

In exercises 24 through 31 the factored for the characteristic equation for certain differential equations are given. In each case state the order of the differential equation and give the general form of the solution of the differential equations.

24)  $(m - 3)(m + 2)^2(m^2 - 2m + 5)(m^2 + 4m + 5)^2 = 0.$

25)  $(m + 1)(m - 1)(m^2 + 1)(m^2 + m + 1) = 0.$

26)  $(2m - 3)(5m + 4)(m^2 + 4)^2(m^2 - m - 1).$

27)  $(m - 3)^3(m + 2)^4 = 0.$

28)  $(m^2 + 4)(m^2 + 1)^2 = 0.$

29)  $(m + 1)(m + 3)(m + 2)^2(m^2 - 2m + 5)^2(m^2 + 9) = 0.$

30)  $(m^2 + 3)(m^2 + 1)^3(m + 1)^3 = 0.$

31)  $(m + 2)(m - 5)^2(m - 4)^3(m^2 + 4)^3 = 0.$

$$24) (m-2)(m+2)^2(m^2-2m+5)(m^2+4m+5)^2 = 0$$

The order of the D.E =  $m \cdot m^2 \cdot m^2 \cdot m^4 = m^9$  (9th order)

~~Q. 24~~

$$m = 2, m = -2, m = 1+2i, m = -2+i$$

$$K = 2$$

$$\alpha = 1, \beta = 2$$

$$\alpha = -2, \beta = 1$$

$$K = 2$$

~~Q. 24~~

G.S.:

$$y = c_1 e^{2x} + c_2 e^{-2x} + c_3 e^{-2x} x + c_4 e^x \sin(2x) + c_5 e^x \cos(2x) + c_6 e^{-2x} \sin(x) \\ + c_7 e^{-2x} \cos(x) + c_8 e^{-2x} x \sin(x) \\ + c_9 x e^{-2x} \cos(x) \quad \#$$

$$+ C_4 x e^{-2x} \cos(x) \quad \#$$

$$25) (m+1)(m-1)(m^2+1)(m^2+m+1) = 0$$

order of the D.E = 6

$$m = -1, \quad m = 1, \quad m = i, \quad m = -\frac{1}{2} + \frac{\sqrt{3}}{2}i$$

$$\alpha = 0, \beta = 1$$

$$\alpha = -\frac{1}{2}, \quad \beta = \frac{\sqrt{3}}{2}$$

GS:

$$y = C_1 e^{-x} + C_2 e^x + C_3 \sin x + C_4 \cos x + C_5 e^{-\frac{x}{2}} \sin\left(\frac{\sqrt{3}x}{2}\right) + C_6 e^{-\frac{x}{2}} \cos\left(\frac{\sqrt{3}x}{2}\right)$$

$$26) (2m-3)(5m+4)(m^2+4)^2(m^2-m-1)=0$$

Order of the D.E = 8

$$m = \frac{3}{2}, m = -\frac{4}{5}, m = 2i (K=2), m = \frac{1+\sqrt{5}}{2}, m = \frac{1-\sqrt{5}}{2}$$

G.S:

$$y = C_1 e^{\frac{3}{2}x} + C_2 e^{-\frac{4}{5}x} + C_3 \sin(2x) + C_4 \cos(2x) + C_5 x \sin(2x) + C_6 x \cos(2x) + C_7 e^{\frac{1+\sqrt{5}}{2}x} + C_8 e^{\frac{1-\sqrt{5}}{2}x}$$

$$27) (m-3)^3(m+2)^4=0$$

Order of the D.E = 7

$$m = 3 (K=3), m = -2 (K=4)$$

G.S:

$$y = C_1 e^{3x} + C_2 x e^{3x} + C_3 x^2 e^{3x} + C_4 e^{-2x} + C_5 x e^{-2x} + C_6 x^2 e^{-2x} + C_7 x^3 e^{-2x}$$

$$28) (m^2+4)(m^2+1)^2=0$$

Order of the D.E = 6

$$m = 2i, m = -2i (K=2)$$

G.S:

$$y = C_1 \sin(2x) + C_2 \cos(2x) + C_3 \sin x + C_4 \cos x + C_5 x \sin x + C_6 x \cos x$$



$$29) (m+1)(m+3)(m+2)^2(m^2-2m+5)^2(m^2+9) = 0$$

Order of the D.E = 10

$$m = -1, m = -3, m = -2 (K=2), m = 1+2i (K=2), m = 3i$$

G.S:

$$y = C_1 e^{-x} + C_2 e^{-3x} + C_3 e^{-2x} + C_4 x e^{-2x} + C_5 e^x \sin(2x) + C_6 e^x \cos(2x) \\ + C_7 x e^x \sin(2x) + C_8 x e^x \cos(2x) + C_9 \sin(3x) + C_{10} \cos(3x)$$


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$$30) (m^2+3)(m^2+1)^3(m+1)^3 = 0$$

Order of the D.E = 11

$$m = \sqrt{3}i, m = i (K=3), m = -1 (K=3)$$

G.S:

$$y = C_1 \sin(\sqrt{3}x) + C_2 \cos(\sqrt{3}x) + C_3 \sin x + C_4 \cos x + x(C_5 \sin x + C_6 \cos x) \\ + x^2(C_7 \sin x + C_8 \cos x) + C_9 e^{-x} + C_{10} e^{-x} x + C_{11} x^2 e^{-x}$$


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$$31) (m+2)(m-5)^2(m-4)^3(m^2+4)^3 = 0$$

Order of the ~~time~~ D.E = 12

$$m = -2, m = 5 (K=2), m = 4 (K=3), m = 2i (K=3)$$

G.S:

$$y = C_1 e^{-2x} + C_2 e^{5x} + C_3 x e^{5x} + C_4 e^{4x} + C_5 x e^{4x} + C_6 x^2 e^{4x} + C_7 \sin(2x) \\ + C_8 \cos(2x) + C_9 x \sin(2x) + C_{10} x \cos(2x) + C_{11} x^2 \sin(2x) \\ + C_{12} x^2 \cos(2x)$$