Practice2 Report 22320607 Xu Ziyang

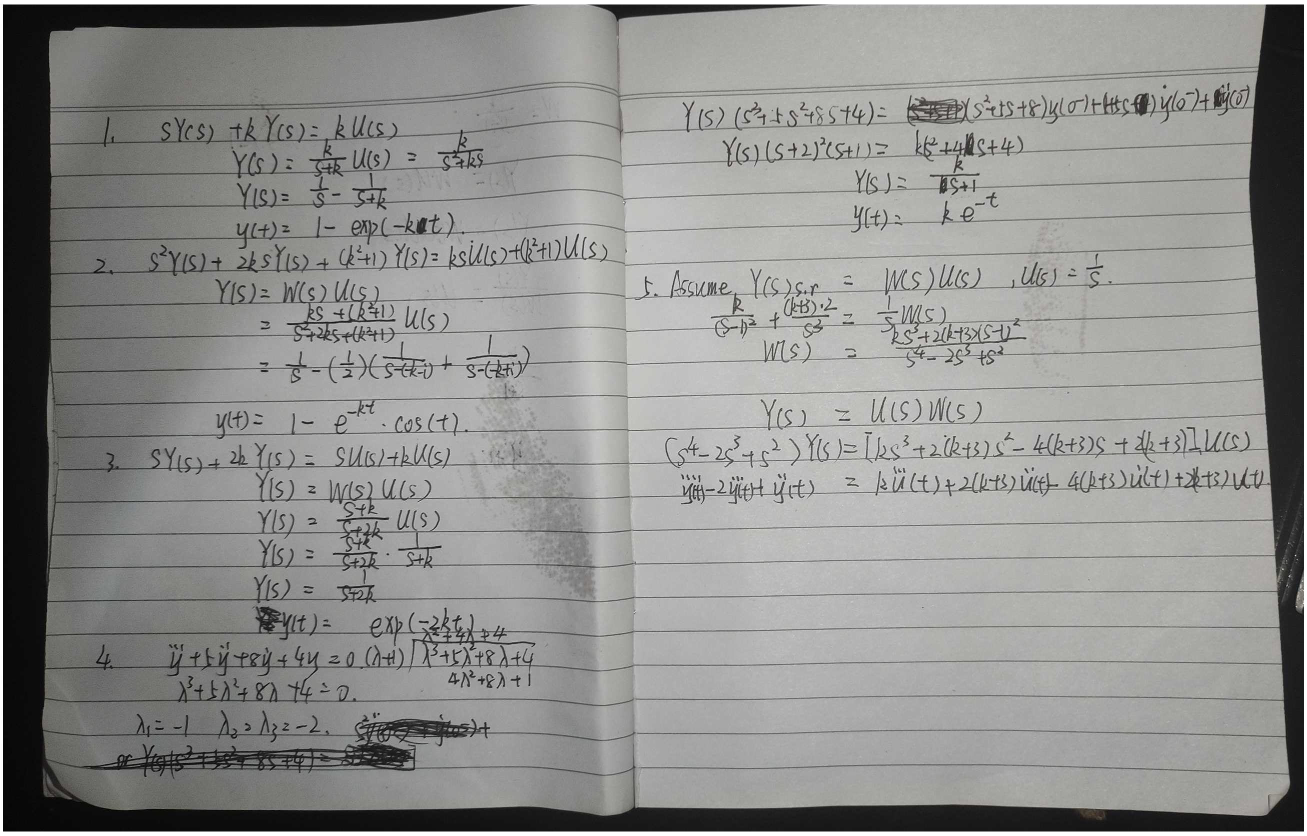
Overview:

1.Calculation

2.Graph

3.Model and code

Part 1:



