

# Final Exam

## Problem 1

```
clear all
syms F0 s omega

rng('shuffle')

B=randi([1,20],1,2)
```

```
B = 1×2
    12     9
```

```
m=B(1), k=B(2), b=min(B), F0=min(B)
```

```
m = 12
k = 9
b = 9
F0 = 9
```

```
%m*x' + b*x' + k*x = F0*E.
```

```
omega=sym('omega','real')
```

```
omega =  $\omega$ 
```

```
omega=sym('omega','positive')
```

```
omega =  $\omega$ 
```

```
H=(F0)/((m)*s^2+(b)*s+(k)) %transfer function
```

```
H =
```

$$\frac{9}{12s^2 + 9s + 9}$$

```
g=subs(H,s,i*omega) %complex gain
```

```
g =
```

$$\frac{9}{-12\omega^2 + 9\omega i + 9}$$

```
sqrt(simplify(g*conj(g))) %frequency-response function
```

```
ans =
```

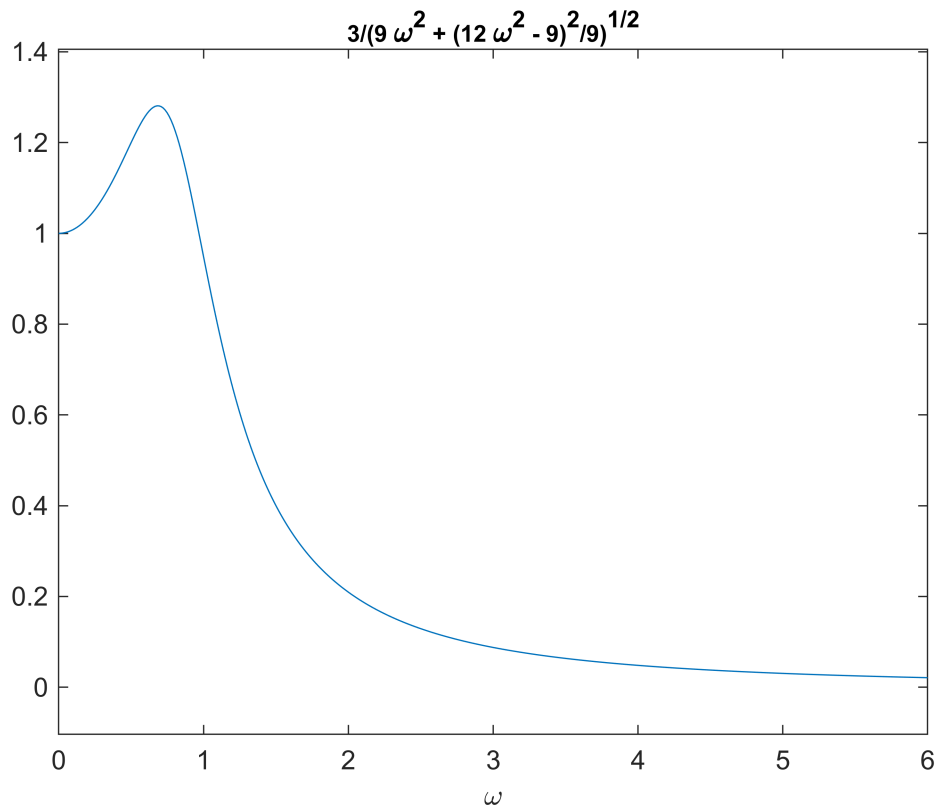
$$\frac{3}{\sqrt{16\omega^4 - 15\omega^2 + 9}}$$

```
g1=simplify(abs(g)) %abs value of gain
```

```
g1 =
```

$$\frac{3}{\sqrt{9\omega^2 + \frac{(12\omega^2 - 9)^2}{9}}}$$

```
ezplot(g1,[0,6])
```



## Problem 2a

```
%L*I'' + R*I' + I/C = F0*U_1(t),    0 < t < 5,  
% U_1(t) switches at t=1
```

```
x0=0; x1=1; xf=5;  
y0=[0,0];  
[t,I]=RK4(@FinalExam2a,[x0,xf],y0,.05);
```

```
dy = 2x1  
0  
0  
dy = 2x1  
0  
0  
dy = 2x1  
0
```

$\text{dy} = \frac{2 \times 1}{0}$

[illegible]

[illegible]

$\text{dy} = \frac{2 \times 1}{0}$



[illegible]



