

1. a) False; b) True; c) False; d) False

2. a) $\omega_0 = 4$ (rad/sec)

b) The beat frequency is $\left| \frac{\omega - \omega_0}{2} \right| = \frac{4.5 - 4}{2} = 0.25$ (rad/sec).

3. $y(t) = \frac{1}{2}e^{-3t} - \frac{1}{2}e^t + \frac{3}{4}te^t$

4. a) $m > \frac{1}{2}$ (kg)

b) The initial value problem is

$$u'' + 2u' + 2u = 0, \quad u(0) = \frac{1}{10}, \quad u'(0) = 0.$$

Its solution is $u(t) = \frac{1}{10}e^{-t} \cos t + \frac{1}{10}e^{-t} \sin t$.

c) $\mu = 1$ (rad/sec)

d) It's overdamped.

5. $y(t) = \frac{-1}{15}e^{2t} + \frac{1}{40}e^{-3t} + \frac{1}{24}e^{5t} + u_1(t)\left(\frac{1}{4}e^{5(t-1)} - \frac{1}{4}e^{-3(t-1)}\right)$

6. a) $f(t) = 1 - u_1(t)$

b) $\frac{1}{4}u'' + 16u = 1 - u_1(t), \quad u(0) = 0, \quad u'(0) = 0.$

c) $u(t) = \frac{1}{16} - \frac{1}{16} \cos 8t - u_1(t)\left(\frac{1}{16} - \frac{1}{16} \cos 8(t-1)\right)$

7. $\mathcal{L}\{f(t)\} = \frac{2}{s^2} + e^{-2s}\left(\frac{2}{s^3} + \frac{2}{s^2}\right)$

8. a) $\mathcal{L}^{-1}\{F(s)\} = e^{2t} \cos 3t + 2e^{2t} \sin 3t$

b) $\mathcal{L}^{-1}\{F(s)\} = u_5(t)\left(-\frac{1}{4} - \frac{1}{2}(t-5) + \frac{1}{4}e^{2(t-5)}\right)$

9. An appropriate form is $Y(t) = (At + B)e^t + (C \cos t + D \sin t) + (Et \cos 2t + Ft \sin 2t)$

Where $A, B, C, D, E,$ and F are some undetermined coefficients.