MECH105: Homework 15

Linear algebraic equations can arise in the solution of differential equations (see section 9.5 in your book). The followeing differential equation results from a steady-state mass balance for a chemical in a one-dimensional canal,

$$0 = D\frac{d^2c}{dx^2} - U\frac{dc}{dx} - kc$$

where x is the distance along the canal (m), c is the concentration, t is the time, D is the diffusion coefficient, U is the fluid velocity, and k is the first-order decay rate.

Part 1

Convert the differential equation into an equivalent system of simultaneous linear algebraic equations using the centered finite difference approximations for the derivatives.

Part 2

Develop a function to solve these equations from $x = 0$ to $x = L$ and return the resulting distances and concentrations. The first line of your function should be:

```
function [x,c] = YourLastName_reactor(D, U, k, c0, cL, L, dx)
```

Part 3

Develop a script that invokes this function and then plots the results.

Part 4

Test your script for the following parameters: $L = 10m$, $\Delta x = 0.5m$, $D = 2m^2/d$, $U = 1m/d$, $k = 0.2/d$, $c(0) = 80mg/L$, and $c(10) = 20mg/L$.