

ECE-205

Exam 1

Fall 2010

Calculators can only be used for simple calculations. Solving integrals, differential equations, systems of equations, etc. does not count as a simple calculation.

You must show your work to receive credit.

Problem 1 _____/10

Problem 2 _____/20

Problem 3 _____/30

Problem 4-13 _____/40

Total _____

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1) (10 points) For a first order system described by the differential equation

$$2\dot{y}(t) + 3ty(t) = x(t-1)$$

with $t_0 = 0$ and $y(t_0) = 1$, use integrating factors to solve the differential equation. Include the initial conditions in your solution.

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2) (20 points) Assume we have a first order system with the governing differential equation

$$0.4\dot{y}(t) + y(t) = 3x(t)$$

The system has the initial value of 1, so $y(0) = 1$. The input to this system is

$$x(t) = \begin{cases} 0 & t < 0 \\ -1 & 0 \leq t < 1 \\ 3 & 1 \leq t < 2 \\ -2 & 2 < t \end{cases}$$

Determine the output of the system in each of the above time intervals. *Simplify your final answer as much as possible and box it. Be sure to include the correct initial value in the first interval!*

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3) (30 points) For the following three differential equations, assume the input is $x(t) = 4u(t)$ (the input is equal to four for time greater than zero), and the initial conditions are $y(0) = \dot{y}(0) = 0$

Determine the solution to each of the following differential equations and put your final answer in a box. Be sure to use the initial conditions to solve for all unknowns. You must show all your work to receive credit.

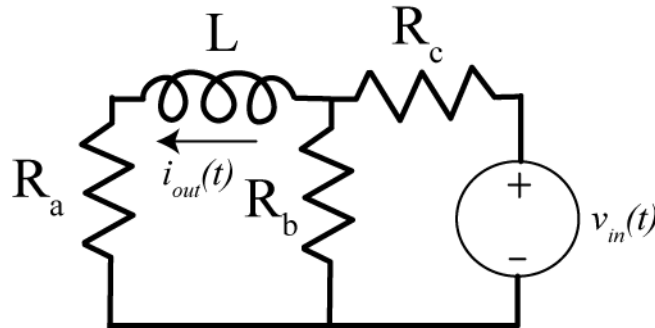
a) $\ddot{y}(t) + 3\dot{y}(t) + 2y(t) = x(t)$

b) $\ddot{y}(t) + 4\dot{y}(t) + 4y(t) = 8x(t)$

c) $\ddot{y}(t) + 4\dot{y}(t) + 16y(t) = 4x(t)$

Problems 4-13, 4 points each, no partial credit (40 points)

Problems 4 and 5 refer to the following circuit



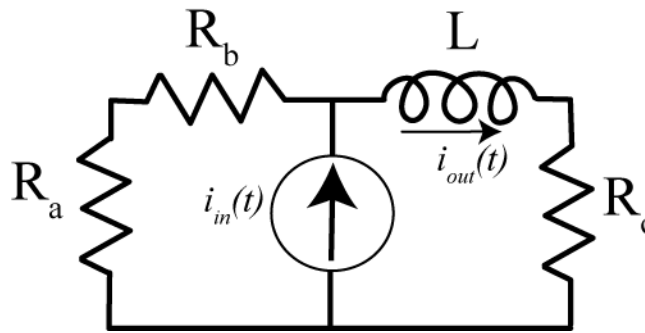
4) The Thevenin resistance seen from the ports of the inductor is

- a) $R_{th} = R_a + R_b \parallel R_c$ b) $R_{th} = R_c + R_a \parallel R_b$ c) $R_{th} = R_a + R_b$ d) $R_{th} = R_a + R_c$ e) none of these

5) The static gain for the system is

- a) $K = 1$ b) $K = \frac{R_b}{R_a + R_b}$ c) $K = \frac{R_a}{R_a + R_b}$ d) $K = \frac{R_b}{R_c + R_b}$ e) none of these

