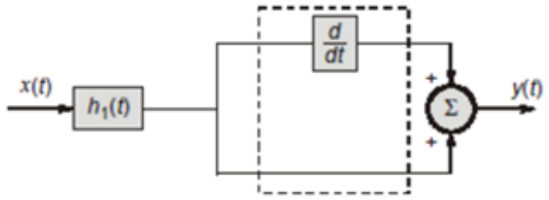
19. A baseband signal $x(t)$ has maximum frequency $f_m=40\,kHz$. The signal is sampled at a rate f_S and passed through an ideal low pass filter with cutoff frequency 50 kHz. Minimum sampling frequency required, to avoid distortion in the reproduced signal is

a) $80\ kHz$ b) $90\ kHz$ c) $100\,kHz$ d) $110\,kHz$

20. Even part of the signal $x(n)$ whose Fourier transform is given as $x(e^{jw}) = 1 + \cos\omega$ is

a) $\left\{\frac{1}{2}, \underset{\uparrow}{1}, \frac{1}{2}\right\}$ b) $\left\{\frac{1}{2}, \underset{\uparrow}{1}, \frac{1}{2}\right\}$ c) $\{1, \underset{\uparrow}{2}, 1\}$ d) $\{\underset{\uparrow}{1}, 2, 1\}$

21. Consider the system shown below



If $h_1(t) = e^{-t}u(t)$, then the impulse response of the entire system is

a) $e^{-t}\,u(t)$ b) $2e^{-t}\,u(t) + \delta(t)$ c) $\delta(t)$ d) None of these

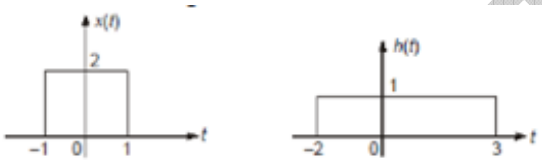
22. If $X(s) = e^{-5s}\left(\frac{-2}{s(s+2)}\right)$ then the initial and final values of $x(t)$ are

a) $-1, 10$ b) $10, -1$ c) $-1, 0$ d) $0, -1$

23. If $x_1(t) = e^{-2t}u(t)$ and $x_2(t) = e^{-3t}u(t)$ are related to $y(t)$ as $y(t) = x_1(t-2) * x_2(-t+3)$ then $Y(s)$ is

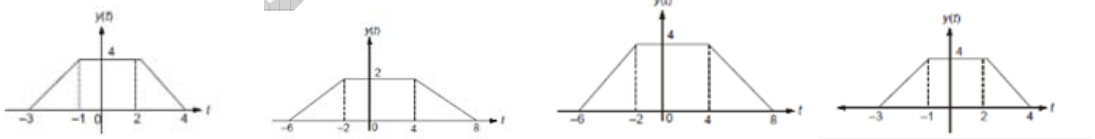
a) $\frac{e^{-5s}}{(s+2)(s-3)}$ b) $\frac{e^{-5s}}{(s+2)(3-s)}$ c) $\frac{e^{s}}{(s+2)(s+3)}$ d) $\frac{e^{+5s}}{(s+2)(s+3)}$

24. Consider the two signals shown below.



If $x\left(\frac{t}{2}\right)$ is convolved with $b\left(\frac{t}{2}\right)$. Then which of the following represents the resultant signal

a)



25. The input $x(t) = 5\sin\left(2t + \frac{\pi}{4}\right)$ is given to a system with impulse response $h(t) = te^{-|t|}$. The output $y(t)$ under steady state condition will be

a) $1.31(\cos 2t - \sin 2t)$ b) $1.31(\sin 2t - \cos 2t)$

c) $1.13(\cos 2t - \sin 2t)$ d) $1.13(\sin 2t - \cos 2t)$

26. Which of the following is the difference equation of the FIR filter of length N, input $x(n)$ and output $y(n)$?

a) $y(n) = \sum_{k=0}^{N+1} b_k\; x(n+k)$ b) $y(n) = \sum_{k=0}^{N+1} b_k\, x(n-k)$

