

ANSWER KEY

1. (a) III (b) I (c) II (d) IV (e) V (f) VI
2. B
3. A
4. C
5. B
6. (a)  $y = 3\cos(2t) - 2\sin(2t)$ , has amplitude  $R = \sqrt{C_1^2 + C_2^2} = \sqrt{13}$ .  
(b)  $\omega = \omega_0 = 2$   
(c) The system must be critically damped or overdamped:  $\gamma \geq 8$ .
7. (a)  $F(s) = e^{-3s} \left( \frac{1}{s^2} + \frac{3}{s} \right)$   
(b)  $f(t) = e^{-2t} \cos(t) - 2e^{-2t} \sin(t)$
8.  $y(t) = 3e^{-2t} + \frac{1}{3}u_3(t)(e^{t-3} + 2e^{-2t+6})$
9. (a) The eigenvalues are purely imaginary. Therefore, the critical point is a *center*, and it is stable (or *neutrally* stable).  
(b)  $x(t) = C_1 \begin{pmatrix} 2 \cos t \\ -\sin t \end{pmatrix} + C_2 \begin{pmatrix} 2 \sin t \\ \cos t \end{pmatrix}$
10. (a)  $x(t) = C_1 \begin{pmatrix} 1 \\ 1 \end{pmatrix} e^{-t} + C_2 \begin{pmatrix} 4 \\ 1 \end{pmatrix} e^{2t}$   
(b)  $\beta = 6$
11. (a) (0,0), (-1,1), (1,-1)  
(b) It is a *spiral point*; asymptotically stable.