1. $sY(s) + kY(s) = kU(s)$

$$Y(s) = \frac{k}{s+k}U(s) = \frac{k}{s^2+ks}$$

$$Y(s) = \frac{1}{s} - \frac{1}{s+k}$$

$$y(t) = 1 - \exp(-kt).$$

2. $s^2Y(s) + 2ksY(s) + (k^2+1)Y(s) = ksU(s) + (k^2+1)U(s)$

$$Y(s) = W(s)U(s)$$

$$= \frac{ks + (k^2+1)}{s^2+2ks+(k^2+1)}U(s)$$

$$= \frac{1}{s} - \left(\frac{1}{2}\right)\left(\frac{1}{s-(-k-i)} + \frac{1}{s-(-k+i)}\right)$$

$$y(t) = 1 - e^{-kt}\cdot\cos(t).$$

3. $sY(s) + 2kY(s) = sU(s) + kU(s)$

$$Y(s) = W(s)U(s)$$

$$Y(s) = \frac{s+k}{s+2k}U(s)$$

$$Y(s) = \frac{s+k}{s+2k}\cdot\frac{1}{s+k}$$

$$Y(s) = \frac{1}{s+2k}$$

$$y(t) = \exp(-2kt)$$

4. $\dddot{y} + 5\ddot{y} + 8\dot{y} + 4y = 0$

$$(\lambda+1)\overline{\big)\lambda^3+5\lambda^2+8\lambda+4}\quad \lambda^2+4\lambda+4$$

