

ENG381: Engineering Mathematics

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15/ENG06/054

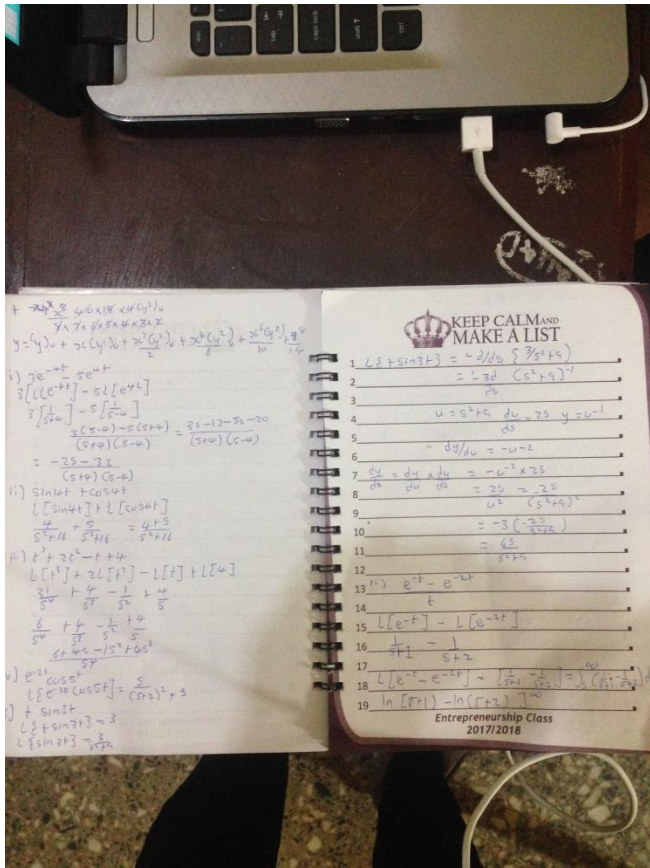
KEEP CALM AND
MAKE A LIST

- 1
- 2 OMASUENTO JEMINE
- 3 15/ENGR06/054
- 4 mechanical ENGR
- 5 1) $(1-x^2) \frac{d^2y}{dx^2} - 2x \frac{dy}{dx} + 2y = 0$
- 6 $\frac{dx^2}{dx^2} \quad \frac{dx}{dx} \quad \downarrow$
- 7 $w_1 - w_2 + w_3 = 0$
- 8 for w_1
- 9 $(1-x^2) = v \quad y'' = u$
- 10 $u^n - 2x = v' \quad y^{n+2} = u^n$
- 11 $-2 = v'' \quad y^{n+1} = u^{n-1}$
- 12 $0 = v''' \quad y^n = u^{n-2}$
- 13 $y^n = u^n v + n u^{n-1} v' + n(n-1) u^{n-2} v'' + \dots$
- 14 $= (y^{n+2})(1-x^2) + (-2xy^{n+1}) + (2y^n)(n^2-n)$
- 15 $= y^{n+2}(1-x^2) - 2xy^{n+1} - n(n^2-n)y^n$
- 16 for w_2
- 17 $2x = v \quad y' = u$
- 18 $2 = v' \quad y^{n+1} = u^n$
- 19 $0 = v'' \quad y^n = u^{n-1}$

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- 1
- 2 $y'' = (y')^2(1+x-2)$
- 3 $= 1018(4^x)$
- 4 $n = 5$
- 5 $y'' = (y')^2(25+5-2)$
- 6 $= 275(4^x) = 0$
- 7 $n = 6$
- 8 $y'' = (y')^2(36+6-2)$
- 9 $= 40(4^x) = 0$
- 10 $n = 7$
- 11 $y'' = (y')^2(49+7-2)$
- 12 $= 56(4^x) = 0$
- 13 Yes!
- 14 all odd y raise to the power of
- 15 odd no is equal to zero
- 16 $y = C_1 u + 2C_2 u + 2^2 C_3 u + 2^3 C_4 u + \dots$
- 17 $2^2(1+y)u^2 + 2^3 u^2 + 2^4 u^2 + \dots$
- 18 $y = C_1 u + 2C_2 u + 2^2 C_3 u + 2^3 C_4 u + \dots$
- 19

