

Question No. 2

Solving the pair of the models

```
1.commandwindow
2.clear
3.clc
4.syms T1(t) T2(t)
5.df = [diff(T1,t)+3*T2 == exp(-2*t) , diff(T2,t)-3*T1 == exp(2*t)]
6.dT2 = diff(T2,t)
7.dT1 = diff(T1,t)
8.dfcondition = [T2(0) == 30 , T1(0) == 30]
9.dg = dsolve(df,dfcondition)
10.T2 = dg.T2
11.T1 = dg.T1
12.pretty(T2)
13.pretty(T1)
```

commandwindow

df(t) =

[3*T2(t) + diff(T1(t), t) == exp(-2*t), diff(T2(t), t) - 3*T1(t) == exp(2*t)]

dT2(t) =

diff(T2(t), t)

dT1(t) =

diff(T1(t), t)

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Solving the pair of the models

dfcondition =

[T2(0) == 30, T1(0) == 30]

dg =

struct with fields:

T2: [1×1 sym]

T1: [1×1 sym]

T2 =

$$(3\exp(-2t))/13 + (2\exp(2t))/13 + (5\sqrt{12170}\cos(3t - \arctan(79/77)))/13$$

T1 =

$$(5\sqrt{12170}\cos(3t + \arctan(77/79)))/13 - (3\exp(2t))/13 - (2\exp(-2t))/13$$

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Solving the pair of the models

$$\frac{\sqrt{12170} \cos\left(\frac{3}{13}t - \arctan\left(\frac{\sqrt{79}}{\sqrt{77}}\right)\right) - \exp(-2t)^3 + \exp(2t)^2}{13}$$

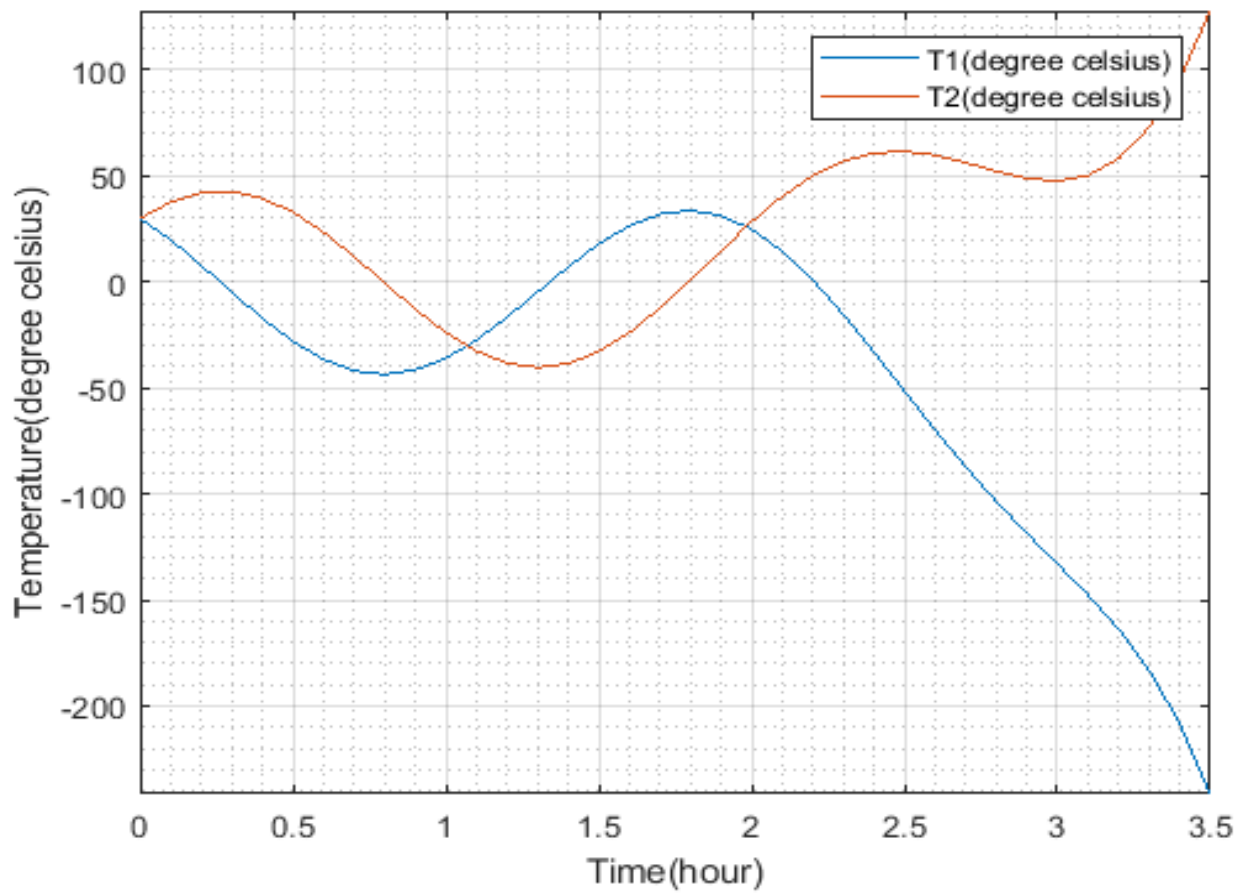
$$\frac{\sqrt{12170} \cos\left(\frac{3}{13}t + \arctan\left(\frac{\sqrt{79}}{\sqrt{77}}\right)\right) - \exp(2t)^3 + \exp(-2t)^2}{13}$$

