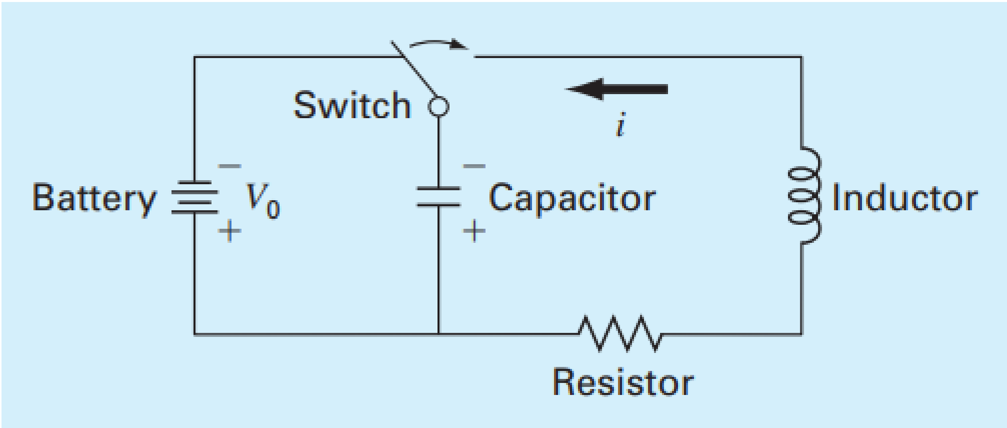
Task4

1 Warm-up question

A simple electric circuit consisting of a resistor, a capacitor, and an inductor is depicted in Fig. P2.6. The charge on the capacitor q(t) as a function of time can be computed as

$$q(t) = q_0 e^{-Rt/(2L)} \cos\left[\sqrt{\frac{1}{LC} - \left(\frac{R}{2L}\right)^2}\, t\right]$$



where t = time, q0 = the initial charge, R = the resistance, L = inductance, and C = capacitance. Use .PY/.M file format to generate a plot of this function from t = 0 to 0.8, given that q0 = 10, R = 60, L = 9, and C = 0.00005.

2 Warm-up question

The standard normal probability density function is a bell-shaped curve that can be represented as

$$f(z) = \frac{1}{\sqrt{2\pi}} e^{-z^2/2}$$

Use PYTHON/MATLAB to generate a plot of this function from z = −5 to 5. Label the coordinate as frequency and the axis as z.

3 Rethinking

Manning's equation can be used to compute the velocity of water in a rectangular open channel:

$$U = \frac{\sqrt{S}}{n}\left(\frac{BH}{B+2H}\right)^{2/3}$$

where U = velocity (m/s), S = channel slope, n = roughness coefficient, B = width (m), and H = depth (m). The following data are available for five channels:

n	***S***	***B***	***H***
0.035	0.0001	10	2
0.020	0.0002	8	1
0.015	0.0010	20	1.5
0.030	0.0007	24	3
0.022	0.0003	15	2.5

Store these values in a matrix where each row represents one of the channels and each column represents one of the parameters. Write a single-line .py/.m statement to compute a column vector containing the velocities based on the values in the parameter matrix.

4 Diagnostic problem

The trajectory of an object can be modeled as

$$y = (\tan\theta_0)x - \frac{g}{2v_0^2\cos^2\theta_0}x^2 + y_0$$

where y = height (m), θ0 = initial angle (radians), x = horizontal distance (m), g = gravitational acceleration (= 9.81 m/s2), v0 = initial velocity (m/s), and y0 = initial height. Use MATLAB/PYTHON to find the trajectories for y0 = 0 and v0 = 28 m/s for initial angles ranging from 15 to 75° in increments of 15°. Employ a range of horizontal distances from x = 0 to 80 m in increments of 5 m. The results should be assembled in an array where the first dimension (rows) corresponds to the distances, and the second dimension (columns) corresponds to the different initial angles. Use this matrix to generate a single plot of the heights versus horizontal distances for each of the initial angles. Employ a legend to distinguish among the different cases, and scale the plot so that the minimum height is zero using the axis command.

5 Home work

The butterfly curve is given by the following parametric equations:

$$x = \sin(t)\left(e^{\cos t} - 2\cos 4t - \sin^5 \frac{t}{12}\right)$$

$$y = \cos(t)\left(e^{\cos t} - 2\cos 4t - \sin^5 \frac{t}{12}\right)$$

It can can also be represented in polar coordinates as

$$r = e^{\sin\theta} - 2\cos(4\theta) - \sin^5\left(\frac{2\theta - \pi}{24}\right)$$

Generate values of r for values of θ from 0 to 8π with $\Delta\theta = \pi/32$. Use the PYTHON/MATLAB function polar to generate the polar plot of the butterfly curve with a dashed red line. Employ the PYTHON/MATLAB Help to understand how to generate the plot.

MAX SCORE =25 POINTS

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