$$4\lambda^2+8\lambda+1$$

$$\lambda^3+5\lambda^2+8\lambda+4=0.$$

$$\lambda_1 = -1 \quad \lambda_2 = \lambda_3 = -2.$$

$$Y(s)(s^3+5s^2+8s+4) = (s^2+5s+8)y(0^-) + (s+5)\dot{y}(0^-) + \ddot{y}(0^-)$$

$$Y(s)(s+2)^2(s+1) = k(s^2+4s+4)$$

$$Y(s) = \frac{k}{s+1}$$

$$y(t) = ke^{-t}$$

5. Assume $Y(s)_{s.r} = W(s)U(s)$, $U(s) = \frac{1}{s}$.

$$\frac{k}{(s-1)^2} + \frac{(k+3)\cdot 2}{s^3} = \frac{1}{s}W(s)$$

$$W(s) = \frac{ks^3+2(k+3)(s-1)^2}{s^4-2s^3+s^2}$$

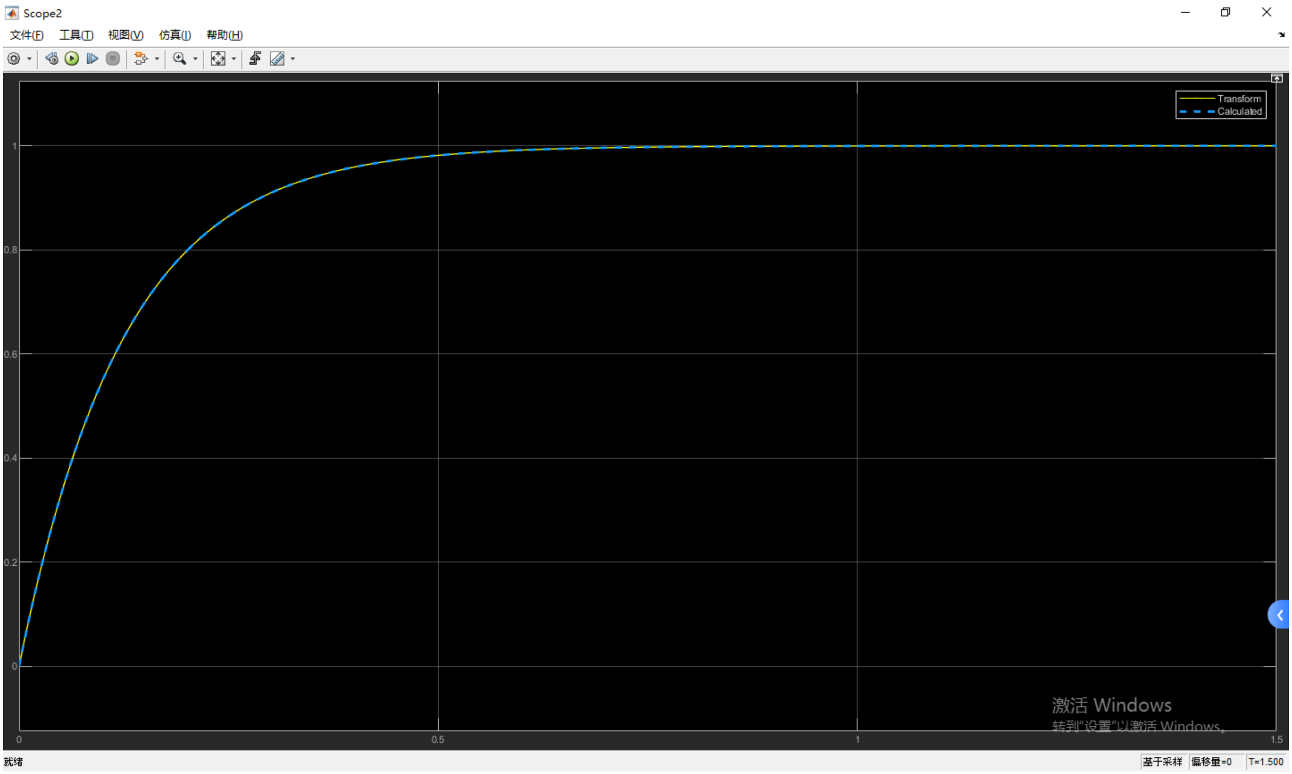
$$Y(s) = U(s)W(s)$$

$$(s^4-2s^3+s^2)Y(s) = [ks^3+2(k+3)s^2-4(k+3)s+2(k+3)]U(s)$$

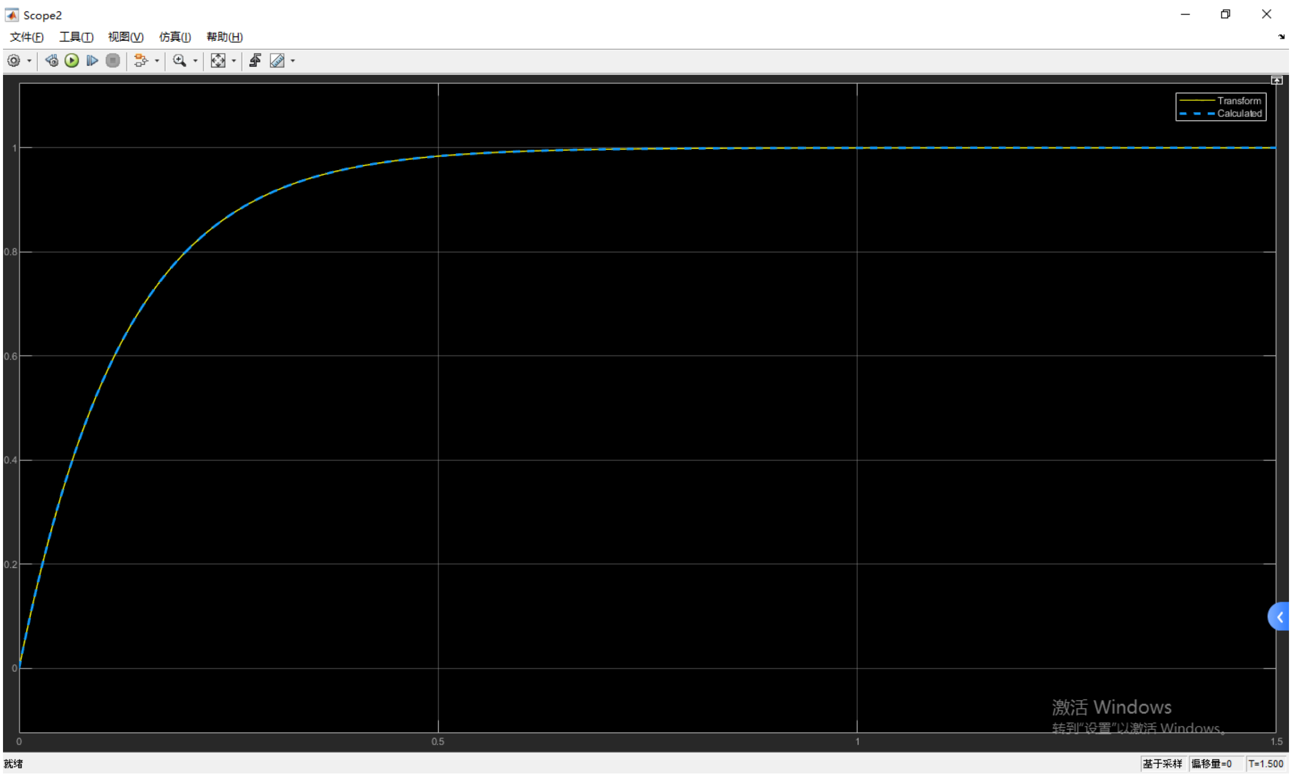
$$\ddddot{y}(t) - 2\dddot{y}(t) + \ddot{y}(t) = k\dddot{u}(t) + 2(k+3)\ddot{u}(t) - 4(k+3)\dot{u}(t) + 2(k+3)u(t)$$