[illegible]

```

dy = 2×1
  0
  0
dy = 2×1
  0
  0
dy = 2×1
  0
  0
dy = 2×1
  0
  0
dy = 2×1
  0
  0
dy = 2×1
  0
  0
A = 1×2      1
  8
L = 8
R = 1
C = 1
F0 = 1
A = 1×2      2
  3
L = 3
R = 2
C = 2
F0 = 2
A = 1×2      13
  7
L = 7
R = 13
C = 7
F0 = 7
A = 1×2      14
  19
L = 19
R = 14
C = 14
F0 = 14
A = 1×2      13
  7
L = 7
R = 13
C = 7
F0 = 7
A = 1×2      4
  3
L = 3
R = 4
C = 3
F0 = 3
A = 1×2      3
  6
L = 6
R = 3
C = 3
F0 = 3
A = 1×2      13
  17
L = 17
R = 13

```

C = 13  
 F0 = 13  
 A = 1×2  
     2      1  
 L = 2  
 R = 1  
 C = 1  
 F0 = 1  
 A = 1×2  
     4      8  
 L = 4  
 R = 8  
 C = 4  
 F0 = 4  
 A = 1×2  
     6      10  
 L = 6  
 R = 10  
 C = 6  
 F0 = 6  
 A = 1×2  
     1      18  
 L = 1  
 R = 18  
 C = 1  
 F0 = 1  
 A = 1×2  
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 L = 8  
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 C = 8  
 F0 = 8  
 A = 1×2  
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 R = 10  
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 F0 = 6  
 A = 1×2  
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 F0 = 14  
 A = 1×2  
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 R = 10  
 C = 7  
 F0 = 7  
 A = 1×2  
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 R = 7  
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 F0 = 4  
 A = 1×2  
     9      15

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 R = 15  
 C = 9  
 F0 = 9  
 A = 1×2  
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 L = 13  
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 C = 13  
 F0 = 13  
 A = 1×2  
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 R = 3  
 C = 3  
 F0 = 3  
 A = 1×2  
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 R = 19  
 C = 1  
 F0 = 1  
 A = 1×2  
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 L = 3  
 R = 19  
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 F0 = 3  
 A = 1×2  
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 C = 7  
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 F0 = 5  
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 F0 = 2  
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 F0 = 10  
 A = 1×2  
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 R = 20  
 C = 18  
 F0 = 18  
 A = 1×2  
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 R = 17  
 C = 15  
 F0 = 15

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 F0 = 3  
 A = 1×2  
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 R = 7  
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 F0 = 7  
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 R = 4  
 C = 4  
 F0 = 4  
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 R = 18  
 C = 9  
 F0 = 9  
 A = 1×2  
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 R = 9  
 C = 9  
 F0 = 9  
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 F0 = 6  
 A = 1×2  
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 R = 10  
 C = 10  
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 F0 = 5  
 A = 1×2  
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 R = 10  
 C = 10  
 F0 = 10  
 A = 1×2  
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 F0 = 13  
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 F0 = 3  
 A = 1×2  
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 F0 = 4  
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 R = 11  
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 F0 = 3  
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 R = 20  
 C = 12  
 F0 = 12  
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 L = 18  
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 F0 = 7  
 A = 1×2  
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 R = 18  
 C = 18  
 F0 = 18  
 A = 1×2  
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 R = 7  
 C = 2  
 F0 = 2  
 A = 1×2  
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 L = 7  
 R = 6  
 C = 6  
 F0 = 6  
 A = 1×2  
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 R = 11  
 C = 1  
 F0 = 1

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 $L = 8$   
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7 19  
 $L = 7$   
 $R = 19$   
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 $F0 = 7$   
 $A = 1 \times 2$   
12 5  
 $L = 12$   
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 $C = 5$   
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 $A = 1 \times 2$   
6 11  
 $L = 6$   
 $R = 11$   
 $C = 6$   
 $F0 = 6$   
 $A = 1 \times 2$   
9 8  
 $L = 9$   
 $R = 8$



