There are only 19 questions — The 20th question did not fit nicely on a page. Everyone get points for #20.

1. The solution of $y' + y = x$ is

   Select the correct answer.

   (a) $y = -x + 1 + ce^{x}$
   (b) $y = -x - 1 + ce^{x}$
   (c) $y = x - 1 + ce^{-x}$
   (d) $y = -x - 1 + ce^{-x}$
   (e) $y = x + 1 + ce^{-x}$

2. The solution of $xy' = (x-1)y^2$

   Select the correct answer.

   (a) $y = 1/(x + \ln x + c)$
   (b) $y = 1/(x - \ln x + c)$
   (c) $y = -c/(x + \ln x)$
   (d) $y = -c/(x - \ln x)$
   (e) $y = -1/(x - \ln x + c)$

3. A frozen chicken at $32°F$ is taken out of the freezer and placed on a table at $70°F$. One hour later the temperature of the chicken is $55°F$. The mathematical model for the temperature $T(t)$ as a function of time t is (assuming Newton's law of warming)

   Select the correct answer.

   (a) $\frac{dT}{dt} = kT$, $T(0) = 32$, $T(1) = 55$
   (b) $\frac{dT}{dt} = k(T - 70)$, $T(0) = 32$, $T(1) = 55$
   (c) $\frac{dT}{dt} = (T - 70)$, $T(0) = 32$, $T(1) = 55$
   (d) $\frac{dT}{dt} = T$, $T(0) = 32$, $T(1) = 55$
   (e) $\frac{dT}{dt} = k(T - 55)$, $T(0) = 32$, $T(1) = 55$

4. In the previous problem, the solution for the temperature is

   Select the correct answer.

   (a) $T(t) = 70 - 38e^{-.930t}$
   (b) $T(t) = 70 - 38e^{.930t}$
   (c) $T(t) = 55 - 32e^{-.930t}$
   (d) $T(t) = 55 - 32e^{.930t}$
   (e) $T(t) = 55e^{-.930t}$

5. The solution of $y'' - 6y' + 8y = 0$ is

   Select the correct answer.

   (a) $y = c_1e^{-2x} + c_2e^{-4x}$
   (b) $y = c_1e^{2x} + c_2xe^{4x}$
   (c) $y = c_1e^{-2x} + c_2xe^{-4x}$
   (d) $y = c_1e^{2x} + c_2e^{4x}$
   (e) $y = c_1e^{2x} + c_2e^{-4x}$

6. The solution of $y'' - 4y' + 20y = 0$ is

   Select the correct answer.

   (a) $y = c_1e^{-2x}\cos(4x) + c_2e^{-2x}\sin(4x)$
   (b) $y = c_1e^{-2x}\cos(4x) + c_2e^{2x}\sin(4x)$
   (c) $y = c_1e^{2x}\cos(4x) + c_2e^{2x}\sin(4x)$
   (d) $y = c_1e^{2x} + c_2e^{4x}$
   (e) $y = c_1\cos(4x) + c_2\sin(4x)$

7. The correct form of the particular solution of $y'' + 2y' + y = e^{-x}$ is

   Select the correct answer.

   (a) $y_p = Ae^{-x}$
   (b) $y_p = Axe^{-x}$
   (c) $y_p = Ax^2e^{-x}$
   (d) $y_p = Ax^3e^{-x}$
   (e) none of the above

8. The solution of $y'' + 2y' = x + e^x$ is

   Select the correct answer.

   (a) $y = c_1 + c_2e^{-2x} + x^2/4 - x/4 + e^x/3$
   (b) $y = c_1 + c_2e^{-2x} + x^2/4 + x/4 - e^x/3$
   (c) $y = c_1 + c_2e^{-2x} + x^2/4 + x/4 + e^x/3$
   (d) $y = c_1 + c_2e^{-2x} - x^2/4 - x/4 - e^x/3$
   (e) $y = c_1 + c_2e^{-2x} - x^2/4 - x/4 + e^x/3$

9. The solution of $y'' + 3y' - 4y = \cos x$ is

   Select the correct answer.

   (a) $y = c_1 e^x + c_2 e^{-4x} + (5\sin x + 3\cos x)/34$
   (b) $y = c_1 e^x + c_2 e^{-4x} + (-5\sin x + 3\cos x)/34$
   (c) $y = c_1 e^x + c_2 e^{-4x} + (-5\cos x - 3\sin x)/34$
   (d) $y = c_1 e^x + c_2 e^{-4x} + (5\cos x + 3\sin x)/34$
   (e) $y = c_1 e^x + c_2 e^{-4x} + (-5\cos x + 3\sin x)/34$

10. The solution of $y'' + y = \tan x$ is

    Select the correct answer.

