Experiment 2.2

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Objectives

To learn to use MATLAB and the Symbolic Math Toolbox to

1. Find Laplace transforms for time functions
2. Find time functions from Laplace transforms
3. Create LTI transfer functions from symbolic transfer functions.
4. Perform solutions of symbolic simultaneous equations.

Minimum Required Software Packages

MATLAB, the Symbolic Math Toolbox, and the Control System Toolbox.

Prelab

Problem 1

Using a hand calculation, find the Laplace transform of:

$$f(t) = 0.0075 - 0.00034e^{-2.5t}\cos(22t) + 0.087e^{-2.5t}\sin(22t) - 0.0072e^{-8t}$$

Answer:

Problem 2

Using a hand calculation, find the inverse Laplace transform of: $F(s) = \dfrac{2(s+3)(s+5)(s+7)}{s(s+8)(s^2+10s+100)}$

Answer:

Problem 3

Use a hand calculation to solve the circuit for the Laplace Transform of the loop currents shown in the Figure below

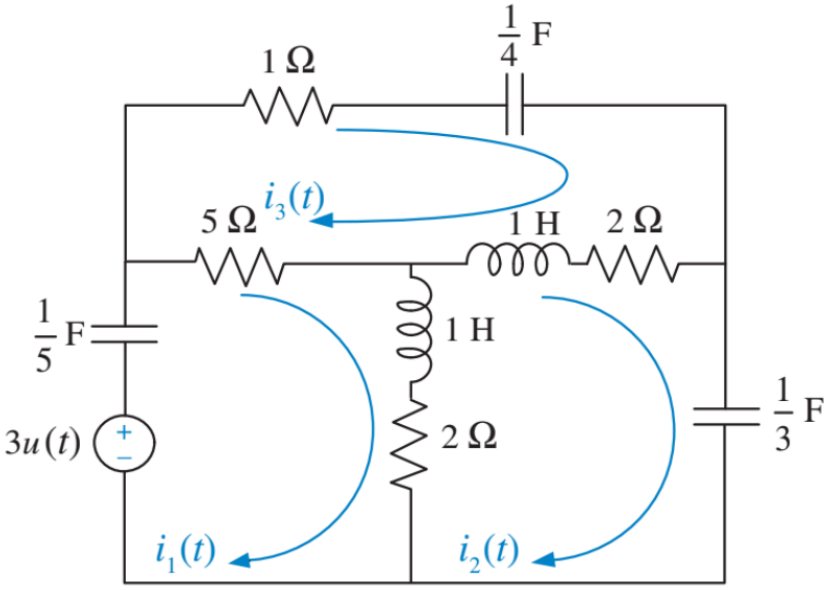


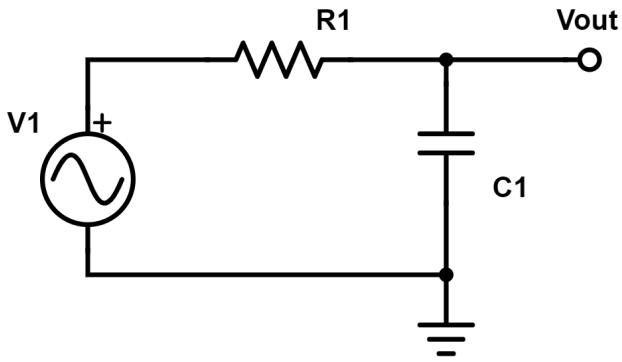
FIGURE P2.41

Answer:

Problem 4

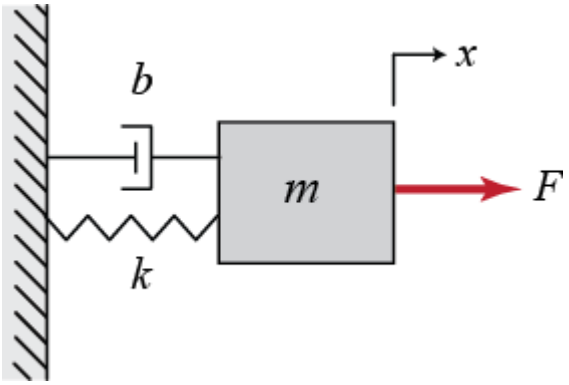
Calculate by hand the transfer function of the following systems. Then solve for the rise time, poles, and the steady-state final value for the step-response.

4.a.



Answer:

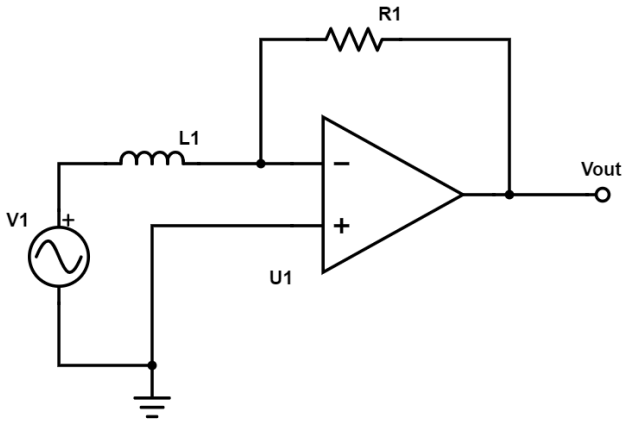
4.b.



For this system, you can ignore the Spring k. You will be looking for the displacement caused by the force.

Answer:

4.c.



Answer:

Lab

Problem 1

Use MATLAB and the Symbolic Math Toolbox to

1.a.

Generate symbolically the time function f(t) shown in Prelab Problem 1

```
% Insert your code here
```

1.b.

Generate symbolically F(s) shown in Prelab Problem 2. Obtain your result symbolically in both factored and polynomial form

```
% Insert your code here
```

1.c.

Find the Laplace Transform of f(t) shown in Prelab Problem 1

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% Insert your code here
```

1.d.

Find the inverse Laplace Transform of F(s) shown in Prelab Problem 2

```
% Insert your code here
```

1.e.

Generate an LTI transfer function for your symbolic representation of F(s) in Prelab Problem 2 in both Polynomial form and Factored form. Start with the F(s) you generated symbolically.

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% Insert your code here
```

1.f.

Solve for the Laplace transforms of the loop currents in Prelab Problem 3

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% Insert your code here
```

Postlab

Problem 1

Discuss the advantages and disadvantages between the Symbolic Math Toolbox and MATLAB alone to convert a transfer function from factored form to polynomial form and vice versa.

Problem 2

Discuss the advantages and disadvantages of using the Symbolic Math Toolbox to generate LTI transfer functions

Problem 3

Discuss the advantages of using the Symbolic Math Toolbox to solve simultaneous equations of the type generated by the electrical network shown in Prelab Problem 3. Is it possible to solve these equations via MATLAB alone? Explain.

Problem 4

Discuss any other observations you had using the Symbolic Math Toolbox.