Part 2:

1.Step response of $\dot{y}(t) + ky(t) = ku(t).$



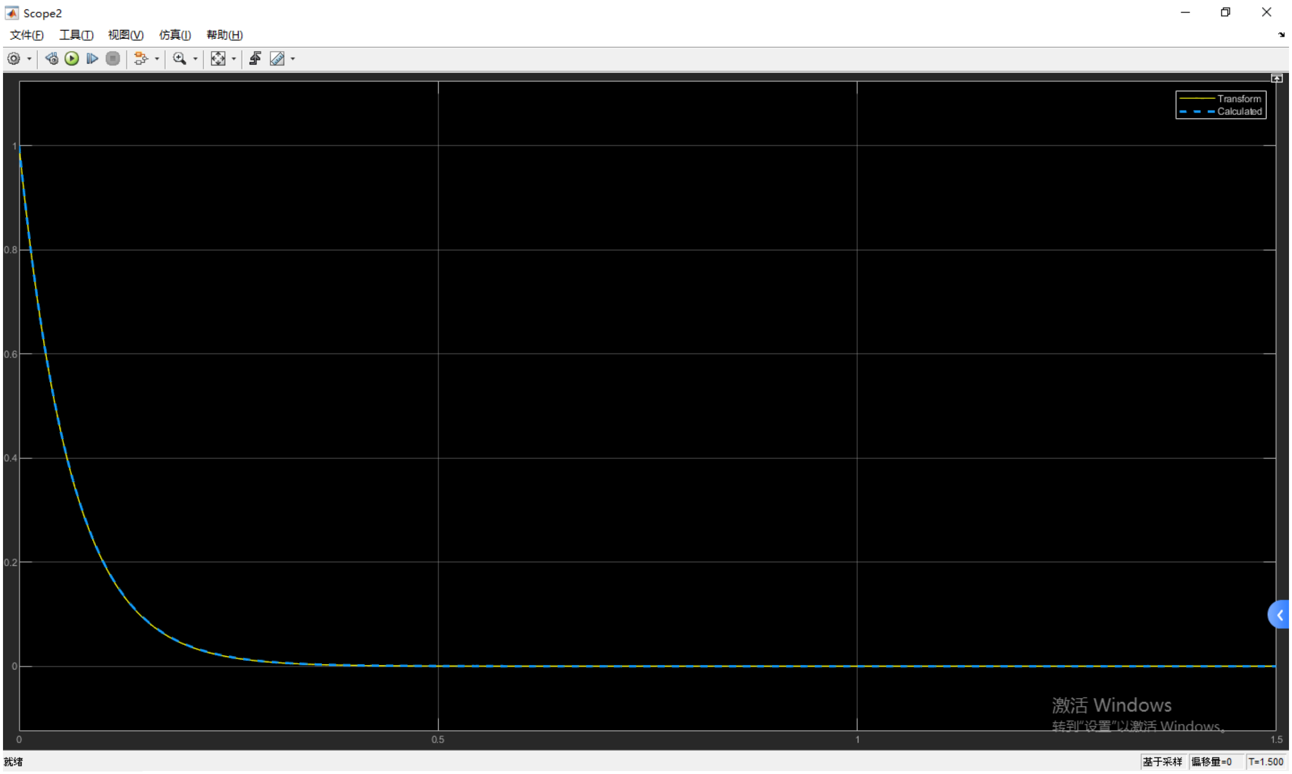
2.Step response of $\ddot{y}(t) + 2k\dot{y}(t) + (k^2+1)y(t) = k\dot{u}(t) + (k^2+1)u(t).$