    (a) $y = c_1 \cos x + c_2 \sin x + \cos x \ln |\sec x + \tan x|$
    (b) $y = c_1 \cos x + c_2 \sin x - \cos x \ln |\sec x + \tan x|$
    (c) $y = c_1 \cos x + c_2 \sin x + \cos x \ln |\sec x|$
    (d) $y = c_1 \cos x + c_2 \sin x - \cos x \ln |\tan x|$
    (e) $y = c_1 \cos x + c_2 \sin x - \cos x \ln |\sec x - \tan x|$

11. The solution of $x^2 y'' - xy' = 0$ is

    Select the correct answer.

    (a) $y = c_1 + c_2 x^{-1}$
    (b) $y = c_1 \ln x + c_2 x^{-1}$
    (c) $y = c_1 + c_2 x^2$
    (d) $y = c_1 + c_2 \ln x$
    (e) $y = c_1 + c_2 x^{-2}$

12. A 4-pound weight is hung on a spring and stretches it 1 foot. The mass spring system is then put into motion in a medium offering a damping force numerically equal to the velocity. If the mass is pulled down 6 inches from equilibrium and released, the initial value problem describing the position, $x(t)$, of the mass at time t is

    Select the correct answer.

    (a) $x'' - 8x' + 32x = 0,\ x(0) = 6,\ x'(0) = 0$
    (b) $x'' + 8x' + 32x = 0,\ x(0) = 6,\ x'(0) = 0$
    (c) $x'' - 8x' + 32x = 0,\ x(0) = 1/2,\ x'(0) = 0$
    (d) $x'' + 8x' + 32x = 0,\ x(0) = 1/2,\ x'(0) = 0$
    (e) $x'' + 32x = 8,\ x(0) = 1/2,\ x'(0) = 0$

21. The solution of $\mathbf{X}' = \begin{pmatrix} 1 & -2 \\ 1 & 4 \end{pmatrix} \mathbf{X}$ is

Select the correct answer.

(13)

(a) $\mathbf{X} = c_1 \begin{pmatrix} 2 \\ 1 \end{pmatrix} e^{-2t} + c_2 \begin{pmatrix} 1 \\ 1 \end{pmatrix} e^{-3t}$

(b) $\mathbf{X} = c_1 \begin{pmatrix} 2 \\ 1 \end{pmatrix} e^{-2t} + c_2 \begin{pmatrix} 1 \\ -1 \end{pmatrix} e^{-3t}$

(c) $\mathbf{X} = c_1 \begin{pmatrix} -2 \\ -1 \end{pmatrix} e^{2t} + c_2 \begin{pmatrix} 1 \\ -1 \end{pmatrix} e^{3t}$

(d) $\mathbf{X} = c_1 \begin{pmatrix} 2 \\ -1 \end{pmatrix} e^{2t} + c_2 \begin{pmatrix} 1 \\ -1 \end{pmatrix} e^{3t}$

(e) $\mathbf{X} = c_1 \begin{pmatrix} 1 \\ -2 \end{pmatrix} e^{2t} + c_2 \begin{pmatrix} 1 \\ -1 \end{pmatrix} e^{3t}$

22. The eigenvalue-eigenvector pairs for the matrix $A = \begin{pmatrix} 4 & 0 & 0 \\ 0 & 3 & 1 \\ 0 & -1 & 1 \end{pmatrix}$ are

Select all that apply.

(14)

(a) $4, \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}$

(b) $2, \begin{pmatrix} 0 \\ 1 \\ -1 \end{pmatrix}$

(c) $2, \begin{pmatrix} 1 \\ -1 \\ 0 \end{pmatrix}$

(d) $2, \begin{pmatrix} 0 \\ 1 \\ 1 \end{pmatrix}$

(e) $2, \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix}$

23. The solution of $\mathbf{X}' = \begin{pmatrix} 4 & 0 & 0 \\ 0 & 3 & 1 \\ 0 & -1 & 1 \end{pmatrix} \mathbf{X}$ is

Select the correct answer.

(a) $X = c_1 \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix} e^{4t} + c_2 \begin{pmatrix} 0 \\ 1 \\ -1 \end{pmatrix} e^{2t} + c_3 \left[\begin{pmatrix} 0 \\ 1 \\ -1 \end{pmatrix} te^{2t} + \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix} e^{2t} \right]$

(15) (b) $X = c_1 \begin{pmatrix} 0 \\ 1 \\ -1 \end{pmatrix} e^{4t} + c_2 \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix} e^{2t} + c_3 \left[\begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix} te^{2t} + \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix} e^{2t} \right]$

(c) $X = c_1 \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} e^{4t} + c_2 \begin{pmatrix} 0 \\ 1 \\ -1 \end{pmatrix} e^{2t} + c_3 \left[\begin{pmatrix} 0 \\ 1 \\ -1 \end{pmatrix} te^{2t} + \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix} e^{2t} \right]$