C = 8  
 F0 = 8  
 A = 1×2  
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 R = 5  
 C = 5  
 F0 = 5  
 A = 1×2  
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 C = 5  
 F0 = 5  
 A = 1×2  
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 C = 1  
 F0 = 1  
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 R = 12  
 C = 3  
 F0 = 3  
 A = 1×2  
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 F0 = 1  
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 F0 = 13  
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 C = 14  
 F0 = 14  
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 C = 2  
 F0 = 2  
 A = 1×2  
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 R = 13  
 C = 5  
 F0 = 5  
 A = 1×2  
     1      6

```

L = 1
R = 6
C = 1
F0 = 1
A = 1×2
    11      6
L = 11
R = 6
C = 6
F0 = 6
A = 1×2
    13      4
L = 13
R = 4
C = 4
F0 = 4
A = 1×2
    9      15
L = 9
R = 15
C = 9
F0 = 9
A = 1×2
    13      1
L = 13
R = 1
C = 1
F0 = 1
A = 1×2
    14      13
L = 14
R = 13
C = 13
F0 = 13
A = 1×2
    1      14
L = 1
R = 14
C = 1
F0 = 1
A = 1×2
    14      19
L = 14
R = 19
C = 14
F0 = 14
A = 1×2
    5      20
L = 5
R = 20
C = 5
F0 = 5
A = 1×2
    20      1
L = 20
R = 1
C = 1
F0 = 1
A = 1×2
    12      10
L = 12
R = 10
C = 10
F0 = 10

```

$A = 1 \times 2$   
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 $R = 9$   
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 $F\emptyset = 9$   
 $A = 1 \times 2$   
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 $L = 6$   
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 $C = 2$   
 $F\emptyset = 2$   
 $A = 1 \times 2$   
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 $R = 17$   
 $C = 5$   
 $F\emptyset = 5$   
 $A = 1 \times 2$   
 9      12  
 $L = 9$   
 $R = 12$   
 $C = 9$   
 $F\emptyset = 9$   
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 16      14  
 $L = 16$   
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 $C = 14$   
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 14      14  
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 $C = 14$   
 $F\emptyset = 14$   
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 12      13  
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 10      16  
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 $F\emptyset = 10$   
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 2      7  
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 $R = 7$   
 $C = 2$   
 $F\emptyset = 2$   
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 8      13  
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 $R = 13$   
 $C = 8$   
 $F\emptyset = 8$   
 $A = 1 \times 2$   
 1      9  
 $L = 1$   
 $R = 9$

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 F0 = 8  
 A = 1×2  
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 R = 7  
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 F0 = 7  
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 F0 = 14  
 A = 1×2  
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 F0 = 4  
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 R = 11  
 C = 4  
 F0 = 4  
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 C = 4  
 F0 = 4  
 A = 1×2  
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 R = 18  
 C = 3  
 F0 = 3  
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 R = 9  
 C = 9  
 F0 = 9  
 A = 1×2  
     11      11  
 L = 11  
 R = 11  
 C = 11  
 F0 = 11  
 A = 1×2  
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 R = 12  
 C = 12  
 F0 = 12  
 A = 1×2  
     12      11

L = 12  
 R = 11  
 C = 11  
 F0 = 11  
 A = 1×2  
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 L = 15  
 R = 11  
 C = 11  
 F0 = 11  
 A = 1×2  
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 L = 14  
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 R = 18  
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 A = 1×2  
     13      15  
 L = 13  
 R = 15  
 C = 13  
 F0 = 13  
 A = 1×2  
     3      17  
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 F0 = 3  
 A = 1×2  
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 C = 1  
 F0 = 1

$A = 1 \times 2$   
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 $F0 = 19$   
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 $C = 6$   
 $F0 = 6$   
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 $R = 3$   
 $C = 3$   
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 4      13  
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 16      11  
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 C = 16  
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 A = 1×2  
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 R = 16  
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 F0 = 12  
 A = 1×2  
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 R = 13  
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 A = 1×2  
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 F0 = 10  
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 F0 = 7  
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 A = 1×2  
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 R = 8  
 C = 4  
 F0 = 4  
 A = 1×2  
     20      8

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 F0 = 3  
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 C = 13  
 F0 = 13  
 A = 1×2  
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 L = 4  
 R = 8  
 C = 4  
 F0 = 4



$A = 1 \times 2$   
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2      13  
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 $A = 1 \times 2$   
13      20  
 $L = 13$   
 $R = 20$   
 $C = 13$   
 $F0 = 13$   
 $A = 1 \times 2$   
15      17  
 $L = 15$   
 $R = 17$   
 $C = 15$   
 $F0 = 15$   
 $A = 1 \times 2$   
17      10  
 $L = 17$   
 $R = 10$   
 $C = 10$   
 $F0 = 10$   
 $A = 1 \times 2$   
4      10  
 $L = 4$   
 $R = 10$   
 $C = 4$   
 $F0 = 4$   
 $A = 1 \times 2$   
4      7  
 $L = 4$   
 $R = 7$