Problems 6 and 7 refer to the following circuit



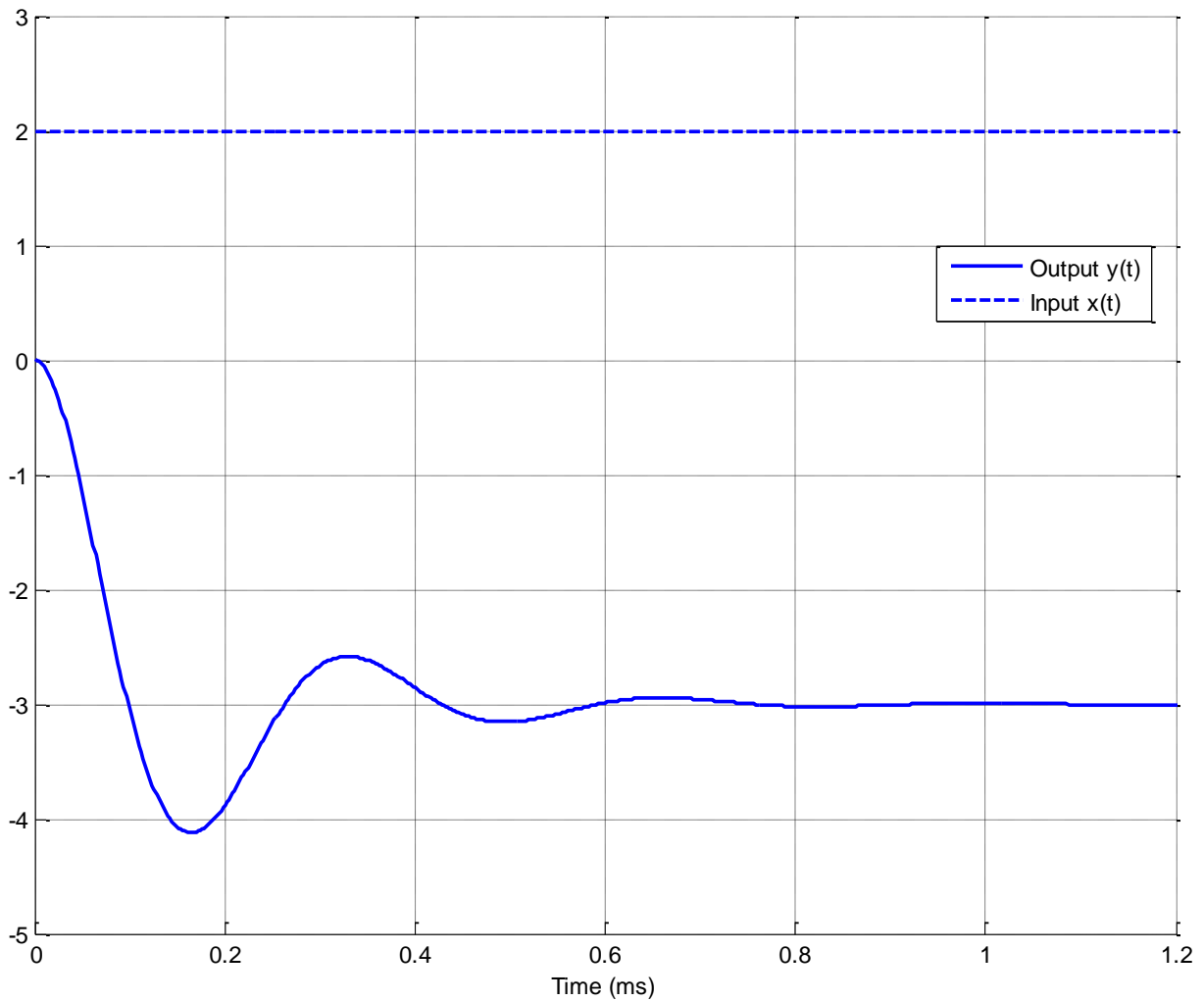
6) The Thevenin resistance seen from the ports of the inductor is

- a) $R_{th} = R_c \parallel (R_a + R_b)$ b) $R_{th} = R_c$ c) $R_{th} = R_a + R_b$ d) $R_{th} = R_a + R_b + R_c$ e) none of these

7) The static gain for the system is

- a) $K = 1$ b) $K = \frac{R_a + R_b}{R_a + R_b + R_c}$ c) $K = \frac{R_c}{R_a + R_b + R_c}$ d) $K = \frac{R_c}{R_a + R_b}$ e) none of these

Problems 8-10 refer the following graph showing the response of a second order system to a step input.



