

Practice3 Report

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Quick View

In today's Report,I will show following things by order:

- 1.Code that can change the question to solve displaced by picture.
- 2.Model that universal for question 1, 2, 3.
- 3.Graph and calculation corresponding to questions and ω .

(I'm tired of using OpenDocument.Hope L^AT_EX can make my format better.)

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1 Code

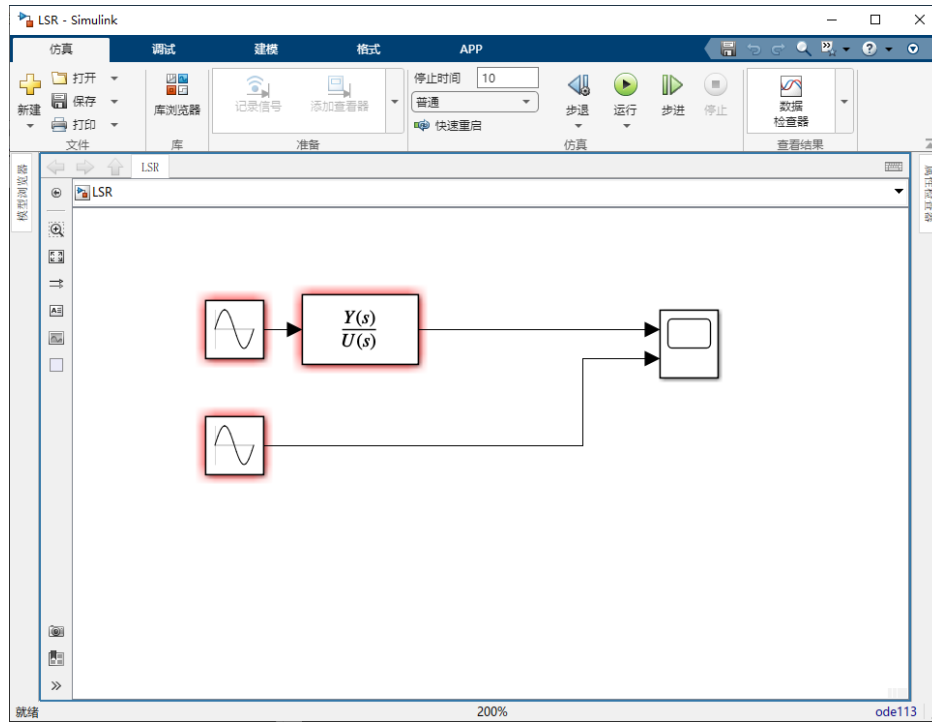
```

1 k = 1 + 7;
2 w = 3;
3 question = 4;
4
5 switch question
6
7     case 1
8         phi0 = pi/6;
9         A0 = 6;
10        P = 4/(3*w^2+12);
11        Q = -2*w/(3*w^2+12);
12        A = AB*sqrt(Q^2+P^2);
13        phi = phi0+atan2(Q,P);
14        b0=0;
15        b=b0;
16        Division = [3 6];
17        Upper = [2];
18
19     case 2
20        phi0 = pi/6;
21        A0 = 6;
22        P = -4/9*(w+2)*(w-2)/((w+2)*(w-2)^2+16*w^2);
23        Q = -4/9*4*w/((w+2)*(w-2)^2+16*w^2);
24        A = AB*sqrt(Q^2+P^2);
25        phi = phi0+atan2(Q,P);
26        b0=0;
27        b=b0;
28        Division = [9 36 36];
29        Upper = 4;
30
31     case 3
32        A0 = 1;
33        phi0 = k*10/100*pi*pi/2;
34        P = 18*(18-2*w^2)/((18-2*w^2)^2+9*w^2);
35        Q = 18*(-3)*w/((18-2*w^2)^2+9*w^2);
36        A = AB*sqrt(Q^2+P^2);
37        phi = phi0+atan2(Q,P);
38        b0=k;
39        b=b0;
40        Division = [2 -3 18];
41        Upper = 18;
42
43     case 4
44        Upper = 18;
45
46 end

