Homework #4: ECE 461

LaPlace Transforms - 1st & 2nd-Order Approximations - Block Diagrams Due Monday, September 24, 2018

LaPlace Transforms

Problem 1: A system has the following transfer function

$$Y = \left(\frac{10(s+6)}{(s+1)(s+7)(s+10)} \right) X$$

1a) What is the differential equation which relates X and Y?

1b) Determine y(t) assuming

$$x(t) = 2 + 3\cos(4t)$$

1c) Determine y(t) assuming

$$x(t) = \begin{cases} 0 & t < 0 \\ 2 & t > 0 \end{cases}$$

1d) Compare your answer for part c) with the response from Matlab

```
G = zpk([-6], [-1, -7, -10], 10);
t = [0:0.01:10]';
y = 2*step(G,t);
```

Problem 2: A system has the following transfer function

$$Y = \left(\frac{50}{(s^2+2s+10)(s+30)} \right) X$$

2a) What is the differential equation which relates X and Y?

2b) Determine y(t) assuming

$$x(t) = 2 + 3\cos(4t)$$

2c) Determine y(t) assuming

$$x(t) = \begin{cases} 0 & t < 0 \\ 2 & t > 0 \end{cases}$$

2d) Compare your answer for part c) with the response from Matlab

```
G = zpk([], [-1+j*3, -1-j*3, -30], 50);
t = [0:0.01:10]';
y = 2*step(G,t);
```

1st & 2nd Order Approximations

Problem 3: Determine a 1st-order system which has approximately the same step response as this system

$$Y = \left(\frac{100{,}000}{(s+2)(s+7)(s+10)(s+15)} \right) X$$

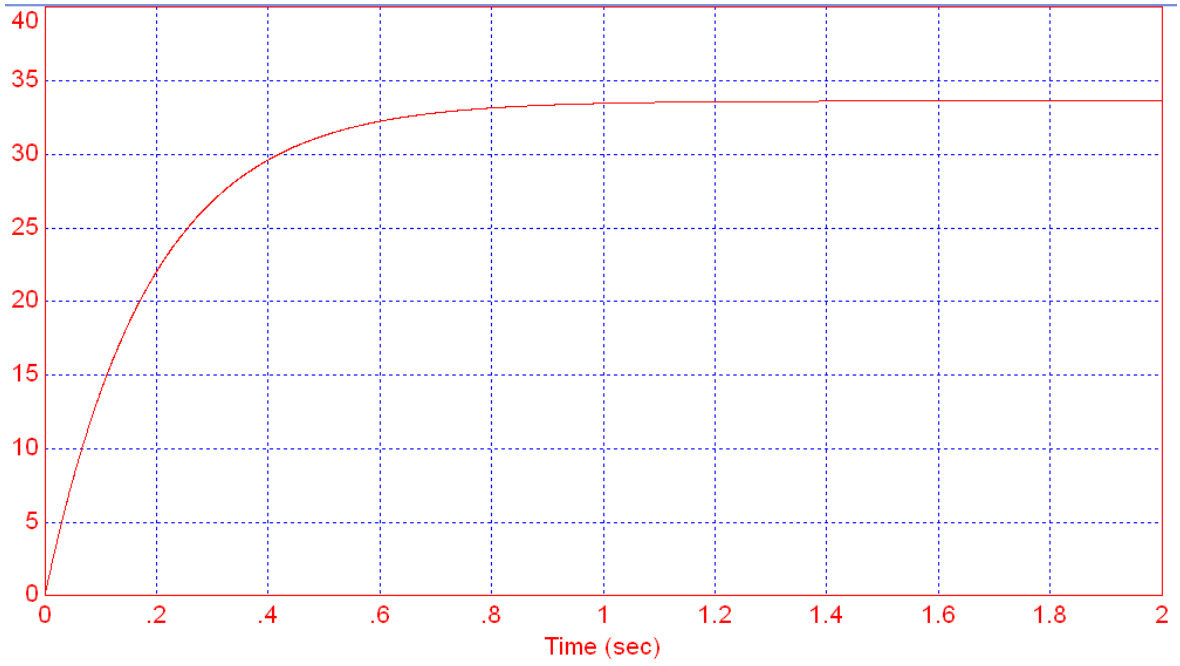
Compare the step response of the two systems in Matlab (or similar program)

Problem 4: Determine a 2nd-order system which has approximately the same step response as this system