C = 4  
 F0 = 4  
 A = 1×2  
     6      17  
 L = 6  
 R = 17  
 C = 6  
 F0 = 6  
 A = 1×2  
     7      17  
 L = 7  
 R = 17  
 C = 7  
 F0 = 7  
 A = 1×2  
     8      11  
 L = 8  
 R = 11  
 C = 8  
 F0 = 8  
 A = 1×2  
     17     17  
 L = 17  
 R = 17  
 C = 17  
 F0 = 17  
 A = 1×2  
     20     5  
 L = 20  
 R = 5  
 C = 5  
 F0 = 5  
 A = 1×2  
     9      17  
 L = 9  
 R = 17  
 C = 9  
 F0 = 9  
 A = 1×2  
     2      10  
 L = 2  
 R = 10  
 C = 2  
 F0 = 2  
 A = 1×2  
     12     5  
 L = 12  
 R = 5  
 C = 5  
 F0 = 5  
 A = 1×2  
     19     11  
 L = 19  
 R = 11  
 C = 11  
 F0 = 11  
 A = 1×2  
     10     3  
 L = 10  
 R = 3  
 C = 3  
 F0 = 3  
 A = 1×2  
     19     8

L = 19  
 R = 8  
 C = 8  
 F0 = 8  
 A = 1×2  
     2      5  
 L = 2  
 R = 5  
 C = 2  
 F0 = 2  
 A = 1×2  
     2      10  
 L = 2  
 R = 10  
 C = 2  
 F0 = 2  
 A = 1×2  
     15      1  
 L = 15  
 R = 1  
 C = 1  
 F0 = 1  
 A = 1×2  
     11      15  
 L = 11  
 R = 15  
 C = 11  
 F0 = 11  
 A = 1×2  
     5      19  
 L = 5  
 R = 19  
 C = 5  
 F0 = 5  
 A = 1×2  
     9      6  
 L = 9  
 R = 6  
 C = 6  
 F0 = 6  
 A = 1×2  
     14      12  
 L = 14  
 R = 12  
 C = 12  
 F0 = 12  
 A = 1×2  
     14      17  
 L = 14  
 R = 17  
 C = 14  
 F0 = 14  
 A = 1×2  
     15      8  
 L = 15  
 R = 8  
 C = 8  
 F0 = 8  
 A = 1×2  
     20      2  
 L = 20  
 R = 2  
 C = 2  
 F0 = 2

$A = 1 \times 2$   
1      7  
 $L = 1$   
 $R = 7$   
 $C = 1$   
 $F\emptyset = 1$   
 $A = 1 \times 2$   
16      4  
 $L = 16$   
 $R = 4$   
 $C = 4$   
 $F\emptyset = 4$   
 $A = 1 \times 2$   
12      19  
 $L = 12$   
 $R = 19$   
 $C = 12$   
 $F\emptyset = 12$   
 $A = 1 \times 2$   
1      11  
 $L = 1$   
 $R = 11$   
 $C = 1$   
 $F\emptyset = 1$   
 $A = 1 \times 2$   
3      3  
 $L = 3$   
 $R = 3$   
 $C = 3$   
 $F\emptyset = 3$   
 $A = 1 \times 2$   
11      8  
 $L = 11$   
 $R = 8$   
 $C = 8$   
 $F\emptyset = 8$   
 $A = 1 \times 2$   
11      12  
 $L = 11$   
 $R = 12$   
 $C = 11$   
 $F\emptyset = 11$   
 $A = 1 \times 2$   
17      5  
 $L = 17$   
 $R = 5$   
 $C = 5$   
 $F\emptyset = 5$   
 $A = 1 \times 2$   
17      9  
 $L = 17$   
 $R = 9$   
 $C = 9$   
 $F\emptyset = 9$   
 $A = 1 \times 2$   
10      17  
 $L = 10$   
 $R = 17$   
 $C = 10$   
 $F\emptyset = 10$   
 $A = 1 \times 2$   
10      6  
 $L = 10$   
 $R = 6$