```

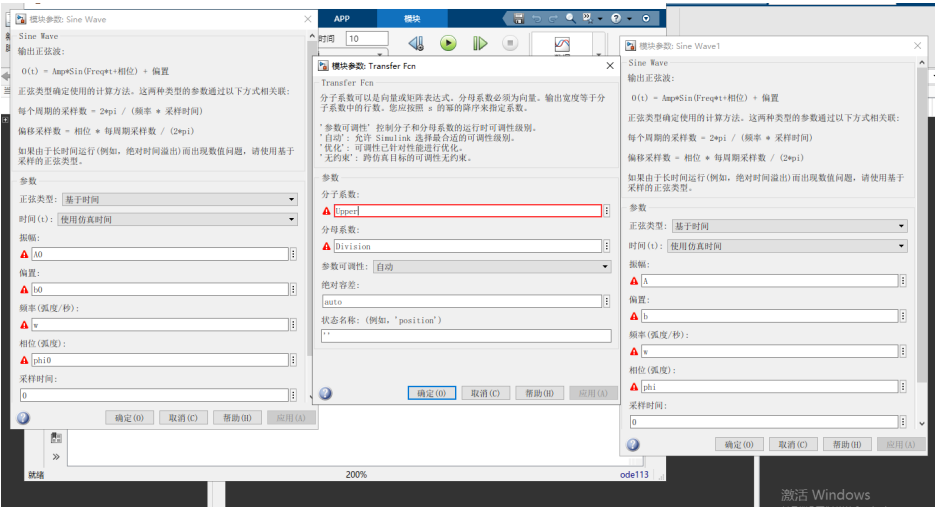
2 Model

Main



Detail

Here are more information of each model and shows which variable is used.



3 Answers

3.1 Question1

3.1.1 Calculation

$$3\dot{y}(t) + 6y(t) = 2u(t)$$

Do laplace transform get:

$$y(s) = \frac{2}{3s + 6}u(s)$$

$$W(s) = \frac{2}{3s + 6}$$

Let $s = j\omega$.

