# * Tutorial Number - 3

Q-0) → $\frac{1}{D^2-7D+6} \cdot e^{2x} =$

→ $\frac{1}{(D^2-7D+6)} \cdot e^{2x} = \frac{1}{(D-6)(D-1)} \cdot e^{2x}$ - (1)

compare equation (1) with $\frac{1}{\phi(D)} \cdot e^{ax}$, we get

$a = 2$ and $\phi(D) = (D-6)(D-1)$

$\therefore \phi(a) = (2-6)(2-1)$

$= -4 \neq 0.$

$$\therefore \frac{1}{(2^2-7D+6)} \cdot e^{2x} = \frac{1}{\phi(a)} \cdot e^{ax}$$

$$= \boxed{\frac{-e^{2x}}{4}}$$

→ option 1.

Q-1) $\frac{1}{D^2-5D+6} \cdot 3e^{5x}$

→ $\frac{1}{D^2-5D+6} \cdot 3e^{5x}$ compare it with $\frac{1}{\phi(D)} \cdot e^{ax}$, we get

$a = 5$, $\phi(D) = D^2-5D+6 = \frac{5 \pm \sqrt{25-24}}{2} = \frac{5 \pm 1}{2} = 3$ and $2$

$= (D-3)(D-2)$

$\phi(a) = (5-3)(5-2)$

$= 6$

$$\therefore \frac{1}{D^2-5D+6} \cdot 3e^{5x} = \cancel{3} \times \frac{1}{\cancel{6}_2} \cdot e^{5x}$$

$$= \boxed{\frac{e^{5x}}{2}}$$

→ option 1.

Q-2) $\frac{1}{(D^2-9)}(e^{3x}+1)$

→ $\frac{1}{(D^2-9)}\cdot e^{3x} + \frac{1}{(D^2-9)}\cdot e^{0x}$ compare with $\frac{1}{\phi(D)}\cdot e^{ax}$, we get.

$\therefore \phi(D) = D^2 - 9$ and $a_1 = 3$ and $a_2 = 0$.

$(D+3)(D-3)$

$\phi(a_1) = \cancel{(3)^2 - 9}$ $\qquad \phi(a_2) = (0)^2 - 9$

$= 0 \qquad\qquad = -9.$

$r = 1.$

$\frac{1}{(D^2-9)}\cdot e^{3x} + \frac{1}{(D^2-9)}\cdot e^{0x} = \left(\frac{x^1}{1!}\right)\cdot\frac{e^{3x}}{(3+3)} + \frac{1}{-9}\cdot e^{0x}.$

$= \boxed{\frac{xe^{3x}}{6} - \frac{1}{9}}$

↳ option 4.

Q-3) $\frac{1}{(D^2+4D+3)}\cdot e^{-3x}$

→ $\frac{1}{(D^2+4D+3)}\cdot e^{-3x}$ compare with $\frac{1}{\phi(D)}\cdot e^{ax}$, we get.

$a = -3,\ \phi(D) = (D^2+4D+3) = (D+3)(D+1)$

$\therefore \frac{1}{(D+3)(D+1)}\cdot e^{-3x} = \left(\frac{x^1}{1!}\right)\cdot\frac{e^{-3x}}{(-3+1)} = \boxed{\frac{-x\cdot e^{-3x}}{2}}$

↳ option 2

Q-4) $\frac{1}{(D-2)^3}\cdot(e^{2x}+3^x)$

$\frac{1}{(D-2)^3}\cdot e^{2x} + \frac{1}{(D-2)^3}\cdot e^{x\log 3}$ compare with $\frac{1}{\phi(D)}\cdot e^{ax}$, we get.

$\phi(D) = (D-2)^3$ , $a_1 = 2$ $a_2 = \log 3$.
$r = 3$.

$\therefore \frac{1}{(D-2)^3}\cdot e^{2x} + \frac{1}{(D-2)^3}\cdot e^{x\log 3} = \boxed{\left(\frac{x^3}{3!}\right)\cdot\frac{e^{2x}}{1} + \frac{e^{x\log 3}}{[(\log 3)-2]^3}}$

$\hookrightarrow$ option 1.

Q-5) $\frac{1}{D^5-D}\cdot 12e^x$

$\rightarrow$ $\frac{1}{D^5-D}\cdot 12e^x$ compare with $\frac{1}{\phi(D)}\cdot e^{ax}$, we get.

$a = 1$, $\phi(D) = D(D^4-1) = D(D^2+1)(D^2-1)$
$= D(D^2+1)(D+1)(D-1)$
$r = 1$.