Plotting the dynamic responses of T1 and T2

```
1.commandwindow
2.clear
3.clc
4.syms T1(t) T2(t)
5.close all
6.df = [diff(T1,t)+3*T2 == exp(-2*t) , diff(T2,t)-3*T1 == exp(2*t)]
7.dT1 = diff(T1,t)
8.dT2 = diff(T2,t)
9.dfcondition = [T1(0) == 30 , T2(0) == 30]
10.dg = dsolve(df,dfcondition)
11.T1 = dg.T1
12.T2 = dg.T2
13.t = [0:0.1:3.5]
14.DE = subs(T1,t)
15.DF = subs(T2,t)
16.figure(1)
17.plot(t,DE,t,DF)
18.axis tight
19.grid on
20.grid minor
21.xlabel('Time(hour)')
22.ylabel('Temperature(degree celsius)')
23.legend('T1(degree celsius)','T2(degree celsius)')
```

commandwindow

Plotting the dynamic responses of T1 and T2



$df(t) =$

$[3T_2(t) + \frac{dT_1(t)}{dt} = \exp(-2t), \frac{dT_2(t)}{dt} - 3T_1(t) = \exp(2t)]$

$\frac{dT_1(t)}{dt} =$

$\frac{dT_1(t)}{dt}$

Plotting the dynamic responses of T1 and T2

$dT_2(t) =$

$\text{diff}(T_2(t), t)$

$df_{\text{condition}} =$

$[T_1(0) == 30, T_2(0) == 30]$

$dg =$

struct with fields:

T2: [1×1 sym]

T1: [1×1 sym]

T1 =

$(5 \cdot 12170^{1/2} \cdot \cos(3t + \text{atan}(77/79)))/13 - (3 \cdot \exp(2t))/13 - (2 \cdot \exp(-2t))/13$

T2 =

Plotting the dynamic responses of T1 and T2

$$(3*\exp(-2*t))/13 + (2*\exp(2*t))/13 + (5*12170^{(1/2)}*\cos(3*t - \operatorname{atan}(79/77)))/13$$