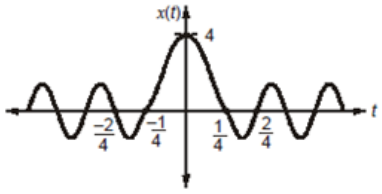
c) $y(n) = \sum_{k=0}^{N-1} b_k\, x(n-k)$ d) None of these

27. For a discrete time signal $x(n)$, the z-transform is defined as $X(z)$. If $x(n)$ is defined as

$$x(n)=\begin{cases}\dfrac{(2)^{-n}}{n!} & ;\ n\geq 0\\ 0 & ;\ Otherwise\end{cases}$$

Then the value of $X(1)$ is _____

28. Consider a since pulse $x(t)$ shown below.



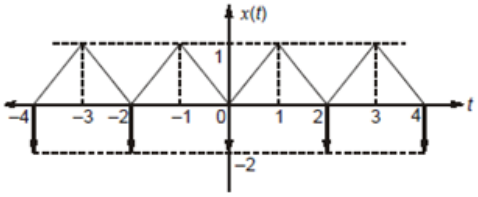
The energy of the signal $x\left(\dfrac{-3t-1}{2}\right)$ is _____

29. For the impulse response $h(n)$ of the system $H(z)$ is given as

$$H(z)=\frac{Y(z)}{X(z)}=\frac{1-\frac{1}{4}z^{-1}}{1-\frac{1}{2}z^{-1}}$$

If input to the system is $x(n)=3^n$, then $y(-2)$ is _____

30. For the figure shown below, the trigonometric Fourier series coefficient is given as a_k. Then the value of "$-a_2$" is _____



31. Consider a discrete time sequence $x(n)$ and its DFT (discrete fourier transform) as $X(k)$. If $x(n)=\{2,1,3,4\}$ then $\prod_{k=0}^{3}X(k)=$ _____

32. For a discrete time LTI system, the input signal $x(n)=\underset{\uparrow}{\{1,2,3,4\}}$ and the output signal $y(n)=\underset{\uparrow}{\{3,6,9,12\}}$. If the unit impulse response of the given system is $h(n)$, then the value of summation $\sum_{n=-\infty}^{\infty}x(n)h(n)$ will be _____

33. The value of integral *I* is _____

$$I=\int_{-\infty}^{\infty}e^{-(2t-t)}.\delta\left(t-\frac{1}{2}\right)\sin^2\left(\frac{\pi}{2}t\right)dt$$

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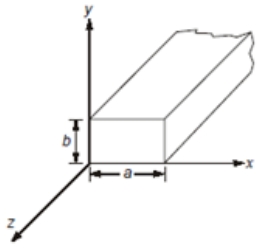
1. 

Consider the rectangular waveguide shown in the above figure. If $b > a$, the dominant mode of the waveguide is

a) TE_{10} b) TE_{01} c) TM_{01} d) Both (b) and (c)

2. A conductor of length 4m long lies along the y-axis with a current of 10 A in the a_y direction. The force on the conductor if the magnetic flux density in the region $\overline{B} = 0.05 a_x T$ is

a) $2\ a_z N$ b) $-2\ a_z N$ c) $2 a_y N$ d) $-2\ a_y N$

3. The displacement current J_d is

a) hypothetical b) dominant at low frequencies

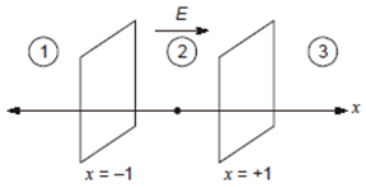
c) dominant at high frequencies d) dominant in time independent case