C = 6  
 F0 = 6  
 A = 1×2  
     8      12  
 L = 8  
 R = 12  
 C = 8  
 F0 = 8  
 A = 1×2  
     11      8  
 L = 11  
 R = 8  
 C = 8  
 F0 = 8  
 A = 1×2  
     2      2  
 L = 2  
 R = 2  
 C = 2  
 F0 = 2  
 A = 1×2  
     8      4  
 L = 8  
 R = 4  
 C = 4  
 F0 = 4  
 A = 1×2  
     17      5  
 L = 17  
 R = 5  
 C = 5  
 F0 = 5  
 A = 1×2  
     12      15  
 L = 12  
 R = 15  
 C = 12  
 F0 = 12  
 A = 1×2  
     20      1  
 L = 20  
 R = 1  
 C = 1  
 F0 = 1  
 A = 1×2  
     16      10  
 L = 16  
 R = 10  
 C = 10  
 F0 = 10  
 A = 1×2  
     16      1  
 L = 16  
 R = 1  
 C = 1  
 F0 = 1  
 A = 1×2  
     9      3  
 L = 9  
 R = 3  
 C = 3  
 F0 = 3  
 A = 1×2  
     1      11

```

L = 1
R = 11
C = 1
F0 = 1
A = 1×2      13
    13
L = 13
R = 13
C = 13
F0 = 13
A = 1×2      20
    12
L = 12
R = 20
C = 12
F0 = 12
A = 1×2      20
    10
L = 10
R = 20
C = 10
F0 = 10
A = 1×2      6
    20
L = 20
R = 6
C = 6
F0 = 6
A = 1×2      1
    17
L = 17
R = 1
C = 1
F0 = 1
A = 1×2      8
    19
L = 19
R = 8
C = 8
F0 = 8
A = 1×2      2
    10
L = 10
R = 2
C = 2
F0 = 2
A = 1×2      20
    11
L = 11
R = 20
C = 11
F0 = 11
A = 1×2      17
    14
L = 14
R = 17
C = 14
F0 = 14
A = 1×2      14
    12
L = 12
R = 14
C = 12
F0 = 12

```

$A = 1 \times 2$   
19 2  
 $L = 19$   
 $R = 2$   
 $C = 2$   
 $F0 = 2$   
 $A = 1 \times 2$   
12 19  
 $L = 12$   
 $R = 19$   
 $C = 12$   
 $F0 = 12$   
 $A = 1 \times 2$   
19 7  
 $L = 19$   
 $R = 7$   
 $C = 7$   
 $F0 = 7$   
 $A = 1 \times 2$   
2 16  
 $L = 2$   
 $R = 16$   
 $C = 2$   
 $F0 = 2$   
 $A = 1 \times 2$   
10 20  
 $L = 10$   
 $R = 20$   
 $C = 10$   
 $F0 = 10$   
 $A = 1 \times 2$   
9 10  
 $L = 9$   
 $R = 10$   
 $C = 9$   
 $F0 = 9$   
 $A = 1 \times 2$   
10 15  
 $L = 10$   
 $R = 15$   
 $C = 10$   
 $F0 = 10$   
 $A = 1 \times 2$   
2 4  
 $L = 2$   
 $R = 4$   
 $C = 2$   
 $F0 = 2$   
 $A = 1 \times 2$   
5 11  
 $L = 5$   
 $R = 11$   
 $C = 5$   
 $F0 = 5$   
 $A = 1 \times 2$   
5 15  
 $L = 5$   
 $R = 15$   
 $C = 5$   
 $F0 = 5$   
 $A = 1 \times 2$   
11 12  
 $L = 11$   
 $R = 12$

C = 11  
 F0 = 11  
 A = 1×2  
     12      13  
 L = 12  
 R = 13  
 C = 12  
 F0 = 12  
 A = 1×2  
     16      4  
 L = 16  
 R = 4  
 C = 4  
 F0 = 4  
 A = 1×2  
     16      10  
 L = 16  
 R = 10  
 C = 10  
 F0 = 10  
 A = 1×2  
     12      8  
 L = 12  
 R = 8  
 C = 8  
 F0 = 8  
 A = 1×2  
     15      1  
 L = 15  
 R = 1  
 C = 1  
 F0 = 1  
 A = 1×2  
     7      20  
 L = 7  
 R = 20  
 C = 7  
 F0 = 7  
 A = 1×2  
     18      15  
 L = 18  
 R = 15  
 C = 15  
 F0 = 15  
 A = 1×2  
     20      9  
 L = 20  
 R = 9  
 C = 9  
 F0 = 9  
 A = 1×2  
     16      15  
 L = 16  
 R = 15  
 C = 15  
 F0 = 15  
 A = 1×2  
     2      11  
 L = 2  
 R = 11  
 C = 2  
 F0 = 2  
 A = 1×2  
     20      14