3.

For $u(t) = e^{-kt}$ find the forced response of the system

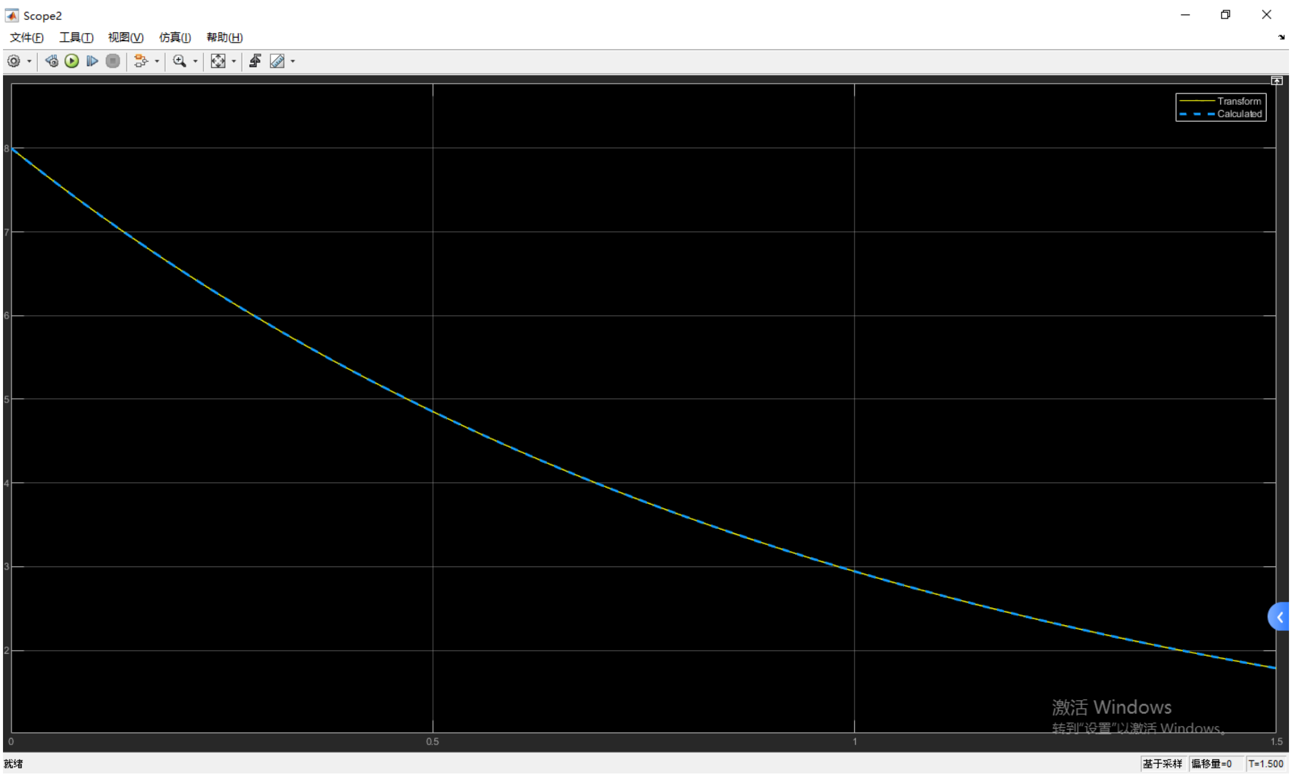
$$\dot{y}(t) + 2ky(t) = \dot{u}(t) + ku(t).$$