4. The vector transformation between cylindrical and spherical coordinates is given below. The expression for $A + B$ is _____

$$\begin{bmatrix} A_r \\ A_\theta \\ A_\phi \end{bmatrix} = \begin{bmatrix} A & 0 & B \\ \cos\theta & 0 & -\sin\theta \\ 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} A_\rho \\ A_\phi \\ A_z \end{bmatrix}$$

a) $\cos\theta + \sin\theta$ b) $-\cos\theta + \sin\theta$ c) $-\sin\theta + \cos\theta$ d) $-\sin\theta - \cos\theta$

5. Two infinite uniform sheets of charge, each located at x = -1 and x = +1, with charge density as $-\rho_s$ and ρ_s respectively. The electric field intensity $\vec{E}$ in region (2) is



a) $\frac{\rho_s}{\epsilon_0} a_x$ b) 0 c) $\frac{-\rho_s}{\epsilon_0} a_x$ d) $-\frac{\rho_s}{2\epsilon_0} a_x$

6. If $\vec{A}$ is the magnetic vector potential, then the units of line integral of $\vec{A}$ i.e. $\oint \vec{A}.\vec{dl}$ is given by

a) Wb b) $\frac{wb}{m}$ c) $\frac{wb}{m^2}$ d) $Wb - m^2$

7. Consider a point charge 'Q' at origin. The divergence of electric flux density vector at a radial distance 'r' is

a) $\frac{Q}{4\pi}$ b) 1 c) 0 d) $\frac{Q}{4\pi r}$

8. The units of $\left(\overline{E}\times\overline{H}\right)$ is

(where $\overline{E}$ is electric field intensity and $\overline{H}$ is magnetic field intensity)

a) Watts b) Watts/meter c) Watts/(meter)² d) Watts (meter)³

9. Fraday's law is valid for both open loop and closed loop. The Lenz's law is valid for

a) Only open loop b) Only closed loop c) Both open and closed loop d) None

10. The electric field component of a plane wave in a certain lossy medium is given by $\vec{E}=25e^{\frac{z}{50}}\cos\left(1.5\times10^{8}t-2\pi z\right)\hat{y}V/m$. The propagation constant (in m^{-1}) of the medium is given by

a) $50-j2\pi$ b) $50+j2\pi$ c) $0.02+j2\pi$ d) $0.02-j2\pi$

11. An end – fire array consisting of several half wavelength long isotropic radiators is to have a directive gain of 30. Beam width between first nulls (BWFN) is given by _____ (degrees)

12. What is the value of standing wave ratio (SWR) in free space for reflection coefficient $\Gamma=\frac{-1}{3}$?

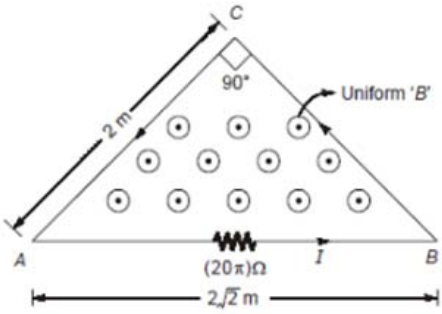
13. A non magnetic medium has an intrinsic impedance of $350<30^{o}\,\Omega$. The loss tangent is _____

14. Given a vector $\vec{A}$ in spherical coordinates as $\vec{A}=5\sin\theta\,a_{\theta}+5\sin\phi a_{\theta}$. The divergence of $\vec{A}$ il.e., $\nabla\cdot\vec{A}$ at $\left(r=1,\theta=\frac{\pi}{2},\phi=\frac{\pi}{3}\right)$ is _____

15. For a sinusoidal current distribution, the ratio of physical length and effective length of an antenna is _____

16. For a transmission line, the power attenuation is given as 0.6 dB/km. After 10 km, the output power is _____ times that of input power.

