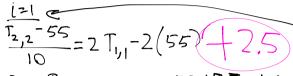
## ChBE 2120, Numerical Methods, Paravastu Section, Fall 2015 Quiz 4: 20 points possible

1) (12.5 points) Setup a matrix problem that could be used to solve the Boundary Value Problem below, describing a counter-current heat exchanger. To approximate the derivatives, use the following finite difference

formula: 
$$f'(x) \cong \frac{f(x_{l+1}) - f(x_l)}{h}$$
. Use a step size,  $h = 10$ .  $t = 1$ .

$$X=0$$
 10 20 30  $T=T_{1}$ ,  $T_{1}$ ,  $T_{2}$   $T_{3}$  25  $T=55$   $T_{2}$   $T_{3}$ 



$$\Rightarrow$$
 2  $T_{1,1} - 0.1 T_{2,2} = -110 + 5.5 = -104.5$ 

$$\frac{T_{1,2} - T_{1,1}}{10} = 1.5 \hat{J}_{1,1} - 1.5 (55)$$

$$= 3(1.5 + 0.1)T_{1,1} - 0.1T_{1,2} = 82.5$$

$$\frac{T_{2,3} - \hat{1}_{2,2}}{10} = 2\hat{1}_{1,2} - 2T_{2,2}$$

$$\Rightarrow 2T_{1,2} + (-2+01)T_{2,2} + (-0.1)T_{2,3} = 0$$

$$T_{1,2} - T_{1,2} = 0$$

$$\frac{T_{1,3}-T_{1,2}}{10}=1.5T_{1,2}-1.5T_{2,2}$$

$$\Rightarrow (1.5 + 0.1) T_{1,2} + (-1.5) T_{2,2} + (-0.1) T_{1,3} = 0$$

$$\frac{T_{2,4}-T_{2,3}}{10} = 2T_{1,3}-2T_{2,3}$$

$$\Rightarrow 2T_{1,3}+(-2+01)T_{2,3}+(-01)T_{2,4}=0$$

$$\frac{-1.7}{25-7_{1/3}}=1.57_{1/3}-1.57_{2/3}$$

$$\frac{25 - T_{1,3}}{10} = 1.5T_{1,3} - 1.5T_{2,3}$$

$$\frac{6}{2} - \frac{1}{19} = \frac{1}{19} =$$

$$\begin{bmatrix} T_{2,3} \\ T_{2,14} \end{bmatrix} \begin{bmatrix} 0 \\ 2.5 \end{bmatrix}$$

2) (7.5 points) Using the functions defined in the headers below, write Matlab code to solve Problem (1) using the Shooting Method.

[~, Tseries]=ODERungeKutta4(@InitialValveODE,[0 30],[55; alpha], 0.01);

IVPEnor=Tseries(2,end)-25;

Function Header 1: function [ Tprime ] = InitianValueODE( x, T )

Function Header 2: function [ tSolution, Ysolution ] = ODERungeKutta4 ( Yprime, tRange, Y0, h )

%Y = [T2; T1]

Function Header 3: function [ xRoot ] = SecantMethod( x0, x1, f, EaMax )