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Method of Evaluation (P.I.)

Case 4: When $Q = e^{ax}V$, where V is a function of x

$$\frac{e^{ax}V}{f(D)} = e^{ax}\frac{V}{f(D+a)}$$

$$(D^2+3D+2)y = e^{2x}\sin 3x$$

$$\text{PI} \quad y = \frac{e^{2x}\sin 3x}{D^2+3D+2}$$

$$y = e^{2x}\left[\frac{\sin 3x}{(D+2)^2+3(D+2)+2}\right]$$

$$y = e^{2x}\left[\frac{\sin 3x}{D^2+7D+12}\right] = e^{2x}\left[\frac{\sin 3x}{-9+7D+12}\right]$$

$$y = e^{2x}\left[\frac{(7D-3)\sin 3x}{(7D-3)(7D+3)}\right] = e^{2x}\left[\frac{(7D-3)\sin 3x}{49D^2-9}\right]$$

$$y = e^{2x}\left[\frac{7D(\sin 3x)-3\sin 3x}{49(-9)-9}\right]$$

$$y = \frac{e^{2x}}{-450}\left[21\cos 3x - 3\sin 3x\right]$$

$$(D^2+3D+2)y = e^{2x}(x^2+x)$$

$$y = \frac{e^{2x}(x^2+x)}{D^2+3D+2}$$

$$y = e^{2x}\left[\frac{x^2+x}{(D+2)^2+3(D+2)+2}\right]$$

$$y = e^{2x}\left(\frac{x^2+x}{D^2+7D+12}\right) = \frac{e^{2x}}{12}\left[1+\frac{7D+D^2}{12}\right]^{-1}(x^2+x)$$

$$y = \frac{e^{2x}}{12}\left(1-\frac{7D+D^2}{12}+\left(\frac{7D+D^2}{12}\right)^2 - \cdots\right)(x^2+x)$$

$$y = \frac{e^{2x}}{12}\left(1-\frac{7D}{12}-\frac{D^2}{12}+\frac{49D^2}{144}\right)(x^2+x)$$

$$y = \frac{e^{2x}}{12}\left(1-\frac{7D}{12}+\frac{37D^2}{144}\right)(x^2+x)$$

$$y = \frac{e^{2x}}{12}\left[x^2+x-\frac{7}{12}(2x+1)+\frac{37}{72}\right]$$

$$\frac{d^2y}{dx^2} + 4\frac{dy}{dx} - 12y = (x-1)e^{2x}$$ Let PI of D.E is $P(x)$

$P(1)$

(a) $\frac{7e^2}{64}$ (b) $-\frac{7e^2}{64}$

(c) $\frac{5e^2}{64}$ (d) $-\frac{5e^2}{64}$

$$y = \frac{(x-1)e^{2x}}{D^2+4D-12}$$

$$y = e^{2x}\left[\frac{x-1}{(D+2)^2+4(D+2)-12}\right]$$

$$y = e^{2x}\left(\frac{x-1}{D^2+8D}\right)$$

$$y = \frac{e^{2x}}{8D}\left(1+\frac{D}{8}\right)^{-1}(x-1)$$

$$y = \frac{e^{2x}}{8D}\left(1-D/8\right)(x-1)$$

$$y = \frac{e^{2x}}{8D}\left(x-1-1/8\right) = \frac{e^{2x}}{8D}\left(x-\frac{9}{8}\right)$$

$$P(x) = \frac{e^{2x}}{8}\left(\frac{x^2}{2} - \frac{9x}{8}\right)$$

$$P(1) = \frac{e^2}{8}\left(\frac{1}{2} - \frac{9}{8}\right) = \frac{e^2}{8}\left(-5/8\right) = = \frac{-5e^2}{64}$$

Q1 A particular solution of the differential equation

$$y''' - 3y'' + 3y' - y = e^x \cos 2x \text{ is}$$

(a) $\cancel{-\frac{1}{8}e^x \sin 2x}$

(b) $\frac{1}{8}e^x \sin 2x$

(c) $\frac{1}{8}e^x \cos 2x$

(d) $e^x \sin 2x$

$y = \frac{e^x \cos 2x}{(D^3 - 3D^2 + 3D - 1)}$

$y = \frac{e^x \cos 2x}{(D-1)^3}$

$y = e^x \left(\frac{\cos 2x}{D^3} \right)$

$y = e^x \left(\frac{\cos 2x}{D^2 \cdot D} \right)$

$y = e^x \left(\frac{\cos 2x}{-4D} \right)$

$y = \frac{e^x}{-4} \left(\frac{\sin 2x}{2} \right) = -\frac{e^x}{8} \sin 2x$

Case 5: To find the P.I. for $Q = x^n \sin ax$ or $Q = x^n \cos ax$

Write

$$\frac{1}{f(D)} x^n \sin ax = \text{Imaginary Part (IP) in } e^{iax} \frac{1}{f(D+ia)} x^n$$

