

GLY 5826**Assignment 3**

1. Beginning with the 1-D Laplace equation ($\frac{\partial^2 h}{\partial x^2} = 0$), write a general analytical expression for $h(x)$. Using the boundary conditions $h(0) = 0$ m and $h(100) = 1$ m, solve for the constants in your general expression and write the specific solution.
2. Repeat 1 but change the BCs to $dh/dx|_{x=0} = 10^{-3}$ and $h(100) = 1$.
3. Derive the finite difference expression for the 1-D Laplace equation ($\frac{\partial^2 h}{\partial x^2} = 0$). Show all steps.
4. In 1 you used the boundary conditions $h(0) = 0$ m and $h(100) = 1$ m, to determine the analytical solution to the 1-D Laplace equation. Now solve the same problem using a spreadsheet finite difference model. Plot the results from both approaches on the same graph; use open symbols for the numerical solution and a solid line for the analytical solution.
5. Repeat 4 but change the BCs to $dh/dx|_{x=0} = 10^{-3}$ and $h(100) = 1$.
6. Create a MATLAB 'm-file' of the lines below. Add contour labels. Add a quiver plot showing the direction of ground water flow. Note that you need to work with the transpose of h (i.e., rows and columns switched; h' in Matlab) to compute the gradient components.

```
%Wang and Anderson Equation 2.1 (Toth (1962) regional solution)
```

```
%Clear memory and close any open figures
clear
close('all')
```

```
%set up x and y loops; print x so you know progress
```

```
for x=1:100
  x
  for y = 1:50
```

```
  %Refer to Figures 1.6 and 1.7
```

```
  %c is total head gradient
  c=.001;
```

```
%s is length of domain
s=100;

%y0 is total head at x = 0
y0=60;

%Do summation
%zero accumulator term
summation=0;
%loop through 100 terms
for m=0:100

summation=summation+cos((2*m+1)*pi*x/s)*cosh((2*m+1)*pi*y/s)/((2*m+1)^2*co
sh((2*m+1)*pi*y0/s));
end

%Compute h(x,y)
h(x,y)=y0+c*s/2-4*c*s/(pi^2)*summation;
end
end

%Plot the transpose of h
contour(h')
axis('equal')
```