t =

Columns 1 through 7

0 0.1000 0.2000 0.3000 0.4000 0.5000 0.6000

Columns 8 through 14

0.7000 0.8000 0.9000 1.0000 1.1000 1.2000 1.3000

Columns 15 through 21

1.4000 1.5000 1.6000 1.7000 1.8000 1.9000 2.0000

Columns 22 through 28

2.1000 2.2000 2.3000 2.4000 2.5000 2.6000 2.7000

Columns 29 through 35

Plotting the dynamic responses of T1 and T2

2.8000 2.9000 3.0000 3.1000 3.2000 3.3000 3.4000

Column 36

3.5000

DE =

```
[ 30, (5*12170^(1/2)*cos(atan(77/79) + 3/10))/13 - (3*exp(1/5))/13 - (2*exp(-1/5))/13,
(5*12170^(1/2)*cos(atan(77/79) + 3/5))/13 - (3*exp(2/5))/13 - (2*exp(-2/5))/13,
(5*12170^(1/2)*cos(atan(77/79) + 9/10))/13 - (3*exp(3/5))/13 - (2*exp(-3/5))/13,
(5*12170^(1/2)*cos(atan(77/79) + 6/5))/13 - (3*exp(4/5))/13 - (2*exp(-4/5))/13,
(5*12170^(1/2)*cos(atan(77/79) + 3/2))/13 - (3*exp(1))/13 - (2*exp(-1))/13,
(5*12170^(1/2)*cos(atan(77/79) + 9/5))/13 - (3*exp(6/5))/13 - (2*exp(-6/5))/13,
(5*12170^(1/2)*cos(atan(77/79) + 21/10))/13 - (3*exp(7/5))/13 - (2*exp(-7/5))/13,
(5*12170^(1/2)*cos(atan(77/79) + 12/5))/13 - (3*exp(8/5))/13 - (2*exp(-8/5))/13,
(5*12170^(1/2)*cos(atan(77/79) + 27/10))/13 - (3*exp(9/5))/13 - (2*exp(-9/5))/13,
(5*12170^(1/2)*cos(atan(77/79) + 3))/13 - (3*exp(2))/13 - (2*exp(-2))/13,
(5*12170^(1/2)*cos(atan(77/79) + 33/10))/13 - (3*exp(11/5))/13 - (2*exp(-11/5))/13,
(5*12170^(1/2)*cos(atan(77/79) + 18/5))/13 - (3*exp(12/5))/13 - (2*exp(-12/5))/13,
(5*12170^(1/2)*cos(atan(77/79) + 39/10))/13 - (3*exp(13/5))/13 - (2*exp(-13/5))/13,
(5*12170^(1/2)*cos(atan(77/79) + 21/5))/13 - (3*exp(14/5))/13 - (2*exp(-14/5))/13,
(5*12170^(1/2)*cos(atan(77/79) + 9/2))/13 - (3*exp(3))/13 - (2*exp(-3))/13,
(5*12170^(1/2)*cos(atan(77/79) + 24/5))/13 - (3*exp(16/5))/13 - (2*exp(-16/5))/13,
(5*12170^(1/2)*cos(atan(77/79) + 51/10))/13 - (3*exp(17/5))/13 - (2*exp(-17/5))/13,
(5*12170^(1/2)*cos(atan(77/79) + 27/5))/13 - (3*exp(18/5))/13 - (2*exp(-18/5))/13,
(5*12170^(1/2)*cos(atan(77/79) + 57/10))/13 - (3*exp(19/5))/13 - (2*exp(-19/5))/13,
(5*12170^(1/2)*cos(atan(77/79) + 6))/13 - (3*exp(4))/13 - (2*exp(-4))/13,
(5*12170^(1/2)*cos(atan(77/79) + 63/10))/13 - (3*exp(21/5))/13 - (2*exp(-21/5))/13,
(5*12170^(1/2)*cos(atan(77/79) + 33/5))/13 - (3*exp(22/5))/13 - (2*exp(-22/5))/13,
(5*12170^(1/2)*cos(atan(77/79) + 69/10))/13 - (3*exp(23/5))/13 - (2*exp(-23/5))/13,
(5*12170^(1/2)*cos(atan(77/79) + 36/5))/13 - (3*exp(24/5))/13 - (2*exp(-24/5))/13,
(5*12170^(1/2)*cos(atan(77/79) + 15/2))/13 - (3*exp(5))/13 - (2*exp(-5))/13,
(5*12170^(1/2)*cos(atan(77/79) + 39/5))/13 - (3*exp(26/5))/13 - (2*exp(-26/5))/13,
(5*12170^(1/2)*cos(atan(77/79) + 81/10))/13 - (3*exp(27/5))/13 - (2*exp(-27/5))/13,
(5*12170^(1/2)*cos(atan(77/79) + 42/5))/13 - (3*exp(28/5))/13 - (2*exp(-28/5))/13,
(5*12170^(1/2)*cos(atan(77/79) + 87/10))/13 - (3*exp(29/5))/13 - (2*exp(-29/5))/13,
(5*12170^(1/2)*cos(atan(77/79) + 9))/13 - (3*exp(6))/13 - (2*exp(-6))/13,
(5*12170^(1/2)*cos(atan(77/79) + 93/10))/13 - (3*exp(31/5))/13 - (2*exp(-31/5))/13,
```


Plotting the dynamic responses of T1 and T2

```
(5*12170^(1/2)*cos(atan(77/79) + 48/5))/13 - (3*exp(32/5))/13 - (2*exp(-32/5))/13,  
(5*12170^(1/2)*cos(atan(77/79) + 99/10))/13 - (3*exp(33/5))/13 - (2*exp(-33/5))/13,  
(5*12170^(1/2)*cos(atan(77/79) + 51/5))/13 - (3*exp(34/5))/13 - (2*exp(-34/5))/13,  
(5*12170^(1/2)*cos(atan(77/79) + 21/2))/13 - (3*exp(7))/13 - (2*exp(-7))/13]
```

