1. In the above RL circuit, the inductor voltage satisfies the equation $y(t) = L \frac{di}{dt}$.

   (a) The switch is closed at time $t = 0$; find the transfer function $H(s)$ of the system with input voltage $x(t)$ and output $y(t)$.

   (b) The sinusoidal voltage $x(t) = \cos(\omega_0 t)$ is applied after $t = 0$ and the **steady state** output of the circuit is measured to be $\frac{1}{2} \cos(\omega_0 t) - \frac{1}{2} \sin(\omega_0 t)$. Find $H(i\omega_0)$ and deduce the value of $(L\omega_0)/R$.

   (c) Determine $y(t)$ for all times (not just steady state); here you can assume $\omega_0 = 1$.

2. We are given a system with transfer function

   $$H(s) = \frac{1 - s}{s^2 + 2s + 2}.$$  

   (a) We are seeking a sinusoidal input $x(t) = \sin(\omega_0 t)$, $\omega_0 \neq 0$ such that the corresponding output is $y(t) = K \sin(\omega_0 t)$, with $K > 0$. Can this happen? If so, find $\omega_0$ and $K$.

   (b) Repeat the question if now we want an output $y(t) = -K \sin(\omega_0 t)$, with $K > 0$.

3. For the following functions, find out whether they are periodic, and if so, give the period.

   (a) $\cos(\sqrt{2} t) + \sin(1 - 3\sqrt{2} t)$;  
   (b) $u(\sin(t))$  
   (c) $\sin(u(t))$.

4. Consider the periodic function $f$ of period 2 defined by $f(t) = t^2$ for $-1 < t < 1$.

   (a) Find the Fourier series representation $\sum_{n=-\infty}^{\infty} F_n e^{i\omega_0 t}$.

   (b) Find the sine-cosine Fourier series representation.