(d) $X = c_1 \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} e^{4t} + c_2 \begin{pmatrix} 0 \\ 1 \\ 1 \end{pmatrix} e^{2t} + c_3 \left[\begin{pmatrix} 0 \\ 1 \\ 1 \end{pmatrix} te^{2t} + \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix} e^{2t} \right]$

(e) $X = c_1 \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} e^{4t} + c_2 \begin{pmatrix} 1 \\ -1 \\ 0 \end{pmatrix} e^{2t} + c_3 \left[\begin{pmatrix} 1 \\ -1 \\ 0 \end{pmatrix} te^{2t} + \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix} e^{2t} \right]$

24. The solution of $\mathbf{X}' = \begin{pmatrix} 1 & 1 \\ -2 & -1 \end{pmatrix} \mathbf{X}$ is

Select the correct answer.

(a) $\mathbf{X} = c_1 \left[\begin{pmatrix} 1 \\ -1 \end{pmatrix} \cos t - \begin{pmatrix} 0 \\ 1 \end{pmatrix} \sin t \right] + c_2 \left[\begin{pmatrix} 1 \\ -1 \end{pmatrix} \sin t + \begin{pmatrix} 0 \\ 1 \end{pmatrix} \cos t \right]$

(b) $\mathbf{X} = c_1 \begin{pmatrix} 1 \\ 0 \end{pmatrix} e^{\sqrt{3}t} + c_2 \begin{pmatrix} 0 \\ 1 \end{pmatrix} e^{-\sqrt{3}t}$

(16) (c) $\mathbf{X} = c_1 \begin{pmatrix} 1 \\ 0 \end{pmatrix} e^{t} + c_2 \begin{pmatrix} 0 \\ 1 \end{pmatrix} e^{-t}$

(d) $\mathbf{X} = c_1 \left[\begin{pmatrix} 1 \\ -1 \end{pmatrix} \cos(\sqrt{3}t) - \begin{pmatrix} 0 \\ 1 \end{pmatrix} \sin(\sqrt{3}t) \right] +$
$c_2 \left[\begin{pmatrix} 1 \\ -1 \end{pmatrix} \sin(\sqrt{3}t) + \begin{pmatrix} 0 \\ 1 \end{pmatrix} \cos(\sqrt{3}t) \right]$

(e) $\mathbf{X} = c_1 \left[\begin{pmatrix} 1 \\ 1 \end{pmatrix} \cos(2t) - \begin{pmatrix} 0 \\ -1 \end{pmatrix} \sin(2t) \right] + c_2 \left[\begin{pmatrix} 1 \\ 1 \end{pmatrix} \sin(2t) + \begin{pmatrix} 0 \\ -1 \end{pmatrix} \cos(2t) \right]$

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8. The solution of $y'' - 4y' + 13y = 0$ is

   Select the correct answer.

   (a) $y = c_1 e^{-2x} \cos(3x) + c_2 e^{2x} \sin(3x)$
   (b) $y = c_1 e^{-2x} \cos(3x) + c_2 e^{-2x} \sin(3x)$
   (c) $y = c_1 e^{2x} \cos(3x) + c_2 e^{2x} \sin(3x)$
   (d) $y = c_1 e^{2x} + c_2 e^{2x}$
   (e) $y = c_1 \cos(3x) + c_2 \sin(3x)$

(18)

12. A 1-kilogram mass is hung on a spring with a spring constant of $4N/m$. The mass spring system is then put into motion in a medium offering a damping force numerically equal to four times the velocity. If the mass is pulled down 10 centimeters from equilibrium and released, and a forcing function equal to $2e^{-3t}$ is applied to the system, the initial value problem describing the position, $x(t)$, of the mass at time t is

    Select the correct answer.

    (a) $x'' - 4x' + 4x = 2e^{-3t}$, $x(0) = .1$, $x'(0) = 0$
    (b) $x'' + 4x' + 4x = 2e^{-3t}$, $x(0) = .1$, $x'(0) = 0$
    (c) $x'' - 4x' + 4x = 2e^{-3t}$, $x(0) = 10$, $x'(0) = 0$
    (d) $x'' + 4x' + 4x = 2e^{-3t}$, $x(0) = 10$, $x'(0) = 0$
    (e) $x'' + 4x = 4 + 2e^{-3t}$, $x(0) = 10$, $x'(0) = 0$

13. In the previous problem, the solution for the position, $x(t)$, is

    Select the correct answer.

(19)

    (a) $x = 2.2e^{-2t} - 1.9te^{-2t} + 2e^{-3t}$
    (b) $x = 2.2e^{-2t} + 1.9te^{-2t} + 2e^{-3t}$
    (c) $x = 2.2e^{-2t} - 1.9te^{-2t} - 2e^{-3t}$
    (d) $x = 1.9e^{-2t} + 2.2te^{-2t} + 2e^{-3t}$
    (e) $x = -1.9e^{-2t} + 2.2te^{-2t} + 2e^{-3t}$

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