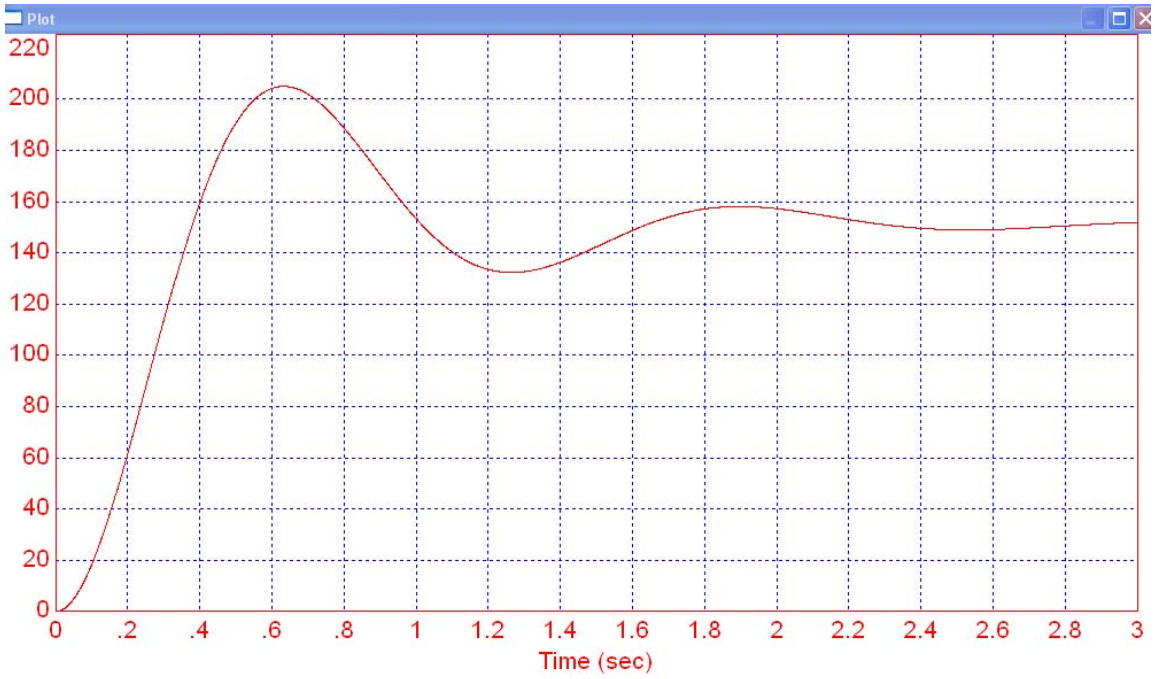
$$Y = \left(\frac{100{,}000}{(s^2+3s+15)(s+20)(s+50)} \right) X$$

Compare the step response of the two systems in Matlab (or similar program)

Problem 5: Find the transfer function for a system with the following step response:

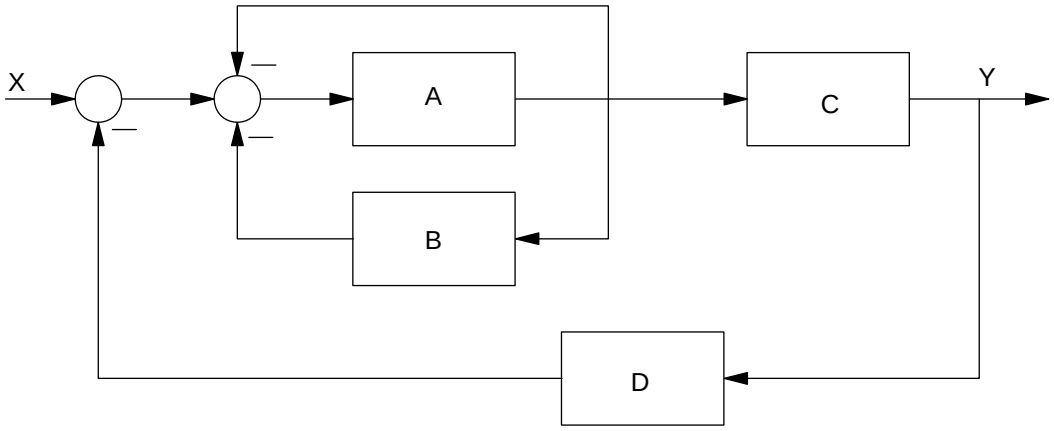


Problem 6: Find the transfer function for a system with the following step response:

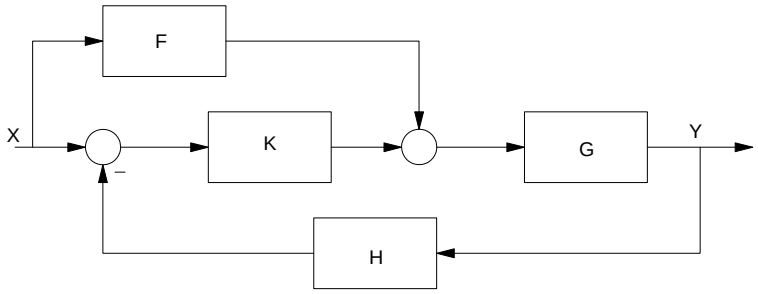


Block Diagrams

Problem 7) Find the transfer function from X to Y



Problem 8: Find the transfer funciton from X to Y



Problem 9: Find the transfer funciton from X to Y