L = 20  
 R = 14  
 C = 14  
 F0 = 14  
 A = 1×2  
     18      10  
 L = 18  
 R = 10  
 C = 10  
 F0 = 10  
 A = 1×2  
     6      3  
 L = 6  
 R = 3  
 C = 3  
 F0 = 3  
 A = 1×2  
     17      18  
 L = 17  
 R = 18  
 C = 17  
 F0 = 17  
 A = 1×2  
     6      3  
 L = 6  
 R = 3  
 C = 3  
 F0 = 3  
 A = 1×2  
     14      15  
 L = 14  
 R = 15  
 C = 14  
 F0 = 14  
 A = 1×2  
     19      9  
 L = 19  
 R = 9  
 C = 9  
 F0 = 9  
 A = 1×2  
     15      10  
 L = 15  
 R = 10  
 C = 10  
 F0 = 10  
 A = 1×2  
     15      7  
 L = 15  
 R = 7  
 C = 7  
 F0 = 7  
 A = 1×2  
     13      1  
 L = 13  
 R = 1  
 C = 1  
 F0 = 1  
 A = 1×2  
     1      12  
 L = 1  
 R = 12  
 C = 1  
 F0 = 1

$A = 1 \times 2$   
 $10 \quad 12$   
 $L = 10$   
 $R = 12$   
 $C = 10$   
 $F0 = 10$   
 $A = 1 \times 2$   
 $16 \quad 19$   
 $L = 16$   
 $R = 19$   
 $C = 16$   
 $F0 = 16$   
 $A = 1 \times 2$   
 $7 \quad 17$   
 $L = 7$   
 $R = 17$   
 $C = 7$   
 $F0 = 7$   
 $A = 1 \times 2$   
 $4 \quad 20$   
 $L = 4$   
 $R = 20$   
 $C = 4$   
 $F0 = 4$   
 $A = 1 \times 2$   
 $8 \quad 18$   
 $L = 8$   
 $R = 18$   
 $C = 8$   
 $F0 = 8$   
 $A = 1 \times 2$   
 $17 \quad 4$   
 $L = 17$   
 $R = 4$   
 $C = 4$   
 $F0 = 4$   
 $A = 1 \times 2$   
 $16 \quad 15$   
 $L = 16$   
 $R = 15$   
 $C = 15$   
 $F0 = 15$   
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 $10 \quad 5$   
 $L = 10$   
 $R = 5$   
 $C = 5$   
 $F0 = 5$   
 $A = 1 \times 2$   
 $2 \quad 5$   
 $L = 2$   
 $R = 5$   
 $C = 2$   
 $F0 = 2$   
 $A = 1 \times 2$   
 $14 \quad 12$   
 $L = 14$   
 $R = 12$   
 $C = 12$   
 $F0 = 12$   
 $A = 1 \times 2$   
 $6 \quad 14$   
 $L = 6$   
 $R = 14$

C = 6  
 F0 = 6  
 A = 1×2  
     20      7  
 L = 20  
 R = 7  
 C = 7  
 F0 = 7  
 A = 1×2  
     18      20  
 L = 18  
 R = 20  
 C = 18  
 F0 = 18  
 A = 1×2  
     20      6  
 L = 20  
 R = 6  
 C = 6  
 F0 = 6  
 A = 1×2  
     3      2  
 L = 3  
 R = 2  
 C = 2  
 F0 = 2  
 A = 1×2  
     12      5  
 L = 12  
 R = 5  
 C = 5  
 F0 = 5  
 A = 1×2  
     6      6  
 L = 6  
 R = 6  
 C = 6  
 F0 = 6  
 A = 1×2  
     9      14  
 L = 9  
 R = 14  
 C = 9  
 F0 = 9  
 A = 1×2  
     8      18  
 L = 8  
 R = 18  
 C = 8  
 F0 = 8  
 A = 1×2  
     3      17  
 L = 3  
 R = 17  
 C = 3  
 F0 = 3  
 A = 1×2  
     5      4  
 L = 5  
 R = 4  
 C = 4  
 F0 = 4  
 A = 1×2  
     19      7

