

MATH045/EE020A ODE HW week#7

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Due May. 20, 2022

1. At $t = 0$ a current of 2 amperes flows in an RLC circuit with resistance $R = 4$ ohms, inductance $L = 0.05$ henrys, and capacitance $C = 0.008$ farads. The initial charge on the capacitor is -1 coulomb, and there is no impressed voltage for $t > 0$.
 - (a) Find the current flowing in the circuit at $t > 0$.
 - (b) Show that the current is a transient solution.
2. Consider an RLC circuit with resistance $R = 2$ ohms, inductance $L = 0.1$ henrys, and capacitance $C = 0.01$ farads. The initial charge and current is 1 coulomb and 10 amperes, respectively. Assume that there is an impressed voltage of $3 \cos 50t - 6 \sin 50t$.
 - (a) Find the particular solution of the current, in other words, steady state solution of the current.
 - (b) Does the initial charge and current affect the steady state current?
3. Consider the same RLC circuit as in problem 2, with impressed voltage of $6 \cos 10t - 3 \sin 10t$.
 - (a) Find the particular solution of the current, in other words, steady state solution of the current.
 - (b) Compare the amplitude of the steady state current between problem 2 and 3. Which is larger?
4. Find the Laplace transformation of the following functions and the range of s that it is valid.
 - (a) t^2
 - (b) $e^{-2t} + 3e^t$
5. Find the Laplace transformation of the following functions and the range of s that it is valid.
 - (a) $\sin\left(t + \frac{\pi}{4}\right)$
 - (b) $\sin^2(t)$ (Hint. use trigonometric identities to reduce the power)