$= 12\left(\frac{x^1}{1!}\right)\cdot\frac{e^x}{(1)(1^2+1)(1+1)}$

$= \frac{12xe^x}{4}$

$= \boxed{3xe^x}$

$\hookrightarrow$ D.

Q-6) $\frac{1}{(D^2+1)(D-1)} \cdot e^x$

$\rightarrow$ $\frac{1}{(D^2+1)(D-1)} \cdot e^x$ compare with $\frac{1}{\phi(D)} \cdot e^{ax}$, we get.

$a = 1, \quad \phi(D) = (D^2+1)(D-1)$

$\therefore \quad \cancel{y} = \left(\frac{x^1}{1!}\right) \cdot \frac{e^x}{(1^2+1)}$

$= \boxed{\frac{xe^x}{2}} \rightarrow$ (C).

Q-7) $\frac{1}{D^2-4D+4} \cdot \sin 2x$

$\rightarrow$ $a = 2 \quad \therefore$ sub $D^2 = -4$

$\therefore \quad \frac{1}{(\cancel{-4}) - 4D \cancel{+4}} \cdot \sin 2x$

$= \frac{-1}{4D} \cdot \sin 2x$

$= \frac{-D}{4D^2} \cdot \sin 2x$

$= \frac{-D}{4(-4)} \cdot \sin 2x$

$= \frac{D \sin 2x}{16}$

$= \frac{2 \cos 2x}{16}$

$= \boxed{\frac{\cos 2x}{8}} \rightarrow$ (B)

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Q-8) $\frac{1}{D^3+D} \cdot \cos x$

→ $\Delta = 1. \therefore$ sub $D^2 = -1$.

$\frac{1}{D(D^2+1)} \cdot \cos x$.

as $D^2+1 = 0$ when $D^2 = -1$.

$\therefore$

$$\frac{1}{D(D^2+1)} \cdot \cos x = \cancel{\left(\frac{-x}{2(1)}\right)^1 \cdot \frac{1}{1!} \cdot \cos\left(x + \frac{\pi}{2}\right)}$$

$$= \frac{D}{(D^2+1)D^2} \cdot \cos x.$$

$$= \frac{1}{D^2+1}\left[D \cdot \frac{1}{D^2} \cdot \cos x\right]$$

$$= \frac{1}{D^2+1}\left[\frac{D \cdot \cos x}{-1}\right]$$

$$= \frac{+\sin x}{+(D^2+1)}$$

$$= \left(\frac{-x}{2(1)}\right)^1 \cdot \frac{1}{1!} \cdot \sin\left(x + \frac{\pi}{2}\right)$$

$$= \frac{-x \cdot \left[\sin x \cdot \cos(\pi/2) + \cos x \cdot \sin(\pi/2)\right]}{2}$$

$$= \boxed{\frac{-x \cdot \cos x}{2}}$$

→ (D).

Q-9) $\frac{1}{D^2+1} \cdot \sin x$

$\rightarrow$ $a = 1$, $D^2 \rightarrow -1$, $\therefore r = 1$.

$$\therefore \frac{1}{(D^2+1)} \cdot \sin x = \left(\frac{-x}{2(1)}\right)^1 \cdot \frac{1}{1!} \cdot \sin\left(x + \frac{\pi}{2}\right)$$

$$= \frac{-x}{2} \cdot \left[\sin x \cdot \cos(\pi/2) + \cos x \cdot \sin(\pi/2)\right]$$

$$= \boxed{\frac{-x \cdot \cos x}{2}}$$

$\hookrightarrow$ A.

Q-10) $\frac{1}{D^3+9D} \cdot \sin 3x$.

$$\rightarrow \frac{1}{D(D^2+9)} \cdot \sin 3x = \frac{1}{(D^2+9)}\left[\frac{D}{D^2} \cdot \sin 3x\right]$$

$$= \frac{D}{(D^2+9)}\left[\frac{1}{D^2} \cdot \sin 3x\right]$$

$a = 3$, $D^2 \rightarrow -9$

$$= \frac{D}{D^2+9}\left[\frac{\sin 3x}{-9}\right]$$

$$= \frac{D \sin 3x}{-9(D^2+9)}$$

$$= \frac{3 \cos 3x}{-9(D^2+9)}$$

$$= \frac{-1}{3}\left[\frac{\cos 3x}{D^2+9}\right]$$

$$= \frac{-1}{3}\left[\left(\frac{-x}{2(3)}\right)^1 \cdot \frac{1}{1!} \cdot \cos\left(3x + \frac{\pi}{2}\right)\right]$$

$$= \frac{-1}{3}\left[\frac{-x}{6} \cdot \left\{\cos(3x)\cos\frac{\pi}{2} - \sin(3x)\sin\left(\frac{\pi}{2}\right)\right\}\right]$$