4. Find the output $y(t)$ of the system

$$\dddot{y} + 5\ddot{y} + 8\dot{y} + 4y = \ddot{u} + u,$$

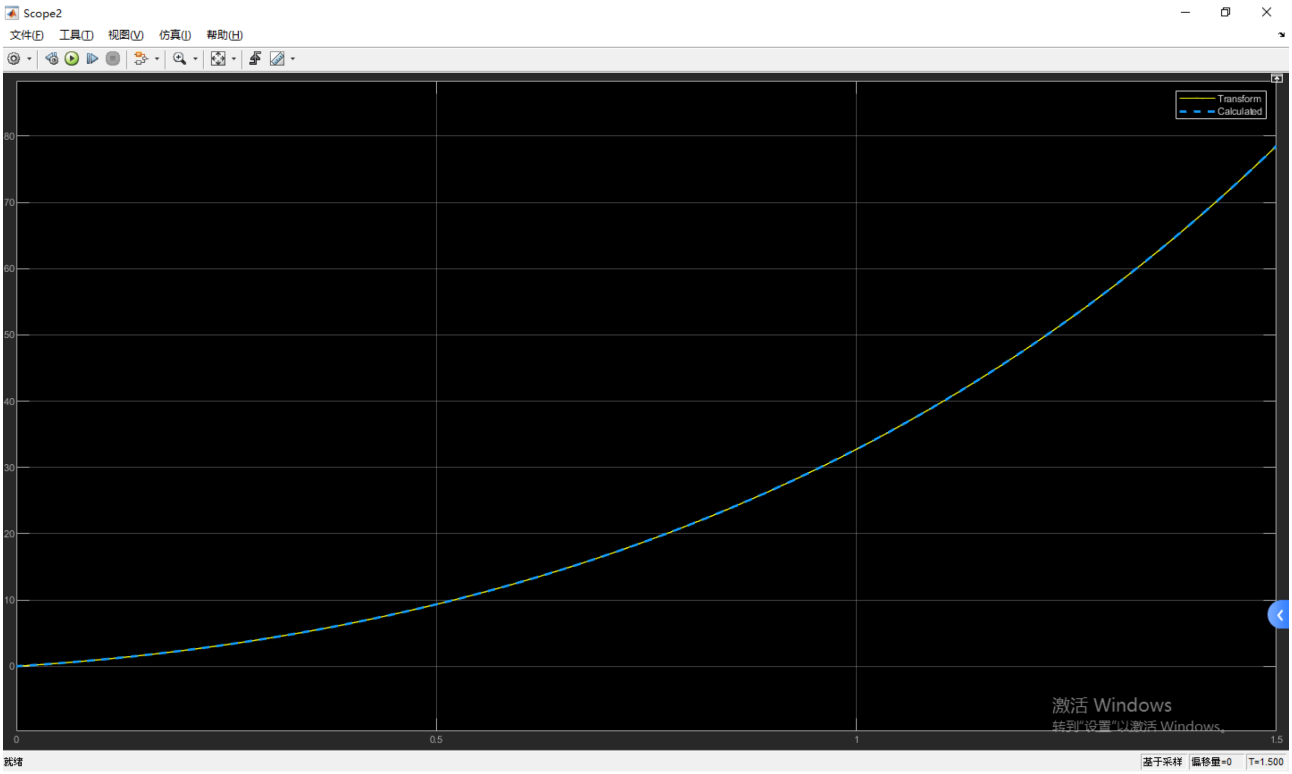
$$u(t) = 3k\cos(t) + 2k\sin(t), \quad y(0) = k, \quad \dot{y}(0) = -k, \quad \ddot{y}(0) = k.$$



