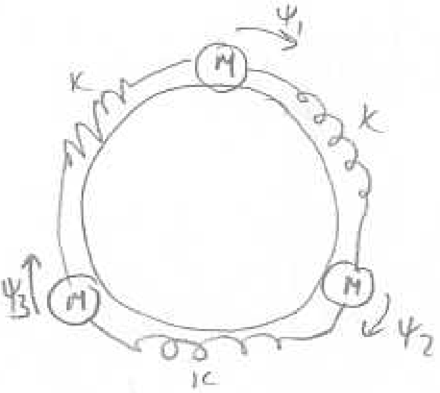

$$U = \frac{1}{2}k\left((\psi_2-\psi_1)^2+(\psi_3-\psi_2)^2+(\psi_3-\psi_1)^2\right)$$

$$\begin{cases} m\ddot{\psi}_1 = +k(\psi_2-\psi_1)+k(\psi_3-\psi_1) \\ m\ddot{\psi}_2 = -k(\psi_2-\psi_1)+k(\psi_3-\psi_2) \\ m\ddot{\psi}_3 = -k(\psi_3-\psi_2)-k(\psi_3-\psi_1) \end{cases}$$

$$\alpha \equiv \frac{k}{m}$$

$$\begin{pmatrix} \ddot{\psi}_1 \\ \ddot{\psi}_2 \\ \ddot{\psi}_3 \end{pmatrix} = -\alpha \begin{pmatrix} 2 & -1 & -1 \\ -1 & 2 & -1 \\ -1 & -1 & 2 \end{pmatrix} \begin{pmatrix} \psi_1 \\ \psi_2 \\ \psi_3 \end{pmatrix}$$

$$\begin{vmatrix} 2-\lambda & -1 & -1 \\ -1 & 2-\lambda & -1 \\ -1 & -1 & 2-\lambda \end{vmatrix} = 0$$

$$(2-\lambda)\left((2-\lambda)^2-1\right)+(-2+\lambda-1)-(1+2-\lambda) = 0$$

$$(2-\lambda)\left((2-\lambda-1)(2-\lambda+1)\right)+\lambda-3-3+\lambda = 0$$

$$(2-\lambda)(3-\lambda)(1-\lambda)+2(\lambda-3) = 0$$

$$(3-\lambda)(\cancel{2}-2\lambda-\lambda+\lambda^2-\cancel{2}) = 0$$

$$\lambda_{1,2} = 3 \quad \lambda_3 = 0$$

$\lambda=0 \Leftarrow \omega^2=0 \Leftarrow \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}$ - ו"ע $\psi_1=\psi_2=\psi_3$ - כל המסות נעות ביחד מסתובבות..

$\lambda=3 \Leftarrow \omega^2=\frac{3k}{m}$ - ע"ע מנוון פעמיים:

נבחר ו"ע $\begin{pmatrix} 1 \\ -1 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 \\ 1 \\ -2 \end{pmatrix}$

$\psi_3=0$ ו $\psi_1=-\psi_2$ $\quad \psi_3=-2\psi_1=-2\psi_2$