17. Consider the figure shown below. Let the magnetic flux density (coming out of the plane of the paper) $B=10\cos120\pi t\left(mWb/m^{2}\right)$, and assume that the magnetic field produced by current 'I' shown in the figure is negligible. The maximum value of I is



a) 0.12 A b) 0.48 A c) 0.24 A d) 0.36 A

18. A uniform plane wave in air is normally incident on a dielectric material $\left(\sigma=0,\mu_{r}=1,\in_{r}=3\right)$. The transmitted wave is given by $7.32\cos\left(\omega t-z\right)a_{y}\ V/m.$ The incident wave expression is _____

a) $5.8\cos\left(\omega t+z\right)ayV/m$ b) $10\cos\left(\omega t-z\right)ayV/m$

c) $5.8\cos\left(\omega t-z\right)ay\ V/m$ d) $10\cos\left(\omega t+z\right)ay\ V/m$

19. In a non magnetic medium, the electric field of an EM wave is $\overline{E} = 6\sqrt{\pi}\sin\left(2\pi\times10^8 t - \frac{8\pi}{3}x\right)a_z\ V/m$. The total power crossing through a square plate of side 10 cm of plane $x+y=1$ is

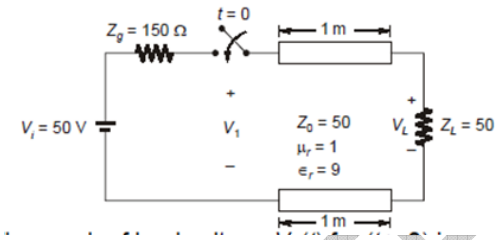
a) 10 mW b) $8.48\ mW$ c) $4.24\,mW$ d) $2.12\ mW$

20. An antenna consists of 4 identical Hertzian dipoles uniformly located along the z-axis and polarized in 'z' direction. The spacing between the dipoles is $\frac{\lambda}{4}$. The group pattern function is ()Assume initial phase difference between the dipoles is zero degrees)

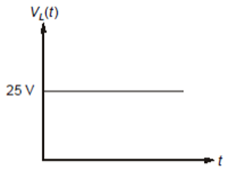
a) $4\cos\left(\frac{\pi}{4}\cos\theta\right)\cos\left(\frac{\pi}{2}\cos\theta\right)$ b) $4\cos\left(\frac{\pi}{4}\cos\theta\right)\cos\left(\frac{\pi}{8}\cos\theta\right)$

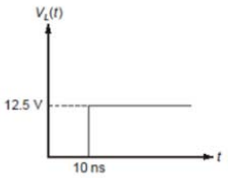
c) $4\cos\left(\frac{\pi}{4}\cos\theta\right)\sin\left(\frac{\pi}{2}\cos\theta\right)$ d) $4\cos\left(\frac{\pi}{4}\cos\theta\right)\sin\left(\frac{\pi}{8}\cos\theta\right)$

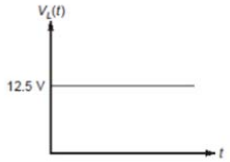
21. Consider the following transmission line of length 1m as shown below. The switch is closed at $t=0$

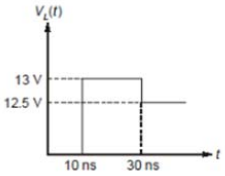


The graph of load voltage $V_L(t)\ for\ (t>0)$ is

a) 

b) 

c) 

d) 

22. In air – filled rectangular waveguide, a TE mode operating at 6 GHz has electric field component

$$E_y = 15\sin\left(\frac{2\pi x}{a}\right)\cos\left(\frac{\pi y}{b}\right)\sin(\omega t - 12z)V/m$$

.

The cutoff frequency of the corresponding TE mode waveguide is _____

a) $5.56\,GHz$ b) $6.13\ GHz$ c) $5.97\ GHz$ d) $5.37\ GHz$

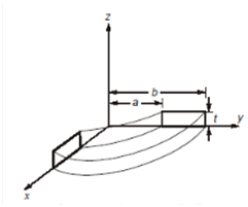
23. An electromagnetic wave travelling in a vaccum has the electric field component given by $\vec{E} = 50\sin(\omega t + 6x - 8y)\,\hat{z}\ mV/m$. The frequency of the wave is