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$$y = \frac{1}{2} \left(\frac{1}{s+4} + \frac{1}{s+2} \right) + \frac{1}{2} \left(\frac{1}{s+4} - \frac{1}{s+2} \right)$$

$$y = \frac{1}{2} \left(\frac{1}{s+4} + \frac{1}{s+2} + \frac{1}{s+4} - \frac{1}{s+2} \right) = \frac{1}{s+4}$$

$$y = \frac{1}{s+4} \Rightarrow y = e^{-4t}$$

iii) $\frac{1}{s^2+1} = \frac{A}{s+i} + \frac{B}{s-i}$

$$1 = A(s-i) + B(s+i)$$

$$1 = (A+B)s - iA + iB$$

$$\begin{cases} A+B=0 \\ -iA+iB=1 \end{cases} \Rightarrow \begin{cases} B=-A \\ -iA+i(-A)=1 \\ -2iA=1 \\ A = \frac{1}{-2i} = \frac{i}{2} \\ B = -\frac{i}{2} \end{cases}$$

$$\frac{1}{s^2+1} = \frac{i}{2} \frac{1}{s+i} - \frac{i}{2} \frac{1}{s-i}$$

$$\mathcal{L}^{-1} \left[\frac{1}{s^2+1} \right] = \frac{i}{2} e^{-it} - \frac{i}{2} e^{it} = \frac{i}{2} (e^{-it} - e^{it}) = \frac{i}{2} (-2i \sin t) = \sin t$$

iv) $\frac{1}{s^2+4} = \frac{A}{s+2i} + \frac{B}{s-2i}$

$$1 = A(s-2i) + B(s+2i)$$

$$1 = (A+B)s - 2iA + 2iB$$

$$\begin{cases} A+B=0 \\ -2iA+2iB=1 \end{cases} \Rightarrow \begin{cases} B=-A \\ -2iA+2i(-A)=1 \\ -4iA=1 \\ A = \frac{1}{-4i} = \frac{i}{4} \\ B = -\frac{i}{4} \end{cases}$$

$$\frac{1}{s^2+4} = \frac{i}{4} \frac{1}{s+2i} - \frac{i}{4} \frac{1}{s-2i}$$

$$\mathcal{L}^{-1} \left[\frac{1}{s^2+4} \right] = \frac{i}{4} e^{-2it} - \frac{i}{4} e^{2it} = \frac{i}{4} (e^{-2it} - e^{2it}) = \frac{i}{4} (-2i \sin 2t) = \frac{1}{2} \sin 2t$$

v) $\frac{1}{s^2+9} = \frac{A}{s+3i} + \frac{B}{s-3i}$

$$1 = A(s-3i) + B(s+3i)$$

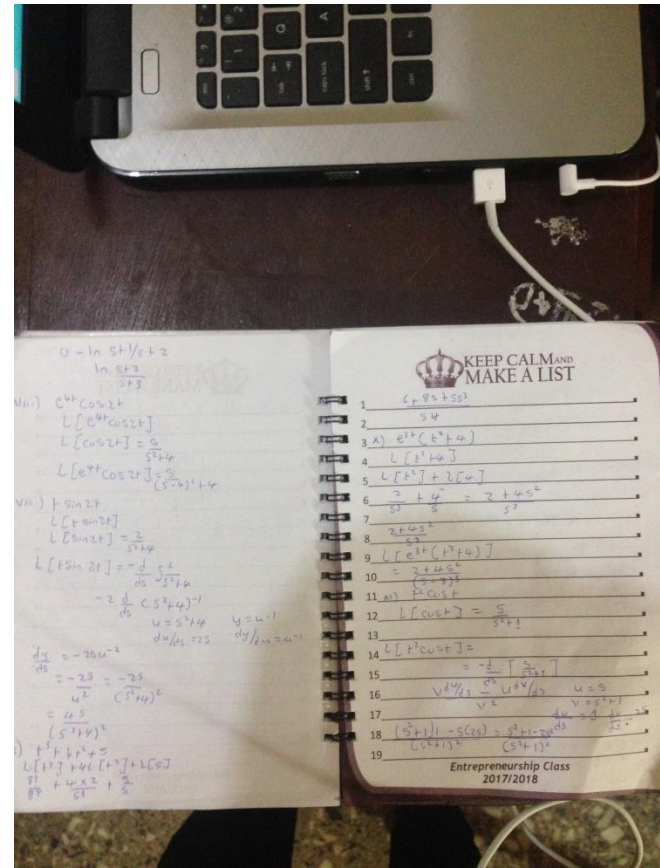
$$1 = (A+B)s - 3iA + 3iB$$

$$\begin{cases} A+B=0 \\ -3iA+3iB=1 \end{cases} \Rightarrow \begin{cases} B=-A \\ -3iA+3i(-A)=1 \\ -6iA=1 \\ A = \frac{1}{-6i} = \frac{i}{6} \\ B = -\frac{i}{6} \end{cases}$$

