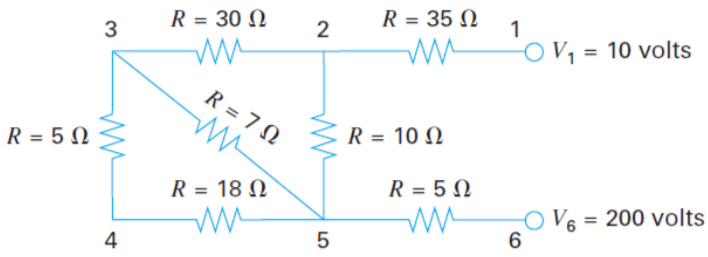
Scientific Computing and Mathematical Modeling
MSc by Research in Electrical and Electronics Engineering
Department of Electrical and Electronics Engineering
Sample Project

You can use any method and any Scientific Computing Environment to solve the following problems.
In your solution you should develop the rationale of the solution and include the setup of the problem and the solution runs.

Problem 0.1 *An oscillating current in an electronic circuit is described as* $i(t) = 9\exp^{-t}\cos(2\pi t)$, *where time* t *is measured in* $secs$. *Determine all values such that* $i(t) = 3.5$.

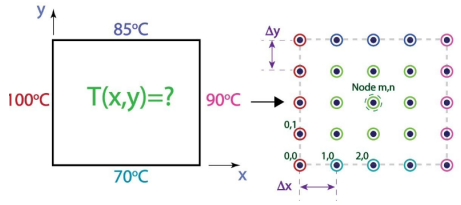
Problem 0.2 *Apply Kirchhoff's Laws to compute the voltage in any branch of the following circuit.*



Problem 0.3 *The temperature distribution on a heated plate can be modeled by Laplace Equation.*

$$\frac{\partial^2 T}{\partial x^2}(x\,,\,y) + \frac{\partial^2 T}{\partial y^2}(x\,,\,y) = 0$$

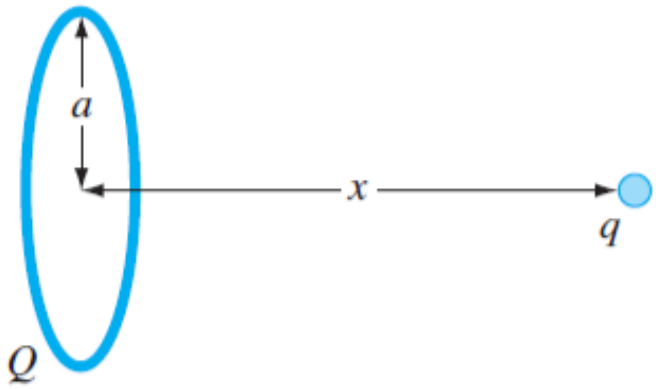
If the plate is described by the following grid and derivatives are approximated by a central differences formula the problem is transformed into a linear system. Approximate the temperature in the nodes.



Problem 0.4 *A total electric charge Q is uniformly distributed around a ring-shaped conductor of radius a. Another charge q lies in distance x from the center of the ring. The force exerted on the load by the ring is given by the relation:*

$$F = \frac{1}{4\pi e_0} \frac{qQx}{(x^2 + a^2)^{\frac{3}{2}}}$$

where $e_0 = 8.85 \times 10^{-12}\, C^2/(n \cdot m^2)$, $q = Q = 2 \times 10^{-5}\, C$ and $a = 0.9\, m$. Determine the distance x at which the force on the charge q takes its maximum value.



Σχήμα 1: Σχήμα της ’σκησης 4