And $\frac{1}{f(D)} x^n \cos ax = \text{Real Part (RP) in } e^{iax} \frac{1}{f(D+ia)} x^n$

$$y = I.P. \text{ of } \frac{\cos x + i \sin x}{25}\left[(4-3i)x + \frac{(9-58i)}{25}\right]$$

$$= \frac{\cos x}{25}\left(-3x - \frac{58}{25}\right) + \frac{\sin x}{25}\left(4x + \frac{9}{25}\right)$$

$$e^{iax} = \cos ax + i \sin ax$$

$$\cos ax = R.P. \text{ of } e^{iax}$$

$$\sin ax = I.P. \text{ of } e^{iax}$$

$$y = I.P. \text{ of } \frac{x e^{ix}}{D^2+3D+5} = I.P. \text{ of } e^{ix}\left(\frac{x}{(D+i)^2+3(D+i)+5}\right)$$

$$y = I.P. \text{ of } e^{ix}\left[\frac{x}{D^2+2iD-1+3D+3i+5}\right] = I.P. \text{ of } e^{ix}\left(\frac{x}{D^2+2iD+3D+3i+4}\right)$$

$$I.P. \text{ of } \frac{e^{ix}}{3i+4}\left(1 - \frac{\cancel{D^2}+2iD+3D}{3i+4}\right)^{-1} x = I.P. \text{ of } \frac{e^{ix}}{3i+4}\left[x - \frac{2i+3}{3i+4}\right]$$

$$y = I.P. \text{ of } \frac{e^{ix}}{4+3i} \times \frac{4-3i}{4-3i}\left[x - \frac{2i+3}{4+3i} \times \frac{4-3i}{4-3i}\right]$$

$$y = I.P. \text{ of } \frac{(\cos x + i \sin x)(4-3i)}{25}\left[x - \frac{-i+18}{25}\right]$$

$$(4-3i)(18-i) = 72 - 4i - 54i - 3$$

Q2. A particular integral of the differential equation $\frac{d^2y}{dx^2}-2\frac{dy}{dx}=e^{2x}\sin x$ is

(a) $\frac{e^{2x}}{10}(3\cos x-2\sin x)$ (b) $-\frac{e^{2x}}{10}(3\cos x-2\sin x)$

(c) $-\frac{e^{2x}}{5}(2\cos x+\sin x)$ (d) $\frac{e^{2x}}{5}(2\cos x-\sin x)$

Q3. The general solution of the differential equation

$$y''(x) - 4y'(x) + 8y(x) = 10e^{x}\cos x$$

(a) $e^{2x}(k_1\cos 2x + k_2\sin 2x) + e^{x}(2\cos x + \sin x)$

(b) $e^{2x}(k_1\cos 2x + k_2\sin 2x) + e^{x}(2\cos x - \sin x)$

(c) $e^{-2x}(k_1\cos 2x + k_2\sin 2x) - e^{x}(2\cos x - \sin x)$

(d) $e^{-2x}(k_1\cos 2x + k_2\sin 2x) + e^{x}(2\cos x + \sin x)$

$m^2 - 4m + 8 = 0$

$m = \frac{4 \pm \sqrt{16-32}}{2}$

$= \frac{4 \pm 4i}{2} = 2 \pm 2i$

$y = e^{2x}(c_1\cos 2x + c_2\sin 2x)$

$10e^{x}\left(\frac{\cos x}{D^2 - 2D + 5}\right)$

$10e^{x}\left(\frac{\cos x}{-2D + 4}\right)$

PI $y = \frac{10e^{x}}{-2}\left(\frac{(D+2)\cos x}{(D+2)(D-2)}\right) = -5e^{x}\left(\frac{(D+2)\cos x}{D^2 - 4}\right)$

$= \frac{-5}{-5}e^{x}\left(D(\cos x) + 2\cos x\right)$

$= e^{x}(2\cos x - \sin x)$

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Q.4. Solve $(D^2 - 2D + 1)y = \sin x + x^2 e^x$.