5.Assume that u(s) = 1/s.

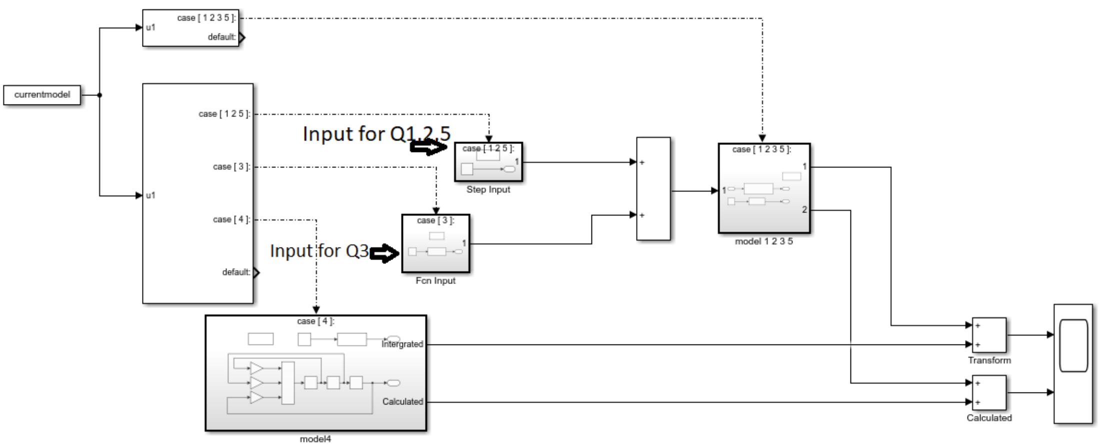
5. Find a differential equation of the system with the following step response:

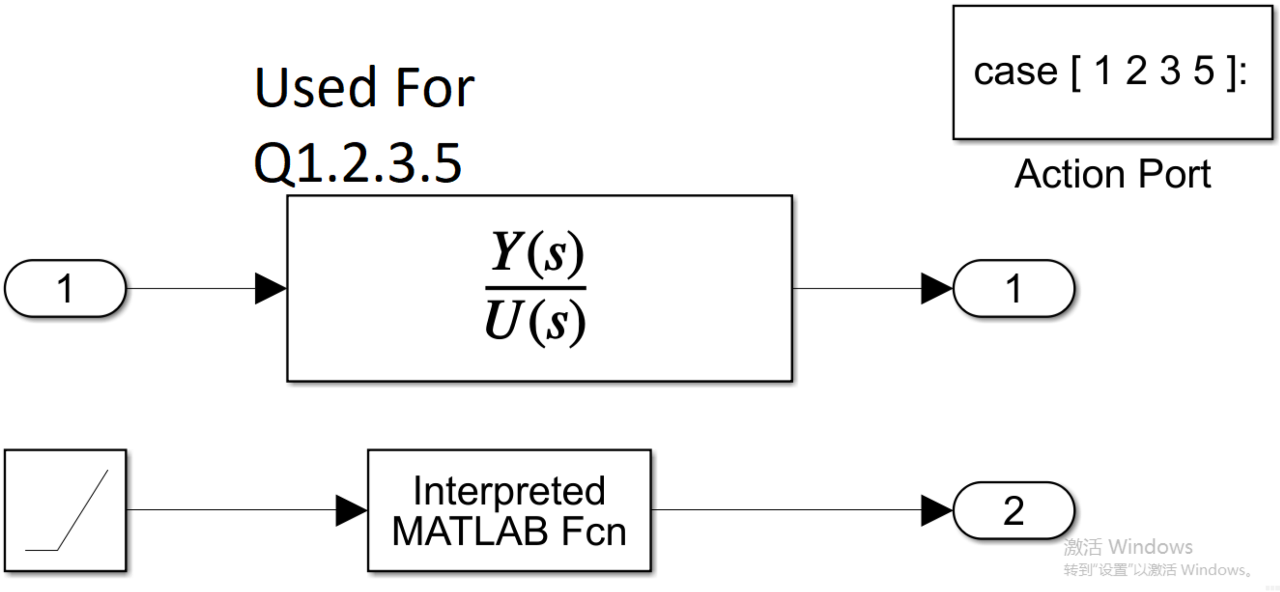
$$y_{\text{step response}} = kte^t + (k+3)t^2.$$