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$$= \frac{-1}{3}\left[\frac{-x}{6}\cdot\{-\sin(3x)\}\right]$$

$$= \boxed{\frac{-x\sin(3x)}{18}} \to (B)$$

Q-11) $\frac{1}{D^4+10D^2+9}(\sin 2x + \cos 4x)$

$\to \frac{1}{[(D^2)^2+10D^2+9]}(\sin 2x) + \frac{1}{[(D^2)^2+10D^2+9]}\cdot(\cos 4x)$

$$= \frac{1}{(D^2+9)(D^2+1)}\cdot\sin 2x + \frac{\cos 4x}{(D^2+9)(D^2+1)}$$

$a=2,\ D^2 \to -4$ $\qquad$ $a=4,\ D^2 \to -16$

$$= \frac{1}{(-4+9)(-4+1)}\cdot\sin 2x + \frac{\cos 4x}{(-16+9)(-16+1)}$$

$$= \boxed{-\frac{\sin 2x}{15} + \frac{\cos 4x}{105}} \to (B)$$

Q-12) $\frac{1}{D^2-2D+5}\cdot 10\sin x$

$\to a=1,\ D^2 \to -1$

$\therefore \frac{1}{-1-2D+5}\cdot 10\sin x = \frac{10\sin x}{-2(-2+D)}$

$$= \frac{-5\sin x\,(D+2)}{D^2-4}$$

$$= \frac{-5\,(D+2)\sin x}{-5}$$

$$= \boxed{\cos x + 2\sin x} \to (A)$$

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Q-. 13) $\frac{1}{D^4-m^4}\cdot\cos mx$

$\rightarrow$ $\frac{1}{(D^2-m^2)(D^2+m^2)}\cdot\cos mx$

$= \frac{1}{(D^2+m^2)}\cdot\left[\frac{1}{(D^2-m^2)}\cdot\cos mx\right]$

$a=m,\ D^2\rightarrow -m^2$

$= \frac{1}{(D^2+m^2)}\cdot\left[\frac{\cos mx}{-2m^2}\right]$

$= \frac{-1}{2m^2}\left[\frac{1}{(D^2+m^2)}\cdot\cos mx\right]$

$= \frac{-1}{2m^2}\left[\left(\frac{-x}{2(m)}\right)\cdot\frac{1}{1!}\cdot\cos\left(mx+\frac{\pi}{2}\right)\right]$

$= \frac{-1}{2m^2}\left[\frac{-x}{2m}\cdot\left[\cos mx\cdot\cos\left(\frac{\pi}{2}\right)-\sin(mx)\cdot\sin\left(\frac{\pi}{2}\right)\right]\right]$

$= \frac{-1}{2m^2}\left[\frac{-x}{2m}\left[-\sin(mx)\right]\right]$

$= \boxed{\frac{-x\sin(mx)}{4m^3}}$ $\rightarrow$ (B).

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Q-14. $\frac{1}{D^3-4D} \cdot 2\cosh(2x)$

$\rightarrow \frac{1}{D(D+2)(D-2)} \cdot \cancel{2}\left[\frac{e^{2x}+e^{-2x}}{\cancel{2}}\right]$

$= \frac{1}{D(D+2)}\left[\frac{1}{(D-2)} \cdot e^{2x}\right] + \frac{1}{D(D-2)}\left[\frac{1}{(D+2)} \cdot e^{-2x}\right]$

$a = 2,\ r = 1 \qquad a = -2,\ r = 1$

$= \therefore \frac{1}{2(2+2)}\left[\frac{x}{1!} \cdot e^{2x}\right] + \frac{1}{(-2)(-2-2)}\left[\frac{x}{1!} \cdot e^{-2x}\right]$

$= \frac{x\,e^{2x}}{8} + \frac{x e^{-2x}}{8}$

$= \frac{x}{4} \cdot \left[\frac{e^{2x}+e^{-2x}}{2}\right] = \boxed{\frac{x}{4} \cdot \cosh(2x)} \rightarrow$ C

