MIE100S – Winter 2017
Tutorial Problem 12a-Solution

$$v = A \sin pt + B \cos pt + \left(\frac{\frac{F_0}{k}}{1 - \left(\frac{\omega}{p}\right)^2} \right) \sin \omega t$$

$$F = 7 \sin 8t, \qquad F_0 = 7 \text{ N} \qquad \omega = 8 \text{ rad/s}, \qquad k = 300 \text{ N/m}$$

$$p = \sqrt{\frac{k}{m}} = \sqrt{\frac{300}{5}} = 7.746 \text{ rad/s}$$

$$y = A \sin 7.746t + B \cos 7.746t + \left(\frac{\frac{7}{300}}{1 - \left(\frac{8}{7.746}\right)^2} \right) \sin 8t$$

$$y = 0.1 \text{ m when } t = 0,$$

$$0.1 = 0 + B - 0; \qquad B = 0.1 \text{ m}$$

$$v = A(7.746) \cos 7.746 - B(7.746) \sin 7.746t - (0.35)(8) \cos 8t$$

$$v = y = 0 \text{ when } t = 0,$$

$$v = A(7.746) - 2.8 = 0; \qquad A = 0.361$$

Expressing the results in mm, we have

$$y = (361 \sin 7.75t + 100 \cos 7.75t - 350 \sin 8t) \text{ mm}$$

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Tutorial Problem 12b-Solution

$$+\Sigma M_O = I_O\,\alpha; \qquad 4(9.81)(0.6) - F_s(1.2) = 4(0.6)^2\ddot{\theta}$$

$$F_s = kx = 15(x + x_{st} - 0.1\cos 15t)$$

$$x_{st} = \frac{4(9.81)(0.6)}{1.2(15)}$$

Thus,

$$-15(x - 0.1\cos 15t)(1.2) = 4(0.6)^2\ddot{\theta}$$

$$x = 1.2\theta$$

$$\theta + 15\theta = 1.25\cos 15t$$

Set $x_p = C\cos 15t$

$$-C(15)^2\cos 15t + 15(C\cos 15t) = 1.25\cos 15t$$

$$C = \frac{1.25}{15 - (15)^2} = -0.00595\text{ m}$$

$$\theta_{\max} = C = 0.00595\text{ rad}$$

$$y_{\max} = (0.6\text{ m})(0.00595\text{ rad}) = 0.00357\text{ rad}$$