기계진동학 연 습 문 제 정 답 (제4장, 1.6절, 2.6절) (2014. 6. 4.)

교 재 : D. J. Inman, Engineering Vibration, 3rd edition, Pearson Education, 2008.
황재혁 등 5인 공역, 최신기계진동학 제3판, 피어슨 에듀케이션 코리아, 2009.

4.1절 <4.1> $\begin{bmatrix} m_1 & 0 \\ 0 & m_2 \end{bmatrix} \begin{Bmatrix} \ddot{x}_1(t) \\ \ddot{x}_2(t) \end{Bmatrix} + \begin{bmatrix} k_1+k_2 & -k_2 \\ -k_2 & k_2+k_3 \end{bmatrix} \begin{Bmatrix} x_1(t) \\ x_2(t) \end{Bmatrix} = \begin{Bmatrix} 0 \\ 0 \end{Bmatrix}$

<4.2> ω_1 = 1.642 rad/s, ω_2 = 2.511 rad/s

<4.3> $\mathbf{u}_1 = \begin{Bmatrix} 1 \\ 0.909 \end{Bmatrix}$, $\mathbf{u}_2 = \begin{Bmatrix} -0.101 \\ 1 \end{Bmatrix}$

<4.4> $x_1(t)$ = 0.916 cos(1.642 t) + 0.0841 cos(2.511 t)

$x_2(t)$ = 0.833 cos(1.642 t) - 0.833 cos(2.511 t)

<4.5> $x_1(t) = \frac{\sqrt{2}}{4}\sin\sqrt{2}\,t + \frac{1}{4}\sin 2t$, $x_2(t) = \frac{3\sqrt{2}}{4}\sin\sqrt{2}\,t - \frac{3}{4}\sin 2t$

<4.6> ω_1 = 0.316 rad/s, ω_2 = 1 rad/s

<4.7> $x_1(t) = \frac{1}{3}\cos\sqrt{2}\,t$, $x_2(t) = \cos\sqrt{2}\,t$.

Both masses oscillate at only one frequency.

<4.8> $\omega_1 = 0.482\sqrt{\frac{k}{J_2}}$, $\omega_2 = 1.198\sqrt{\frac{k}{J_2}}$, $\boldsymbol{u}_1 = \begin{Bmatrix} 0.7676 \\ 1 \end{Bmatrix}$, $\boldsymbol{u}_2 = \begin{Bmatrix} -0.434 \\ 1 \end{Bmatrix}$

<4.9> ω_1 = 0 rad/s, ω_2 = 16.73 rad/s, $\boldsymbol{u}_1 = \begin{Bmatrix} 1 \\ 1 \end{Bmatrix}$, $\boldsymbol{u}_2 = \begin{Bmatrix} 1 \\ -1 \end{Bmatrix}$

<4.10> $x_1(t)$ = 0.05 - 0.05 cos16.73t , $x_2(t)$ = 0.05 + 0.05 cos16.73t

<4.11> ω_1 = 0.674 rad/s , ω_2 = 14.8 rad/s

<4.12> 생략 <4.13> 생략 <4.14> 생략

1.6절 <1.68> 증명 (노트) <1.69> 생략

<1.70> E = 316×10^9 N/m^2 <1.71> c = 14500 N·s/m

<1.72> ζ = 0.344 <1.73> 생략 <1.74> c = 13.9 N·s/m

2.6절 <2.56> 생략 <2.57> 생략 <2.58> 28.8 % <2.59> 생략