"FORMATTED REPORT 1"

"SYSTEM ON ENERGY EQUAPARTITION PAPER IS EXPLAINED ON 3 DOF EXAMPLE SYSTEM"

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"PART 1–ANALYTIC"

"SETTING SYSTEM ATTRIBUTES AND CONTRUCTION OF MASS AND STIFNESS MATRICES"

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"Mass Matrix"

$$\begin{pmatrix} M & 0 & 0 \\ 0 & m_2 & 0 \\ 0 & 0 & m_3 \end{pmatrix}$$

""

"Stiffness Matrix"

$$\begin{pmatrix} k_2 + k_3 + K & -k_2 & -k_3 \\ -k_2 & k_2 & 0 \\ -k_3 & 0 & k_3 \end{pmatrix}$$

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"PART 2–ANALYTIC"

"DEFINING MODAL PLANE MATRICES AND VARIABLES"

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"EigenVectors, Transformation Matrix"

$$\begin{pmatrix} U_{1,1} & U_{1,2} & U_{1,3} \\ U_{2,1} & U_{2,2} & U_{2,3} \\ U_{3,1} & U_{3,2} & U_{3,3} \end{pmatrix}$$

""

"Generalized Coordinates"

$$\begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix}$$

""

"Modal Coodrinates"

$$\begin{pmatrix} \cos(\psi_1 - t\,\omega_1)\,C_1 \\ \cos(\psi_2 - t\,\omega_2)\,C_2 \\ \cos(\psi_3 - t\,\omega_3)\,C_3 \end{pmatrix}$$

""

"Transition To Modal Coordinates"

$$\mathrm{xm} = \mathrm{Um}.\eta\mathrm{m}$$

""

"Displacement Matrix in Modal Plane"

$$\begin{pmatrix} \cos(\psi_1 - t\,\omega_1)\,C_1\,U_{1,1} + \cos(\psi_2 - t\,\omega_2)\,C_2\,U_{1,2} + \cos(\psi_3 - t\,\omega_3)\,C_3\,U_{1,3} \\ \cos(\psi_1 - t\,\omega_1)\,C_1\,U_{2,1} + \cos(\psi_2 - t\,\omega_2)\,C_2\,U_{2,2} + \cos(\psi_3 - t\,\omega_3)\,C_3\,U_{2,3} \\ \cos(\psi_1 - t\,\omega_1)\,C_1\,U_{3,1} + \cos(\psi_2 - t\,\omega_2)\,C_2\,U_{3,2} + \cos(\psi_3 - t\,\omega_3)\,C_3\,U_{3,3} \end{pmatrix}$$

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"PART 3–ANALYTIC"

"CALCULATION OF ENERGIES"

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"Kinetic Energy of Master"

$$\mathrm{EKinN} = \frac{1}{2}\,M\,\left(\frac{\partial \mathrm{xm2}[\![1]\!]}{\partial t}\right)^2$$

""

"Potential Energy of Master"

$$\mathrm{EPotN} = \frac{1}{2}\,K\,\mathrm{xm2}[\![1]\!]^2$$

""

"Kinetic Energy Of Sattelites"

$$\mathrm{EKinm} = \mathrm{Table}\left[\frac{1}{2}\,\mathrm{Mm}[\![i,\,i]\!]\,\left(\frac{\partial \mathrm{xm2}[\![i]\!]}{\partial t}\right)^2,\,\{i,\,2,\,n+1\}\right]$$

""

"Potential Energy Of Sattalites"

$$\mathrm{EPotm} = \mathrm{Table}\left[\frac{1}{2}\,\mathrm{Km}[\![i,\,i]\!]\,(\mathrm{xm2}[\![i]\!] - \mathrm{xm2}[\![1]\!])^2,\,\{i,\,2,\,n+1\}\right]$$

""

"Total Energy by means of summing Total Kin.&Pot. Energy"

$$\mathrm{Etop1} = \mathrm{EKinN} + \mathrm{EPotN} + \mathrm{Total}[\mathrm{EKinm}] + \mathrm{Total}[\mathrm{EPotm}]$$

""

"Total Energy in Quadratic Form"

$$\mathrm{Etop2} = \frac{\mathrm{xm2.Km.xm2}}{2} + \frac{1}{2}\,\frac{\partial \mathrm{xm2}}{\partial t}.\mathrm{Mm}.\frac{\partial \mathrm{xm2}}{\partial t}$$