(a) $(c_1 + c_2 x)e^x + \left(\frac{1}{2}\right)\cos x + \left(\frac{1}{12}\right)x^4 e^x$

(b) $(c_1 + c_2 x)e^{-x} + \left(\frac{1}{2}\right)\cos x - \left(\frac{1}{12}\right)x^4 e^x$

(c) $(c_1 + c_2 x)e^{-x} + \left(\frac{1}{2}\right)\cos x + \left(\frac{1}{12}\right)x^4 e^x$

(d) None of these

$m^2 - 2m + 1 \Rightarrow m = 1, 1$

C.F. $y = (c_1 + c_2 x)e^x$

$y = \frac{\sin x}{D^2 - 2D + 1} + \frac{x^2 e^x}{D^2 - 2D + 1}$

$y = \frac{\sin x}{-2D} + e^x\left(\frac{x^2}{D^2}\right)$

$y = \frac{-1}{2}(-\cos x) + e^x\left(\frac{x^4}{12}\right)$

Q.5. Let p(x) be the particular integral of

$(D^2 + 1)y = e^x \cos x + \sin 3x$ then $p(0)$

(a) $-\dfrac{119}{730}$ (b) $\dfrac{119}{730}$

(c) $\dfrac{19}{730}$ (d) None of these

$$y = \frac{e^x \cos x}{D^2+1} + \frac{\sin 3x}{D^2+1}$$

$$y = e^x\left(\frac{\cos x}{(D+1)^2+1}\right) + \frac{\sin 3x}{-8}$$

$$y = e^x\left(\frac{\cos x}{D^2+2D+2}\right)$$

$$y = e^x\left(\frac{(2D-1)\cos x}{(2D-1)(2D+1)}\right)$$

$$y = e^x\left(\frac{(2D-1)\cos x}{4D^2-1}\right)$$

$$y = \frac{e^x}{-5}\left[-2\sin x - \cos x\right)$$

$$y = \frac{e^x}{5}\left(2\sin x + \cos x\right) = 1/5$$

Q.6. Let p(x) be the particular solution integral of the equation

$(D^2 + 4)y = x\sin x$, then $p\left(\frac{\pi}{2}\right)$.

$x\cos x$

(a) $\pi/3$ (b) $-\pi/6$

(c) $\pi/2$ (d) $\pi/6$

$y = CF + \frac{x e^{ix}}{D^2+4}$

$y = IP \text{ of } e^{ix}\left(\frac{x}{(D+i)^2+4}\right)$

$y = IP \text{ of } e^{ix}\left(\frac{x}{D^2+2iD+3}\right)$

$y = IP \text{ of } \frac{e^{ix}}{3}\left(1+\left(\frac{D^2+2iD}{3}\right)\right)^{-1} x$

$y = IP \text{ of } \frac{e^{ix}}{3}\left(1-\frac{\cancel{D^2}+2iD}{3}+\cdots\right) x$

$y = IP \text{ of } \frac{e^{ix}}{3}\left(1-\frac{2iD}{3}\right) x$

$y = IP \text{ of } \frac{\cos x + i\sin x}{3}\left(x-\frac{2i}{3}\right)$

$p(x) = \frac{-2\cos x}{9} + \frac{x\sin x}{3}$

$p(\pi/2) = 0 + \frac{\frac{\pi}{2}\sin\frac{\pi}{2}}{3} = \pi/6$

Q7. If y(t) is a solution of the differential equation $y'' + 4y = e^{2t}$ then $\lim_{t \to \infty} e^{-t} y(t)$ is equal to

(a) 2/3 (b) 2/5

(c) 2/7 (d) 2/9

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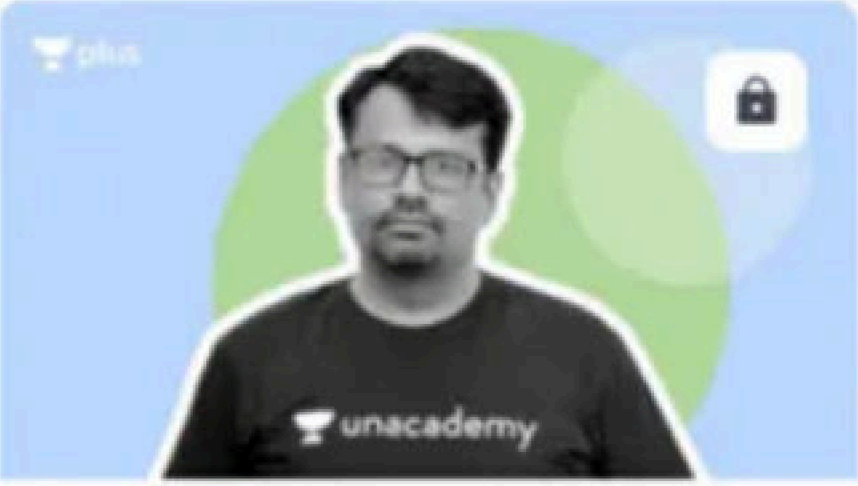

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- Works at **Pacific Science College**
- Studied at **M.Sc., NET, PhD(Algebra), MBA(Finance), BEd**
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