Q-15. $\frac{1}{D^2+6D-9} \cdot \sin h(3x)$

$$\rightarrow \frac{1}{D^2+6D-9} \cdot \left[\frac{e^{3x}-e^{-3x}}{2}\right]$$

$$= \frac{1}{2}\left[\left[\frac{1}{(D^2+6D-9)} \cdot e^{3x}\right] - \left[\frac{1}{(D^2+6D-9)} \cdot e^{-3x}\right]\right]$$

$$= \frac{1}{2}\left[\left[\frac{1}{\cancel{9}+18\cancel{-9}} \cdot e^{3x}\right] - \left[\frac{1}{\cancel{9}-18-\cancel{9}} \cdot e^{-3x}\right]\right]$$

$$= \frac{1}{2}\left[\frac{e^{3x}+e^{-3x}}{18}\right]$$

$$= \frac{1}{18}\left[\frac{e^{3x}+e^{-3x}}{2}\right]$$

$$= \boxed{\frac{\cos h(3x)}{18}} \rightarrow (A).$$

Q-16.) $\frac{1}{D^3+8}(x^4+2x+1)$

$$\rightarrow \frac{1}{(D+2)(D^2-2D+4)} \cdot (x^4+2x+1).$$

$$= \frac{1}{8\left(1+\frac{D^3}{8}\right)} \cdot (x^4+2x+1).$$

$$t = \frac{D^3}{8}, \quad \frac{1}{1+t} = 1-t+t^2-t^3+t^4 \ldots$$

$$\therefore = \frac{1}{8}\left[(1)-\left(\frac{D^3}{8}\right)+\left(\frac{D^3}{8}\right)^2-\left(\frac{D^3}{8}\right)^3+\left(\frac{D^3}{8}\right)^4\right](x^4+2x+1)$$

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$$= \frac{1}{8}\left[1 - \frac{D^3}{8} + \frac{D^6}{64} - \frac{D^9}{8^3}\right](x^4+2x+1)$$

$$\frac{1}{8}\left[(x^4+2x+1) - \frac{(\cancel{24}^{3}x)}{\cancel{8}}\right]$$

$$= \boxed{\frac{1}{8}\left[x^4 - x + 1\right]} \rightarrow \text{D}$$

Q-17) $\frac{1}{(D^4+D^2+1)} \cdot (53x^2+17)$

$\rightarrow$ $\frac{1}{[1+(D^4+D^2)]} \cdot (53x^2+17)$

$t = D^4+D^2$. $\therefore \frac{1}{1+t} = 1 - t + t^2 \ldots$

$$= \left[1 - (D^4+D^2) + (D^4+D^2)^2\right](53x^2+17)$$

$$= \left[1 - \cancel{D^4} - D^2 + D^8 + \cancel{D^4} + 2D^6\right](53x^2+17)$$

$$= \left[D^8 + 2D^6 - D^2 + 1\right](53x^2+17)$$

$$= [-106 + 53x^2 + 17)$$

$$= \boxed{53x^2 - 89} \rightarrow \text{B}$$

Q-18) $\frac{1}{(D^2-D+1)} \cdot (3x^2-1)$

$\rightarrow$ $t = D^2 - D$, $\frac{1}{1+t} = 1 - t + t^2 \ldots$

$$= \left[1 - (D^2-D) + (D^2-D)^2\right](3x^2-1)$$

$$= \left[1 - \cancel{D^2} + D + D^4 + \cancel{D^2} - 2D^3\right](3x^2-1)$$

$$= \left[D^4 - 2D^3 + D + 1\right](3x^2-1)$$

$$= [6x + 3x^2 - 1]$$

$$= \boxed{3x^2 + 6x - 1} \rightarrow \text{C}$$

Q - 19) $\frac{1}{D^2-1} \cdot x^3$

$\rightarrow \frac{-1}{(1-D^2)} \cdot x^3$

$\therefore t = D^2, \quad \frac{1}{1-t} = 1+t+t^2+t^3+\ldots\ldots$

$\therefore = -1\left[1+D^2+(D^2)^2+(D^2)^3\right]x^3$

$= -1\left[1+D^2+D^4+D^6\right]x^3$

$= -\left[x^3+6x\right]$

$= \boxed{-x^3-6x} \rightarrow$ (D)

# Tutorial three

Total points 40/40

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Q zero *

2/2

$$\frac{1}{D^2 - 7D + 6} e^{2x} =$$

$$\frac{-e^{2x}}{4}$$

Option 1

$$\frac{e^{2x}}{4}$$

Option 2