8) The percent overshoot for this system is best estimated as

- a) 400% b) -400 % c) 300% d) -300 % e) -33% f) 33%

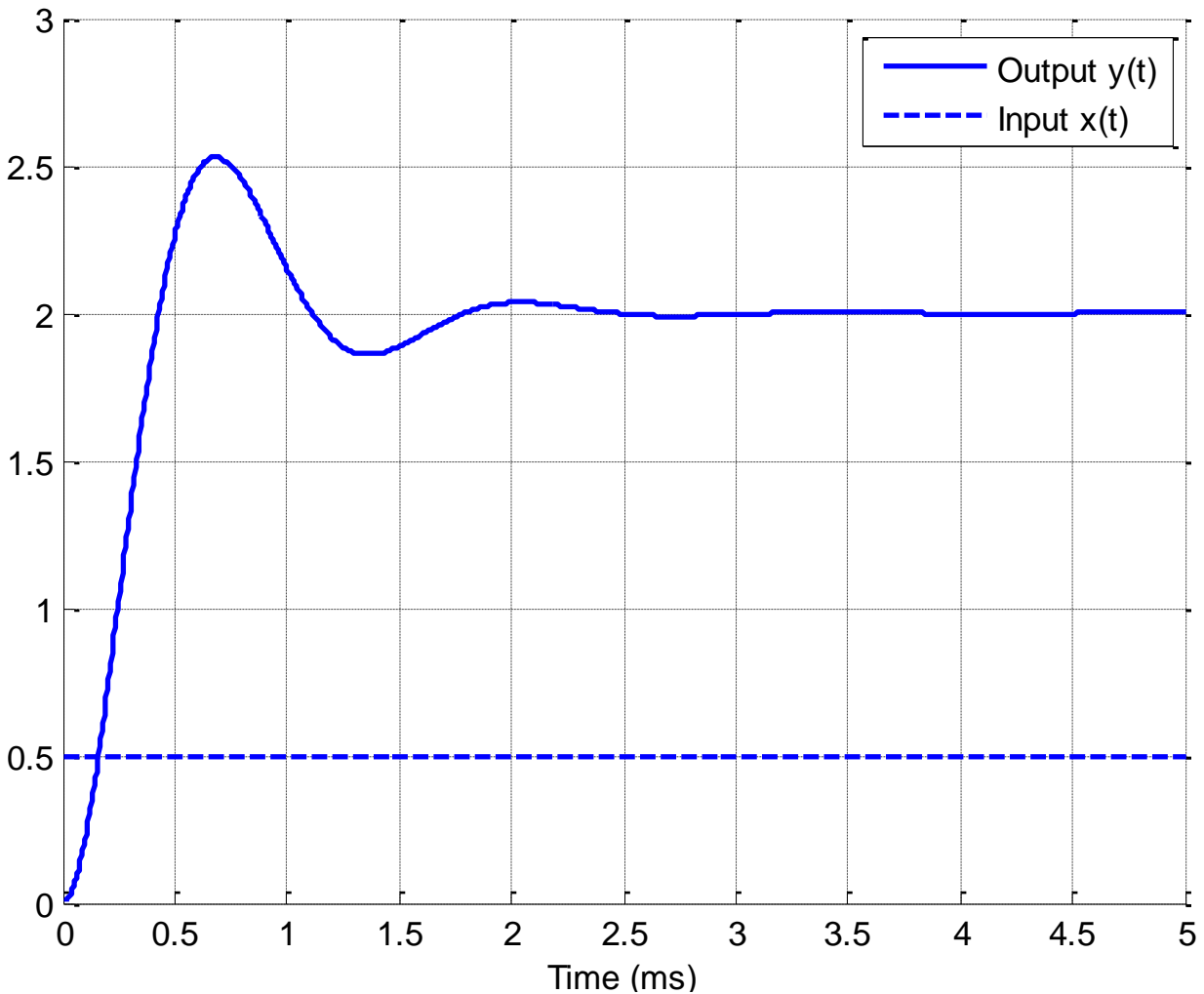
9) The (2%) settling time for this system is best estimated as

- a) 0.3 ms b) 0.6 ms c) 1.0 ms d) 1.2 ms

10) The static gain for this system is best estimated as

- a) 1.5 b) 3 c) -1.5 d) -3

Problems 11-13 refer the following graph showing the response of a second order system to a step input.



11) The percent overshoot for this system is best estimated as

- a) 400% b) 250 % c) 200% d) 150 % e) 100 % f) 25%

12) The (2%) settling time for this system is best estimated as

- a) 1.5 ms b) 2.5 ms c) 4 ms d) 5 ms

13) The static gain for this system is best estimated as

- a) 1 b) 2 c) 3 d) 4

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