DF =

```
[ 30, (3*exp(-1/5))/13 + (2*exp(1/5))/13 + (5*12170^(1/2)*cos(atan(79/77) - 3/10))/13,  
(3*exp(-2/5))/13 + (2*exp(2/5))/13 + (5*12170^(1/2)*cos(atan(79/77) - 3/5))/13,  
(3*exp(-3/5))/13 + (2*exp(3/5))/13 + (5*12170^(1/2)*cos(atan(79/77) - 9/10))/13,  
(3*exp(-4/5))/13 + (2*exp(4/5))/13 + (5*12170^(1/2)*cos(atan(79/77) - 6/5))/13,  
(3*exp(-1))/13 + (2*exp(1))/13 + (5*12170^(1/2)*cos(atan(79/77) - 3/2))/13, (3*exp(-  
6/5))/13 + (2*exp(6/5))/13 + (5*12170^(1/2)*cos(atan(79/77) - 9/5))/13, (3*exp(-  
7/5))/13 + (2*exp(7/5))/13 + (5*12170^(1/2)*cos(atan(79/77) - 21/10))/13, (3*exp(-  
8/5))/13 + (2*exp(8/5))/13 + (5*12170^(1/2)*cos(atan(79/77) - 12/5))/13, (3*exp(-  
9/5))/13 + (2*exp(9/5))/13 + (5*12170^(1/2)*cos(atan(79/77) - 27/10))/13, (3*exp(-  
2))/13 + (2*exp(2))/13 + (5*12170^(1/2)*cos(atan(79/77) - 3))/13, (3*exp(-11/5))/13 +  
(2*exp(11/5))/13 + (5*12170^(1/2)*cos(atan(79/77) - 33/10))/13, (3*exp(-12/5))/13 +  
(2*exp(12/5))/13 + (5*12170^(1/2)*cos(atan(79/77) - 18/5))/13, (3*exp(-13/5))/13 +  
(2*exp(13/5))/13 + (5*12170^(1/2)*cos(atan(79/77) - 39/10))/13, (3*exp(-14/5))/13 +  
(2*exp(14/5))/13 + (5*12170^(1/2)*cos(atan(79/77) - 21/5))/13, (3*exp(-3))/13 +  
(2*exp(3))/13 + (5*12170^(1/2)*cos(atan(79/77) - 9/2))/13, (3*exp(-16/5))/13 +  
(2*exp(16/5))/13 + (5*12170^(1/2)*cos(atan(79/77) - 24/5))/13, (3*exp(-17/5))/13 +  
(2*exp(17/5))/13 + (5*12170^(1/2)*cos(atan(79/77) - 51/10))/13, (3*exp(-18/5))/13 +  
(2*exp(18/5))/13 + (5*12170^(1/2)*cos(atan(79/77) - 27/5))/13, (3*exp(-19/5))/13 +  
(2*exp(19/5))/13 + (5*12170^(1/2)*cos(atan(79/77) - 57/10))/13, (3*exp(-4))/13 +  
(2*exp(4))/13 + (5*12170^(1/2)*cos(atan(79/77) - 6))/13, (3*exp(-21/5))/13 +  
(2*exp(21/5))/13 + (5*12170^(1/2)*cos(atan(79/77) - 63/10))/13, (3*exp(-22/5))/13 +  
(2*exp(22/5))/13 + (5*12170^(1/2)*cos(atan(79/77) - 33/5))/13, (3*exp(-23/5))/13 +  
(2*exp(23/5))/13 + (5*12170^(1/2)*cos(atan(79/77) - 69/10))/13, (3*exp(-24/5))/13 +  
(2*exp(24/5))/13 + (5*12170^(1/2)*cos(atan(79/77) - 36/5))/13, (3*exp(-5))/13 +  
(2*exp(5))/13 + (5*12170^(1/2)*cos(atan(79/77) - 15/2))/13, (3*exp(-26/5))/13 +  
(2*exp(26/5))/13 + (5*12170^(1/2)*cos(atan(79/77) - 39/5))/13, (3*exp(-27/5))/13 +  
(2*exp(27/5))/13 + (5*12170^(1/2)*cos(atan(79/77) - 81/10))/13, (3*exp(-28/5))/13 +  
(2*exp(28/5))/13 + (5*12170^(1/2)*cos(atan(79/77) - 42/5))/13, (3*exp(-29/5))/13 +  
(2*exp(29/5))/13 + (5*12170^(1/2)*cos(atan(79/77) - 87/10))/13, (3*exp(-6))/13 +  
(2*exp(6))/13 + (5*12170^(1/2)*cos(atan(79/77) - 9))/13, (3*exp(-31/5))/13 +  
(2*exp(31/5))/13 + (5*12170^(1/2)*cos(atan(79/77) - 93/10))/13, (3*exp(-32/5))/13 +  
(2*exp(32/5))/13 + (5*12170^(1/2)*cos(atan(79/77) - 48/5))/13, (3*exp(-33/5))/13 +  
(2*exp(33/5))/13 + (5*12170^(1/2)*cos(atan(79/77) - 99/10))/13, (3*exp(-34/5))/13 +  
(2*exp(34/5))/13 + (5*12170^(1/2)*cos(atan(79/77) - 51/5))/13, (3*exp(-7))/13 +  
(2*exp(7))/13 + (5*12170^(1/2)*cos(atan(79/77) - 21/2))/13]
```

Plotting the dynamic responses of T1 and T2

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