

교 재 : D. J. Inman, Engineering Vibration, **4th** edition, Pearson, **2014**.

- 2.1절** <2.1> 2.44 m, 0.444 m <2.2> $0.0476 (\cos 2.0t - \cos 5.0t)$ m
 <2.3> 1.653 % <2.4> 예제 2.1.2
 <2.5> $\omega_n = 52.5 \text{ rad/s}$, $\omega = 47.5 \text{ rad/s}$ 또는 $\omega_n = 47.5 \text{ rad/s}$, $\omega = 52.5 \text{ rad/s}$
 <2.6> $T_b = 10.00 \text{ s}$
 <2.7> $x(t) = -0.290 \cos 10.00t + 0.300 \cos 8.16t$ (m)
 <2.8> (a) $x(t) = 2.80 \sin 4.47t - 1.250 \sin 10.00t$ (mm)
 (b) $x(t) = 2.80 \sin 4.47t + 40.0 \cos 4.47t - 1.250 \sin 10.00t$ (mm)
 <2.9> $x(t) = 5.86 \sin 0.968t - 0.567 \sin 10t$ (mm)
 <2.10> $m \ddot{x}(t) + kx(t) = (90.0 \text{ N}) \sin 2.50t$, $x(t) = -40.0 \sin 5.00t + 80.0 \sin 2.50t$ mm
 <2.11> $x_0 = \frac{f_0}{\omega_n^2 - \omega^2}$, $v_0 = 0$
 <2.12> $k = 60.0 \text{ kN/m}$, $E = 185.8 \text{ kPa}$ <2.13> $|x(t)| = 0.0852 \text{ mm}$
 <2.14> $X = 110 \text{ mm}$ <2.15> $k > \frac{30 J}{\pi} \left(\frac{2M_0}{J} + \frac{\pi \omega^2}{30} \right)$ <2.16> 35.7 rad/s
 <2.17> $\theta(t) = -(0.1955 \times 10^{-3}) \sin 417t + (0.261 \times 10^{-3}) \sin 312t$ rad
 <2.18> $x(t) = (2.50 \text{ m/s}) t \sin 2t$
 <2.19> $x(t) = 1.667 \sin 2t - 0.833 \sin 4t$ (m)

- 2.2절** <2.20> $\phi = \tan^{-1} \frac{(x_0 - X \cos \theta) \omega_d}{v_0 + (x_0 - X \cos \theta) \zeta \omega_n - X \omega \sin \theta}$

$$A = \frac{1}{\omega_d} \sqrt{[v_0 + (x_0 - X \cos \theta) \zeta \omega_n - X \omega \sin \theta]^2 + [(x_0 - X \cos \theta) \omega_d]^2}$$

$$F_0 = 0 \text{ 일 때, } \phi = \tan^{-1} \frac{x_0 \omega_d}{v_0 + x_0 \zeta \omega_n}, \quad A = \frac{1}{\omega_d} \sqrt{(v_0 + x_0 \zeta \omega_n)^2 + (x_0 \omega_d)^2}$$

 <2.21> $X = 0.1333 \text{ m}$, $\theta = \frac{\pi}{2} \text{ rad}$ <2.22> 노트 참조
 <2.23> $x(t) = 1.130 e^{-0.0250t} \sin(2.50 t + 1.200) + 0.0533 \cos(10.00t - 3.14)$ m
 <2.24> $X = 4.00 \text{ mm}$, $\theta = 2.01 \text{ rad}$
 <2.25> $x(t) = 4.20 e^{-5.00t} \sin(15.55 t + 2.72) + 4.00 \cos(18.85 t - 2.01)$ mm
 <2.26> $x(t) = 9.28 e^{-0.05t} \sin(4.12 t + 4.33) + 9.28 \cos(4.00t - 0.381)$ m
 <2.27> $\omega_n = \sqrt{\frac{k l_1^2 + m g l}{m l^2}}$, $\zeta = \frac{c l_2^2}{2 \sqrt{(m l^2)(k l_1^2 + m g l)}}$, $\omega_d =$, $\omega_p =$
 <2.28> $c = 359 \text{ kg/s}$, $\theta = 0.0321 \text{ rad}$ <2.29> 생략
 <2.30> $x(t) = 27.3 e^{-1.002t} \sin(4.358 t + 0.432) + 1.455 \cos(10 t - 2.897)$ mm
 <2.31> $c = 54.3 \text{ kg/s}$ <2.32> $X = 20.3 \text{ mm}$, 비감쇠계에서 $X = 21.7 \text{ mm}$
 <2.33> $x(t) = 0.01776 e^{-0.0571t} \sin(0.974 t + 1.640) + 0.01774 \cos(3.00 t - 3.10)$ m
 <2.34> $m \ddot{x} + c \dot{x} + kx = F \cos \omega t$
 <2.35> $\theta(t) = 0.334 \cos(6.28t - 3.06)$ rad
 <2.36> $\zeta = 0.01$ 일 때 $X = 4.46 \text{ mm}$, $\zeta = 0$ 일 때 $X = 4.47 \text{ mm}$
 <2.37> $c = 1,000 \text{ kg/s}$ <2.38> 생략

2.4절 <2.45> $X_b = 0.1683 \text{ m}$, $X_b/Y = 5.61$ <2.46> 생략

<2.47> $X = 10.00 \text{ cm}$, $F_T = 4,500 \text{ N}$ <2.48> 유도 <2.49> $r = \sqrt{2} \rightarrow TR = 1$

$$\text{<2.50> } F_T = \frac{\frac{c}{m} \omega_b Y}{\sqrt{\left(\frac{k}{m} - \omega_b^2\right)^2 + \left(\frac{c}{m} \omega_b\right)^2}} \quad \text{<2.51> } 171.7 \text{ mm}$$

<2.52> $c = 730 \text{ kg/s}$, $F_T = 320 \text{ N}$

<2.53> $v_1 = 21.7 \text{ km/h}$, $v_2 = 17.3 \text{ km/h}$, $X_1 = 33.2 \text{ mm}$, $X_2 = 40.9 \text{ mm}$

<2.54> 최선의 감쇠비 $\zeta = 0.01$. 바닥 진동수가 증가하면, 작은 감쇠비가 최선,
바닥 진동수가 감소하여 $r < 1.4$ 로 되면, 큰 감쇠비가 최선.

<2.55> $c = 1,161 \text{ kg/s}$ <2.56> 생략

<2.57> $r = 2.5$, $\zeta = 0.05$ 일 때, (a) $k = 53.7 \text{ kN/m}$, $c = 922 \text{ kg/s}$

(b) $X_b = 0.466 \text{ mm}$

<2.58> (교재 $r = 1.5 \rightarrow 1.8$ 정정) (a) $\zeta < 0.16$ ($\zeta < 0.1618$) (b) $F_T/kY = 1.620$

<2.59> $X_1 = 0.1872 \text{ m}$, $X_2 = 0.1060 \text{ m}$ <2.60> $X = 0.498 \text{ m}$

2.5절 <2.61> $X_r = 8.53 \text{ mm}$ <2.62> $\zeta = 0.0500$ <2.63> $X_r = 12.00 \text{ mm}$

<2.64> ($m_0 = 10 \text{ kg}$, $k = 3,200 \text{ N/m}$) $e = 0.500 \text{ m}$ <2.65> $k \leq 2.21 \times 10^6 \text{ N/m}$

<2.66> 실습 <2.67> (a) $X_r = 0.0271 \text{ mm}$ (b) $e = 2.53 \text{ mm}$ <2.68> 생략