L = 19  
 R = 7  
 C = 7  
 F0 = 7  
 A = 1×2  
     6      19  
 L = 6  
 R = 19  
 C = 6  
 F0 = 6  
 A = 1×2  
     5      5  
 L = 5  
 R = 5  
 C = 5  
 F0 = 5  
 A = 1×2  
     2      2  
 L = 2  
 R = 2  
 C = 2  
 F0 = 2  
 A = 1×2  
     16      14  
 L = 16  
 R = 14  
 C = 14  
 F0 = 14  
 A = 1×2  
     20      13  
 L = 20  
 R = 13  
 C = 13  
 F0 = 13  
 A = 1×2  
     18      7  
 L = 18  
 R = 7  
 C = 7  
 F0 = 7  
 A = 1×2  
     10      19  
 L = 10  
 R = 19  
 C = 10  
 F0 = 10  
 A = 1×2  
     19      8  
 L = 19  
 R = 8  
 C = 8  
 F0 = 8  
 A = 1×2  
     12      1  
 L = 12  
 R = 1  
 C = 1  
 F0 = 1  
 A = 1×2  
     13      15  
 L = 13  
 R = 15  
 C = 13  
 F0 = 13

$A = 1 \times 2$   
8      3  
 $L = 8$   
 $R = 3$   
 $C = 3$   
 $F\emptyset = 3$   
 $A = 1 \times 2$   
17      4  
 $L = 17$   
 $R = 4$   
 $C = 4$   
 $F\emptyset = 4$   
 $A = 1 \times 2$   
19      14  
 $L = 19$   
 $R = 14$   
 $C = 14$   
 $F\emptyset = 14$   
 $A = 1 \times 2$   
9      19  
 $L = 9$   
 $R = 19$   
 $C = 9$   
 $F\emptyset = 9$   
 $A = 1 \times 2$   
15      4  
 $L = 15$   
 $R = 4$   
 $C = 4$   
 $F\emptyset = 4$   
 $A = 1 \times 2$   
3      1  
 $L = 3$   
 $R = 1$   
 $C = 1$   
 $F\emptyset = 1$   
 $A = 1 \times 2$   
9      2  
 $L = 9$   
 $R = 2$   
 $C = 2$   
 $F\emptyset = 2$   
 $A = 1 \times 2$   
17      4  
 $L = 17$   
 $R = 4$   
 $C = 4$   
 $F\emptyset = 4$   
 $A = 1 \times 2$   
14      18  
 $L = 14$   
 $R = 18$   
 $C = 14$   
 $F\emptyset = 14$   
 $A = 1 \times 2$   
4      19  
 $L = 4$   
 $R = 19$   
 $C = 4$   
 $F\emptyset = 4$   
 $A = 1 \times 2$   
6      12  
 $L = 6$   
 $R = 12$

C = 6  
 F0 = 6  
 A = 1×2  
     7      14  
 L = 7  
 R = 14  
 C = 7  
 F0 = 7  
 A = 1×2  
     7      8  
 L = 7  
 R = 8  
 C = 7  
 F0 = 7  
 A = 1×2  
     19      9  
 L = 19  
 R = 9  
 C = 9  
 F0 = 9  
 A = 1×2  
     14      5  
 L = 14  
 R = 5  
 C = 5  
 F0 = 5  
 A = 1×2  
     1      18  
 L = 1  
 R = 18  
 C = 1  
 F0 = 1  
 A = 1×2  
     15      6  
 L = 15  
 R = 6  
 C = 6  
 F0 = 6  
 A = 1×2  
     10      2  
 L = 10  
 R = 2  
 C = 2  
 F0 = 2  
 A = 1×2  
     12      16  
 L = 12  
 R = 16  
 C = 12  
 F0 = 12  
 A = 1×2  
     15      10  
 L = 15  
 R = 10  
 C = 10  
 F0 = 10  
 A = 1×2  
     1      12  
 L = 1  
 R = 12  
 C = 1  
 F0 = 1  
 A = 1×2  
     17      14