""

"SAGLAMA ETOPsum–ETOPQuadratik=0"

$$\mathrm{Simplify}[\mathrm{Etop1} - \mathrm{Etop2}]$$

""

"Etop1–Etop2"

$$0$$

""

"PART 4–ANALYTIC"

"MODAL ENERGY CALCULATIONS"

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"Total Energy Imparted to Master"

$$\mathrm{EtotImp} = \frac{M\,\mathrm{V0}^2}{2}$$

""

"Natural Modes (Frequencies) of System"

$$\begin{pmatrix} \omega_1 \\ \omega_2 \\ \omega_3 \end{pmatrix}$$

""

"Modal Energy Form 1"

$$\mathrm{EModal} = \mathrm{Table}\left[\frac{1}{2}\,\left(\omega\mathrm{m}[\![i]\!]^2\,\eta\mathrm{m}[\![j]\!]^2 + \left(\frac{\partial \eta\mathrm{m}[\![i]\!]}{\partial t}\right)^2\right),\,\{i,\,1,\,n+1\},\,\{j,\,1,\,n+1\}\right]$$

""

"Modal Energy Form 1 Expanded"

$$\begin{pmatrix} \frac{1}{2}\,C_1^2\,\omega_1^2 & \frac{1}{2}\,\omega_1^2\,\left(C_1^2\,\sin^2(\psi_1 - t\,\omega_1) + C_2^2\,\cos^2(\psi_2 - t\,\omega_2)\right) & \frac{1}{2}\,\omega_1^2\,\left(C_1^2\,\sin^2(\psi_1 - t\,\omega_1) + C_3^2\,\cos^2(\psi_3 - t\,\omega_3)\right) \\ \frac{1}{2}\,\omega_2^2\,\left(C_2^2\,\sin^2(\psi_2 - t\,\omega_2) + C_1^2\,\cos^2(\psi_1 - t\,\omega_1)\right) & \frac{1}{2}\,C_2^2\,\omega_2^2 & \frac{1}{2}\,\omega_2^2\,\left(C_2^2\,\sin^2(\psi_2 - t\,\omega_2) + C_3^2\,\cos^2(\psi_3 - t\,\omega_3)\right) \\ \frac{1}{2}\,\omega_3^2\,\left(C_3^2\,\sin^2(\psi_3 - t\,\omega_3) + C_1^2\,\cos^2(\psi_1 - t\,\omega_1)\right) & \frac{1}{2}\,\omega_3^2\,\left(C_3^2\,\sin^2(\psi_3 - t\,\omega_3) + C_2^2\,\cos^2(\psi_2 - t\,\omega_2)\right) & \frac{1}{2}\,C_3^2\,\omega_3^2 \end{pmatrix}$$

""

"Modal Energy Form 3"

$$\mathrm{EModal3} = \mathrm{Table}\left[M\,\mathrm{EtotImp}\,\mathrm{Um}[\![i,\,j]\!]^2,\,\{j,\,1,\,n+1\},\,\{i,\,1,\,n+1\}\right]$$

""

"Modal Energy Form 3 Expanded"

$$\begin{pmatrix} \frac{1}{2}\,M^2\,\mathrm{V0}^2\,U_{1,1}^2 & \frac{1}{2}\,M^2\,\mathrm{V0}^2\,U_{2,1}^2 & \frac{1}{2}\,M^2\,\mathrm{V0}^2\,U_{3,1}^2 \\ \frac{1}{2}\,M^2\,\mathrm{V0}^2\,U_{1,2}^2 & \frac{1}{2}\,M^2\,\mathrm{V0}^2\,U_{2,2}^2 & \frac{1}{2}\,M^2\,\mathrm{V0}^2\,U_{3,2}^2 \\ \frac{1}{2}\,M^2\,\mathrm{V0}^2\,U_{1,3}^2 & \frac{1}{2}\,M^2\,\mathrm{V0}^2\,U_{2,3}^2 & \frac{1}{2}\,M^2\,\mathrm{V0}^2\,U_{3,3}^2 \end{pmatrix}$$

""

" numerical values are introduced"

"Note that Modal Energy Form 2 will be given after"

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