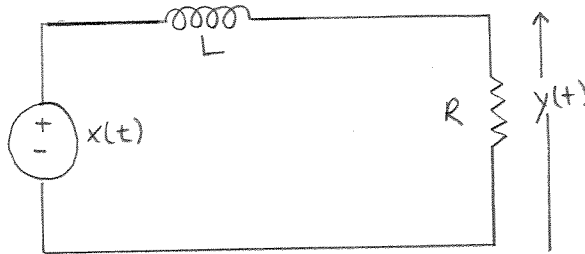


**ECE 360 HOMEWORK #2**  
**Due September 18, 2002**

- Homeworks will be collected before the class begins on the due date.
- Office Hours: M,T,F 10:00-11:30 am at 2210 Engineering Building
- Read Chapter 4 from Ambardar.

1. [20] Consider the RL circuit shown below.

- a) Find the input-output relationship for this circuit.
  - b) Is this system stable? Causal? Dynamic?
  - c) Determine the response of this system to the input signal  $x(t) = e^{-t}u(t-3)$ . Assume  $R=3$  and  $L=1$ , and  $y(0)=0$ .
- Hint:  $e^{-t}u(t-3) = e^{-3}e^{-(t-3)}u(t-3)$ , and use properties of the system.



2. [25] Determine if the following systems are linear, time-invariant, static, causal, stable.

- a)  $y(t) = \sin[x(t+3)]$
- b)  $y(t) = e^{x(t)}$
- c)  $y(t) = \frac{d}{dt}x(t)$  (Differentiator)
- d)  $y(t) = \text{sgn}[x(t)]$  (Sign Inversion)
- e)  $y(t) = x(2t)$  (Time-scaling system)

3. [15] 4.26 from Ambardar

4. [15] A system is governed by the differential equation

$$\pi \frac{df}{dt} = 5 \frac{d^2 y}{dt^2} - \frac{dy}{dt} + 0.25y(t)$$

where  $f(t)$  is the input,  $y(t)$  the output.

- a) Find the natural response of the system.

- b) Find the zero-input response of the system given  $y(0)=1$  and  $y'(0)=-1$ .  
 c) Is this system stable? Justify your answer.

5. [25] The differential equation for the mass-spring-damper system described in class is given by

$$M \frac{d^2 y(t)}{dt^2} + D \frac{dy(t)}{dt} + Ky(t) = x(t)$$

- a) Find the zero-state response of the system to  $x(t) = u(t)$  for  $M=10$ ,  $D=1$ ,  $K=1$ .  
 b) Plot the response over time using MATLAB. You can use the following commands.

```
%example for plotting;
%let y(t)=e^(-t)*sin(2t);
%define time axis;
t=[0:.1:10];
y=exp(-t).*sin(2*t);
plot(t,y)
grid;
xlabel('Time')
ylabel('y(t)')
```

- c) Determine the transient response of the system and from the graph approximate how long it takes for that response to die out.  
 d) Find the zero-state response of the system for an input of  $x(t) = 10 \cos(0.2t)$ .  
 e) Plot the response over time using MATLAB. Determine the steady-state response of the system.

