3.35    삼각파(예제 3.3.1) 가진에 대한 1자유도 감쇠계의 **정상상태** 응답 (그래프 plot 생략)

최대 힘 1 N,  $m = 80$ kg,  $\zeta = 0.1$,  $k = 1000$ N/m,  $T = 2\pi$ s

$$\omega_n = \sqrt{\frac{1000 \text{ N/m}}{80 \text{ kg}}} = \frac{5}{\sqrt{2}} \text{ rad/s} = 3.536 \text{ rad/s}, \quad \omega_T = \frac{2\pi}{T} = \frac{2\pi}{2\pi} = 1 \text{ rad/s}$$

$$F(t) = \sum_{n=1,3,\ldots}^{\infty} \frac{-8}{n^2\pi^2} \cos\frac{2n\pi}{T}t = \sum_{n=1,3,\ldots}^{\infty} \frac{-8}{n^2\pi^2}\cos nt, \qquad a_n = \frac{-8}{n^2\pi^2}$$

$$x_n^c(t) = X_n \cos(n\omega_T t - \theta_n)$$

$$X_n = \frac{a_n/m}{\sqrt{[\omega_n^2 - (n\omega_T)^2]^2 + (2\zeta\omega_n n\omega_T)^2}}$$

$$= \frac{-8}{(80)n^2\pi^2} \frac{1}{\sqrt{[\frac{25}{2} - n^2]^2 + [2(0.1)\frac{5}{\sqrt{2}}n]^2}} = \frac{-0.01013}{n^2\sqrt{(\frac{625}{4} - 25n^2 + n^4) + 0.5n^2}}$$

$$\theta_n = \tan^{-1}\frac{2\zeta\omega_n n\omega_T}{\omega_n^2 - (n\omega_T)^2} = \tan^{-1}\frac{2(0.1)\frac{5}{\sqrt{2}}n}{\frac{25}{2} - n^2} = \tan^{-1}\frac{0.707\,n}{12.5 - n^2} \qquad (0 < \theta_n < \pi)$$

$$x_p(t) = \sum_{n=1,3,\ldots}^{\infty} x_n^c(t) = \sum_{n=1,3,\ldots}^{\infty} X_n \cos(n\omega_T t - \theta_n)$$

$$= \sum_{n=1,3,\ldots}^{\infty} \frac{-0.01013}{n^2\sqrt{n^4 - 24.5n^2 + 156.3}} \cos\left[nt - \tan^{-1}\frac{0.707\,n}{12.50 - n^2}\right] \quad \text{m}$$