1. Consider the differential equation below with initial conditions given.

$$\frac{d^2x}{dt^2} + 4\frac{dx}{dt} + 20x = f(t), \quad x(0) = \frac{dx}{dt}(0) = 0$$

   (a) Find the form of the natural response with cosine and sine terms as well as only a cosine term. Note there will be two unknown coefficients in your answers. Is this differential equation's natural response overdamped or underdamped?

   (b) Given $f(t) = e^{jt}$, solve for the forced response representing complex numbers in polar (complex exponential) form.

   (c) Given $f(t) = \cos(t)$, solve for the forced response and write it using only a cosine.

   (d) Do you notice any similarities in the answers to parts (b) and (c)? Why should they be similar and what type of analysis does this enable?

2. Problem 6.27 via classical techniques noting $r(t) = tu(t)$ and zero-state implies zero initial conditions. Is the circuit's natural response overdamped or underdamped?