Applications of Higher Order Linear Differential Equations

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1. A mass of 1kg is attached to a spring with spring constant 5N/m. The system is subject to damping with a damping coefficient of 6kg/sec. An external force given by $f(t) = 12e^t$ initially stretches the spring 1m. The spring is then released with no initial velocity. Find the equation of motion $x(t)$.
$$mx''(t) + bx'(t) + kx(t) = f(t)$$

2. An electric circuit is being analyzed on an oscilloscope. The circuit contians the elements $C = 400\mu\text{F}$, $L = 1.00\text{H}$, $R = 10.0\Omega$ and a voltage source of $500 \sin 100t$. Find the current as a function of time if the initial current and charge are 0.
$$L\frac{d^2q}{dt^2} + R\frac{dq}{dt} + \frac{q}{C} = E(t)$$

3. A uniform beam of length L is hinged at both ends and has a constant load distribution of w due to its own wieght. Find the deflection y of the beam in terms of the distance x from one end.
$$EI\frac{d^4y}{dx^4} = w(x)$$