a) 1 GHz b) 318 MHz c) 955 MHz d) 438 MHz

24. The electric field in medium-1 for $z<0$ (characterized by $\in_{r1}=4, \mu_{r1}=1$) is given by $\vec{E}(z<0) = 5a_x - 2a_y + 3a_z\ V/m$. The electric field in medium – 2 $\vec{E}(z>0)$ for $z>0$ (characterized by $\in_{r1}=3, \mu_{r1}=1$) is given by

a) $5a_x - 2a_y + 0.25a_z\ V/m$ b) $5a_x + 2a_y + 0.25a_z\ V/m$

c) $5a_x - 2a_y + 4a_z\ V/m$ d) $-5a_x + 2a_y + 4a_z\ V/m$

25. 

A metal bar of conductivity 'σ' is bent to form a flat 90^o sector of inner radius 'a', and outer radius 'b' and thickness 't' as shown. The resistance of the bar between the two horizontal surface at z = 0 and z = t is ____

a) $\dfrac{2t}{\sigma x \ln\left(\dfrac{b}{a}\right)}$ b) $\dfrac{4t}{\sigma x \ln\left(\dfrac{b}{a}\right)}$ c) $\dfrac{2t}{\sigma\pi\left(b^2-a^2\right)}$ d) $\dfrac{4t}{\sigma\pi\left(b^2-a^2\right)}$

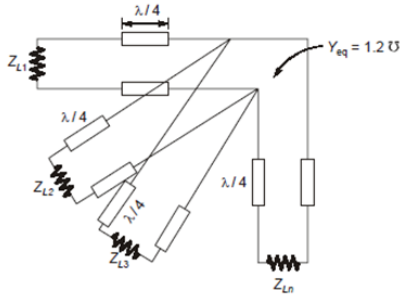
26. Laplace's equation is valid

a) only in free space b) only in charge free dielectric regions

c) only in conductors d) both (a) and (b)

27. A 50Ω lossless line has $V_L = 15e^{/25^\circ}V$ and $Z_L = 75e^{/30^\circ}\Omega$. The current at a distance $\dfrac{\lambda}{n}$ (n being natural number) from load is $0.2e^{j40^\circ}A.$ The value n is _____

28. Consider 'n' 50Ω and $\dfrac{\lambda}{4}$ length loss less lines as shown in figure. All are connected and terminated by $ZL_1 = 25\Omega, Z_{L2} = 50\Omega, Z_{L3} = 75\Omega, Z_{L4} = 100\Omega,$ $_{ZL5} = 125\Omega$ and $Z_{Ln} = (25n)\Omega$



If $Y_{eq} = 1.2\upsilon$, then the value of n is _____

29. A silver coated brass waveguide is operating at 12 GHz. If the minimum thickness of silver coating $(\sigma = 6.1\times10^7\ S/m)$ is 5δ (where δ is the skin depth), the minimum thickness required for waveguide is _____ µm.

30. The core radius of a multimode optical fibre operating at wavelength of 850 nm is 'a'. The core index and cladding index are 1.47 and 1.45 respectively. If V – number is 90, then the core radius 'a' is _____ µm.

31. A radar operating at $f\ GHz$ radiates 100 kW. The receiving antenna is placed at a distance of 1 km from radiating / transmitting antenna, and receives a power of 1 mW. Assuming gain of transmitting antenna and receiving antenna is 10. (i.e. $G_t = G_r = 10$), the value of f is _____ GHz.

32. The radiation intensity of a certain antenna is

$U(\theta,\phi) = 2\sin\theta;$ for $0 < \theta < \pi/2, 0 < \phi < 2\pi$

= 0; otherwise

The directivity of the antenna is _____

33. A time-harmonic electric field causes a conduction current of 1 A at $f\ Hz$ in a medium $(\in = 2\in_0, \mu = \mu_0, \sigma = 60\,mho/m)$ and displacement current of $8.8*10^{-11}A.$ The value of f is _____ Hz.