$$7\left(\frac{1}{h^2}(y_{i+1} - 2y_i + y_{i-1})\right) - 2\left(\frac{1}{2h}(y_{i+1} - y_{i-1})\right) - y_i$$

$$\underbrace{\left(\frac{7}{h^2} + \frac{2}{2h}\right)}_{\alpha} y_{i-1} + \underbrace{\left(\frac{-14}{h^2} - 1\right)}_{\beta} y_i + \underbrace{\left(\frac{7}{h^2} - \frac{2}{2h}\right)}_{\gamma} y_{i+1}$$

$\alpha = .48$

$\beta = -1.56$

$\gamma = 0.08$

$$\begin{bmatrix} -1.56 & .08 & 0 \\ .48 & -1.56 & .08 \\ 0 & .48 & -1.56 \end{bmatrix} \begin{bmatrix} y_5 \\ y_{10} \\ y_{15} \end{bmatrix} = \begin{bmatrix} -5 - 5(.48) \\ -10 \\ -15 - 8(.08) \end{bmatrix}$$

Using code:

$y_5 = 5.188$

$y_{10} = 8.687$

$y_{15} = 12.689$

Q2

$$EI\left(\frac{1}{h^2}\left(y_{i+1}-2y_i+y_{i-1}\right)\right) = \frac{wLx}{2} - \frac{wx^2}{2}$$

α: $\frac{EI}{h^2}$

β: $\frac{-2EI}{h^2}$

γ: $\frac{EI}{h^2}$

Q3

Nodes : $[0.0,\ 0.5,\ 1.0,\ 1.5,\ 2.0]$

$$\frac{\partial^2 T}{\partial x^2} = \frac{hP}{kA}(T - T_\infty)$$

$$\Rightarrow \left(\frac{1}{h^2}(y_{i-1} - 2y_i + y_{i+1})\right) = \frac{hP}{kA}(T - T_\infty)$$

$$\left(\frac{1}{h^2}(y_{i-1} - 2y_i + y_{i+1})\right) - \frac{hP}{kA} y_i = -\frac{hP}{kA} T_\infty$$

$\alpha = \frac{1}{h^2} = 0.04$

$\beta = \frac{-2}{h^2} - \frac{hP}{kA} = -4.08$

$\gamma = \frac{1}{h^2} = 0.04$

$-\frac{hP}{kA} T_\infty = -1200$

$$\begin{bmatrix} \beta & \gamma & 0 \\ \alpha & \beta & \gamma \\ 0 & \alpha & \beta \end{bmatrix} \begin{bmatrix} y_{0.5} \\ y_{1.0} \\ y_{1.5} \end{bmatrix} = \begin{bmatrix} -1200 - \alpha(600) \\ -1200 \\ -1200 - \gamma(350) \end{bmatrix}$$

$$\Rightarrow [600,\ 417,\ 350,\ 333,\ 350]$$