$$W(j\omega) = \frac{2}{3j\omega + 6}$$

$$W(j\omega) = \frac{2(6 - 3j\omega)}{36 + 9\omega^2}$$

$$P(\omega) = \text{Re}(W(j\omega)) = \frac{12}{36 + 9\omega^2}$$

$$Q(\omega) = \text{Im}(W(j\omega)) = \frac{-6\omega}{36 + 9\omega^2}$$

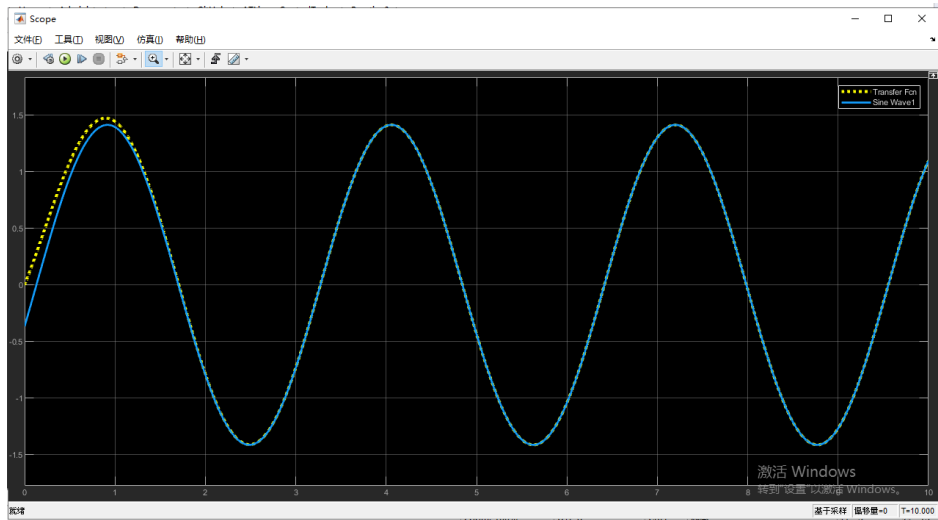
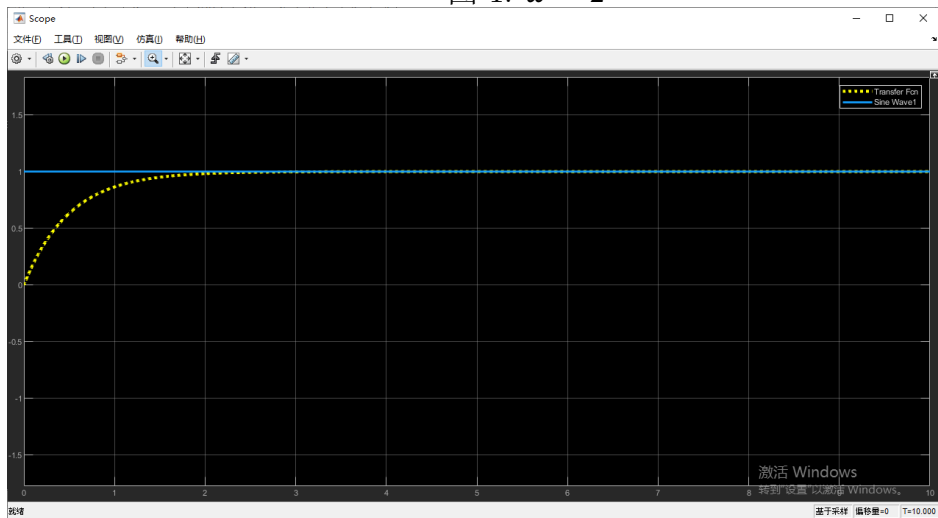
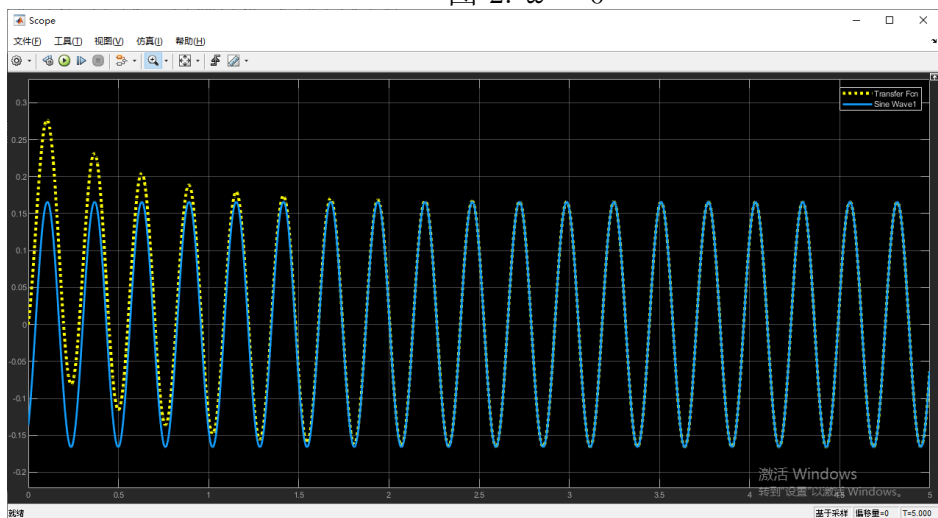
$$A(\omega) = \sqrt{P(\omega)^2 + Q(\omega)^2} = \frac{\sqrt{144 + 36\omega^2}}{36 + 9\omega^2}$$

$$\phi(\omega) = \text{atan2}(Q(\omega), P(\omega))$$

If $u(t) = A\sin(\omega t + \phi_0) + b_0$

$$y(t) = A(\omega)A_0\sin(\omega t + \phi_0 + \phi(\omega)) + b_0$$

3.1.2 Graph

图 1: $\omega = 2$ 图 2: $\omega = 0$ 图 3: $\omega = 3k$

3.2 Question2

3.2.1 Calculation

$$9\ddot{y}(t) + 36\dot{y}(t) + 36y(t) = 4u(t)$$

Do laplace transform get:

$$y(s) = \frac{4}{9s^2 + 36s + 36}u(s)$$

$$W(s) = \frac{4}{9s^2 + 36s + 36}$$

Let $s = j\omega$.

$$W(j\omega) = \frac{4}{-9\omega^2 + 36j\omega + 36}$$

$$W(j\omega) = \frac{4(-9\omega^2 + 36 - 36j\omega)}{(36 - 9\omega^2)^2 + (36\omega)^2}$$

$$P(\omega) = \text{Re}(W(j\omega)) = \frac{4(-9\omega^2 + 36)}{(36 - 9\omega^2)^2 + (36\omega)^2}$$

$$Q(\omega) = \text{Im}(W(j\omega)) = \frac{4(-36\omega)}{(36 - 9\omega^2)^2 + (36\omega)^2}$$

$$A(\omega) = \sqrt[2]{P(\omega)^2 + Q(\omega)^2} = \frac{4\sqrt{(36 - 9\omega^2)^2 + (36\omega)^2}}{(36 - 9\omega^2)^2 + (36\omega)^2}$$

