電磁波與天線導論 HW1

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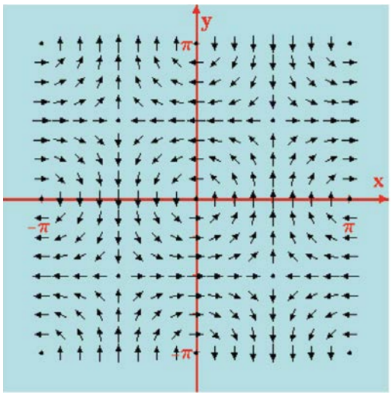
(a)

$A = -\hat{x}cos(x)sin(y) + \hat{y}sin(x)cos(y)$

$\nabla \cdot A = (\hat{x}\frac{\partial}{\partial x} + \hat{y}\frac{\partial}{\partial y}) \cdot (-\hat{x}cos(x)sin(y) + \hat{y}sin(x)cos(y)) = 0 < Ans >$

A的散度為0，代表A在邊界的通量為0，與下圖相符

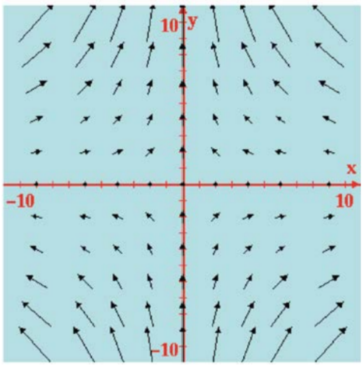


(b)

$A = -\hat{x}xy + \hat{y}y^2$

$\nabla \cdot A = (\hat{x}\frac{\partial}{\partial x} + \hat{y}\frac{\partial}{\partial y}) \cdot (-\hat{x}xy + \hat{y}y^2) = y < Ans >$

A的散度為y，代表A在邊界的通量與y有關，與下圖相符

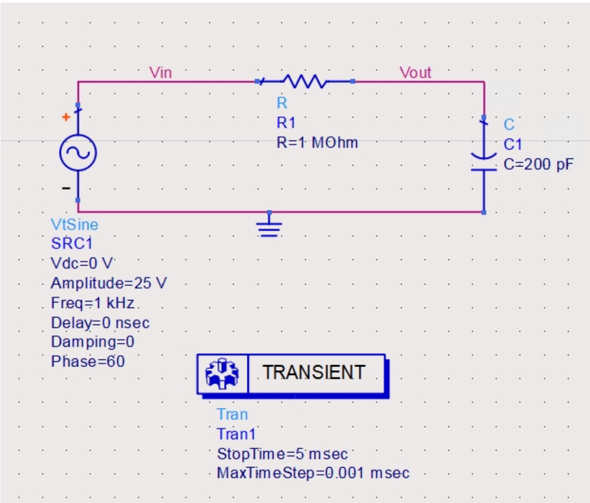


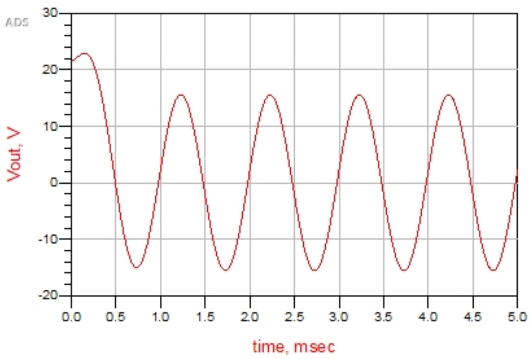
2

$$\begin{aligned} V_s(t) &= 25cos(2\pi \times 10^3 t - 30^\circ) \\ &= 25sin(2\pi \times 10^3 t - 30^\circ + 90^\circ) \end{aligned}$$

$$\begin{gathered} V_s = IR + V_c, \quad where \quad I = C\frac{dV_c}{dt} \\ Take \quad Laplace \quad transform, we \quad can \quad get \\ V_c(s) = \frac{V_s(s) + V_c(0)}{RCs + 1} \\ from \quad inverse \quad laplace \quad transform, then \quad we \quad get \quad V_c(t). \end{gathered}$$

ADS模擬





Matlab計算

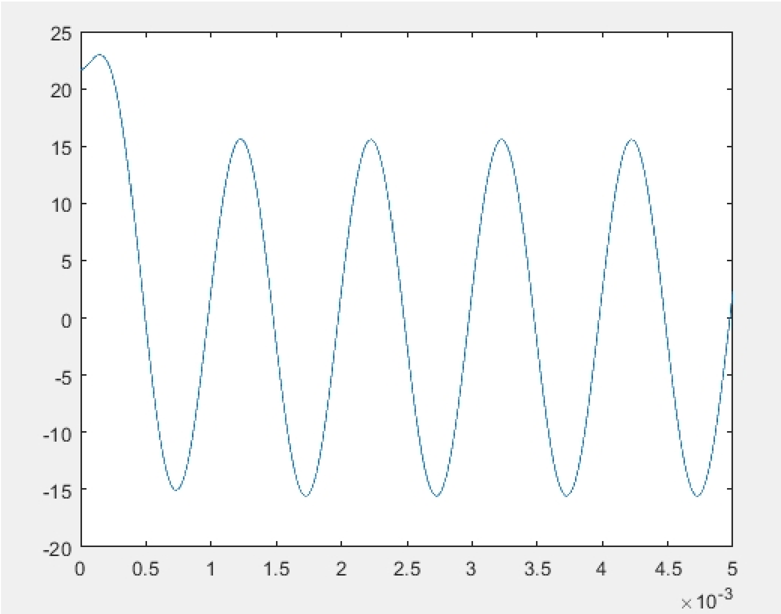
```
clear;close all;
syms R C t s

Vs_t = 25*sin(2*pi*1000*t+pi/3);     % Vs(t)
Vs_s = laplace(Vs_t);                % Vs(s)
G_s = 1/(R*C*s+1);                   % G(s) = Vc(s)/Vs(s)
Vc_0 = subs(Vs_t,t,0);               % initial condition

Vc_s = (Vs_s+R*C*Vc_0)*G_s;
Vc_t = ilaplace(Vc_s,s,t)

t = 0:1e-6:5e-3;
Vc_t = subs(Vc_t,R,1e6);
Vc_t = subs(Vc_t,C,200*(1e-12));
Vc = subs(Vc_t,t);
plot(t,Vc);
```

結果



3

$$
\begin{aligned}
&E_{1t} = E_{2t} \\
&\Rightarrow E_{1x} = E_{2x}, E_{1y} = E_{2y} \\
&\varepsilon_1 E_{1n} - \varepsilon_2 E_{2n} = \rho_s \\
&\Rightarrow 2\varepsilon_0 E_{1z} - 18\varepsilon_0 E_{2z} = \rho_s \\
&\Rightarrow E_{1z} = 19.8941 (V/m) \\
&\Rightarrow E_1 = \hat{x}3 - \hat{y}2 + \hat{z}19.8941 (V/m) - < Ans > \\
&\Rightarrow \theta_2 = 60.9829^\circ, \quad \theta_1 = 10.2726^\circ - < Ans >
\end{aligned}
$$