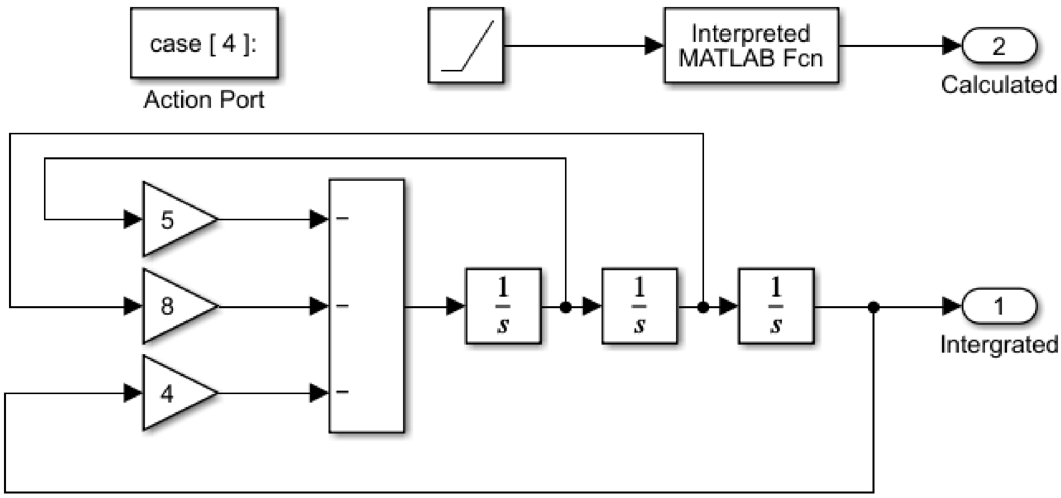
Part 3:

Model:





Used for Q4.



Code:

solves.m

```
k = 7 + 1;
eq1Solve = @(u)(1-exp(-k*u));
eq2Solve = @(u)(1-cos(u)*exp(-k*u));
eq3Solve = @(u)(exp(-2*k*u));
eq5Solve = @(u)(k*u*exp(u)+(k+3)*u^2);
currentmodel = 5;
switch currentmodel
    case 1
        eqSolve = eq1Solve;
        argU = [k];
        argD = [1,k];
        InputGt2 = 0;
```

```
    case 2
        eqSolve = eq2Solve;
        argU = [k (k^2+1)];
        argD = [1 2*k k^2+1];
        InputGt2 = 0;
    case 3
        eqSolve = eq3Solve;
        argU = [1 k];
        argD = [1 2*k];
        InputGt2 = @(u)exp(-k*u);
    case 5
        eqSolve = eq5Solve;
        InputGt2 = 0;
        argU = [k 2*(k+3) -4*(k+3) 2*(k+3)];
        argD = [1 -2 1 0 0];
end
```