$$\phi(\omega) = \text{atan2}(Q(\omega), P(\omega))$$

If $u(t) = A\sin(\omega t + \phi_0) + b_0$

$$y(t) = A(\omega)A_0\sin(\omega t + \phi_0 + \phi(\omega)) + b_0$$

3.2.2 Graph

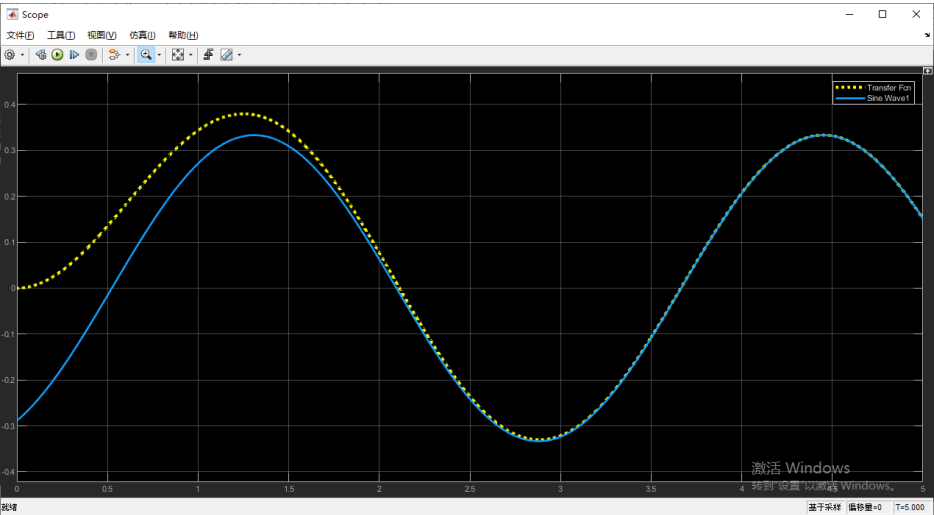


图 4: $\omega = 2$

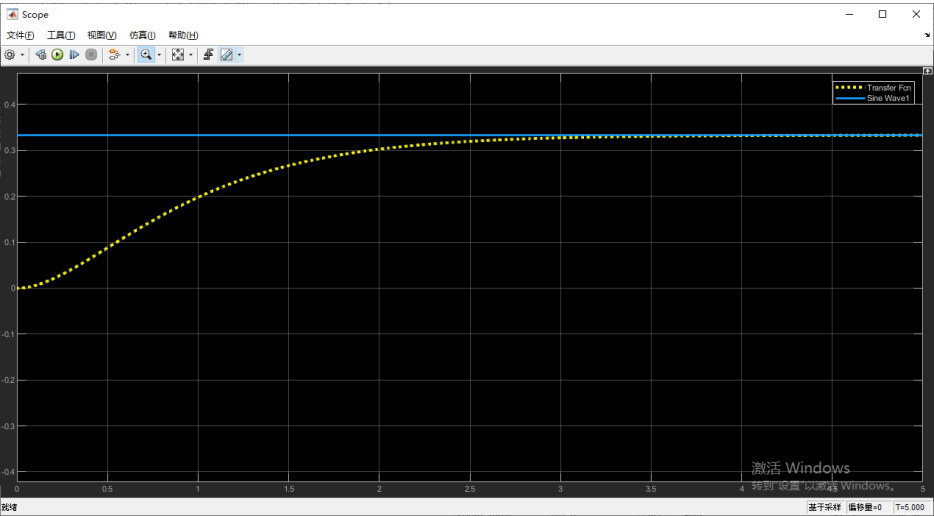


图 5: $\omega = 0$

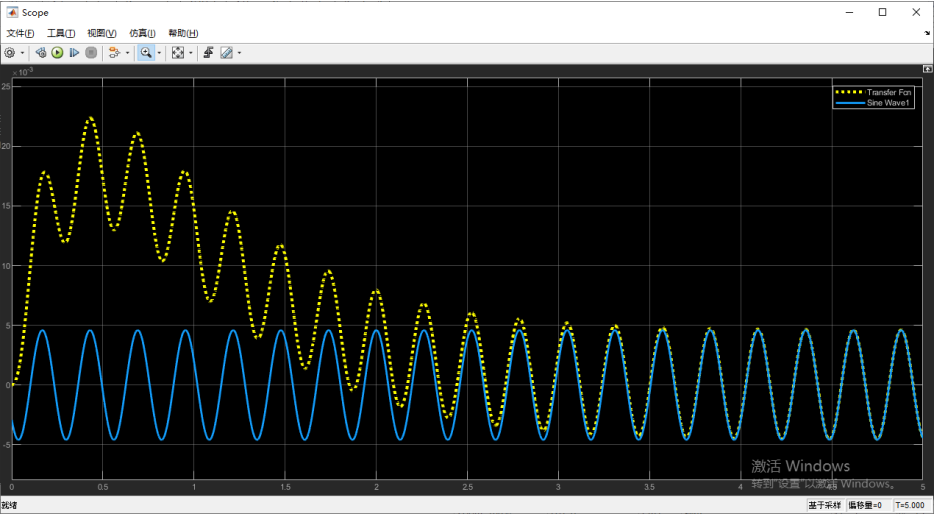


图 6: $\omega = 3k$

3.3 Question3

3.3.1 Calculation

$$2\ddot{y}(t) + 3\dot{y}(t) + 18y(t) = 18u(t)$$

Do laplace transform get:

$$y(s) = \frac{18}{2s^2 + 3s + 18}u(s)$$

$$W(s) = \frac{18}{2s^2 + 3s + 18}$$

Let $s = j\omega$.

$$W(j\omega) = \frac{18}{-2\omega^2 + 3j\omega + 18}$$

$$W(j\omega) = \frac{18(-2\omega^2 + 18 - 3j\omega)}{(18 - 2\omega^2)^2 + (9\omega)^2}$$

$$P(\omega) = \text{Re}(W(j\omega)) = \frac{18(-2\omega^2 + 18)}{(18 - 2\omega^2)^2 + (9\omega)^2}$$