L = 17  
 R = 14  
 C = 14  
 F0 = 14  
 A = 1×2  
     5          4  
 L = 5  
 R = 4  
 C = 4  
 F0 = 4  
 A = 1×2  
     6          20  
 L = 6  
 R = 20  
 C = 6  
 F0 = 6  
 A = 1×2  
     10          1  
 L = 10  
 R = 1  
 C = 1  
 F0 = 1  
 A = 1×2  
     18          2  
 L = 18  
 R = 2  
 C = 2  
 F0 = 2  
 A = 1×2  
     12          18  
 L = 12  
 R = 18  
 C = 12  
 F0 = 12  
 A = 1×2  
     5          20  
 L = 5  
 R = 20  
 C = 5  
 F0 = 5  
 A = 1×2  
     13          15  
 L = 13  
 R = 15  
 C = 13  
 F0 = 13  
 A = 1×2  
     12          3  
 L = 12  
 R = 3  
 C = 3  
 F0 = 3  
 A = 1×2  
     18          20  
 L = 18  
 R = 20  
 C = 18  
 F0 = 18  
 A = 1×2  
     16          10  
 L = 16  
 R = 10  
 C = 10  
 F0 = 10

```

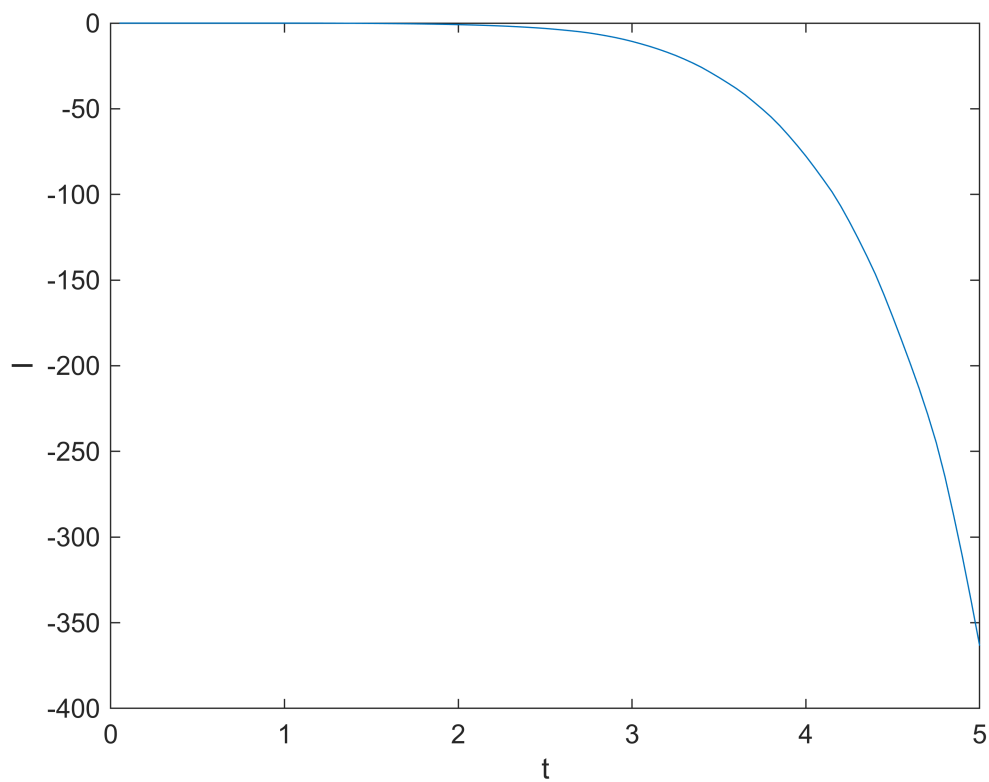
A = 1×2
    16     9
L = 16
R = 9
C = 9
F0 = 9
A = 1×2
     8    17
L = 8
R = 17
C = 8
F0 = 8
A = 1×2
    11     7
L = 11
R = 7
C = 7
F0 = 7
A = 1×2
     5    12
L = 5
R = 12
C = 5
F0 = 5
A = 1×2
     4     4
L = 4
R = 4
C = 4
F0 = 4

```

```

plot(t,I(:,1))
xlabel('t'); ylabel('I')

```





```
[t(end), I(end,:)] %This shows the last entry of vector x1 and matrix y1. Note that we set xf=
```

```
ans = 1x3  
5.0000 -363.4240 -558.4397
```

```
function dy= FinalExam2a(t,y)  
if t < 1  
    dy=zeros(2,1);  
    dy(1) = 0  
    dy(2) = 0  
  
else  
    rng('shuffle')  
  
    A=randi([1,20],1,2)  
  
    L=A(1), R=A(2), C=min(A), F0=min(A)  
    dy=zeros(2,1); %dy is a column vector!  
    dy(1) = y(2);  
    dy(2) = (R/L)*y(2)+(1/(L*C))*y(1)-(F0/L)*heaviside(t-1);  
    %end of function  
end  
end
```