$$Q(\omega) = \text{Im}(W(j\omega)) = \frac{18(-3\omega)}{(18 - 2\omega^2)^2 + (9\omega)^2}$$

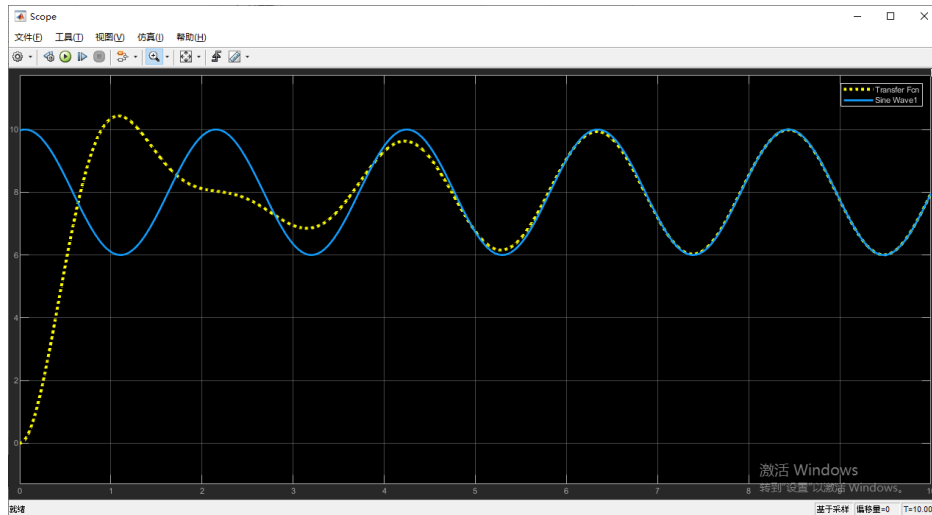
$$A(\omega) = \sqrt[2]{P(\omega)^2 + Q(\omega)^2} = \frac{18\sqrt{(18 - 2\omega^2)^2 + (9\omega)^2}}{(18 - 2\omega^2)^2 + (9\omega)^2}$$

$$\phi(\omega) = \text{atan2}(Q(\omega), P(\omega))$$

$$u(t) = A\sin(3t + \frac{\pi}{2} + \frac{10k\pi}{180}) + k$$

$$y(t) = A(3)\sin(3t + \frac{\pi}{2} + \frac{10k\pi}{180}) + k = 2\sin(3t + \frac{\pi}{2} + \frac{10k\pi}{180}) + k$$

3.3.2 Graph



3.4 Question4

3.4.1 Failed

Reason:

Let $u(t) = 0$.

Think about how to solve $2\ddot{y} - 3\dot{y} + 18 = 0$.

And then consider about equation $2\lambda^2 - 3\lambda + 18 = 0$.

Get that

$$\operatorname{Re}(\lambda) = \frac{3}{4} > 0$$

Then the system is **unstable**. So our method **Failed**.

3.4.2 Graph