$$\frac{1}{s^2+9} = \frac{i}{6} \frac{1}{s+3i} - \frac{i}{6} \frac{1}{s-3i}$$

$$\mathcal{L}^{-1} \left[\frac{1}{s^2+9} \right] = \frac{i}{6} e^{-3it} - \frac{i}{6} e^{3it} = \frac{i}{6} (e^{-3it} - e^{3it}) = \frac{i}{6} (-2i \sin 3t) = \frac{1}{3} \sin 3t$$

- KEEP CALM AND MAKE A LIST**
1. $\mathcal{L}[\sin 3t] = \frac{3}{s^2+9}$
 2. $\mathcal{L}[\cos 3t] = \frac{s}{s^2+9}$
 3. _____
 4. $u = s^2+5 \quad du = 2s \quad y = u^{-1}$
 5. $-dy/du = -u^{-2}$
 6. _____
 7. $\frac{dy}{dx} = \frac{dy}{du} \frac{du}{dx} = -u^{-2} \times 2s$
 8. $= 2s \times \frac{1}{(s^2+5)^2}$
 9. $= -3 \left(\frac{-3s}{s^2+5} \right)$
 10. $= \frac{9s}{s^2+5}$
 11. _____
 12. _____
 13. $\mathcal{L}^{-1} \left[\frac{e^{-t} - e^{-2t}}{t} \right]$
 14. _____
 15. $\mathcal{L} \left[\frac{1}{t} \right] = \int_s^{\infty} \frac{1}{u} du = \lim_{b \rightarrow \infty} \left[\ln u \right]_s^b = \lim_{b \rightarrow \infty} (\ln b - \ln s) = \infty - \ln s = \infty$
 16. _____
 17. $\ln [f(t)] = \ln (f+3) - \ln (f+2)$
 18. _____
 19. _____
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$$u = \ln s^2 + 5t^2$$

$$\ln \frac{du}{ds} = \ln 2s$$

$$\frac{du}{ds} = 2s$$

$$u = s^2 + 5 \quad du = 2s \quad y = u^{-1}$$

$$-dy/du = -u^{-2}$$

$$\frac{dy}{dx} = \frac{dy}{du} \frac{du}{dx} = -u^{-2} \times 2s$$

$$= 2s \times \frac{1}{(s^2+5)^2}$$

$$= -3 \left(\frac{-3s}{s^2+5} \right)$$

$$= \frac{9s}{s^2+5}$$

iii) $\mathcal{L}^{-1} \left[\frac{1}{s^2+1} \right] = \frac{1}{2} \left(\frac{1}{s+i} - \frac{1}{s-i} \right)$

$$= \frac{1}{2} (e^{-it} - e^{it}) = \frac{1}{2} (-2i \sin t) = -i \sin t$$

iv) $\mathcal{L}^{-1} \left[\frac{1}{s^2+4} \right] = \frac{1}{4} \left(\frac{1}{s+2i} - \frac{1}{s-2i} \right)$

$$= \frac{1}{4} (e^{-2it} - e^{2it}) = \frac{1}{4} (-2i \sin 2t) = -\frac{i}{2} \sin 2t$$

v) $\mathcal{L}^{-1} \left[\frac{1}{s^2+9} \right] = \frac{1}{6} \left(\frac{1}{s+3i} - \frac{1}{s-3i} \right)$

$$= \frac{1}{6} (e^{-3it} - e^{3it}) = \frac{1}{6} (-2i \sin 3t) = -\frac{i}{3} \sin 3t$$

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 6. $\frac{1}{s^2+4} = \frac{A}{s+2i} + \frac{B}{s-2i}$
 7. $1 = A(s-2i) + B(s+2i)$
 8. $1 = (A+B)s - 2iA + 2iB$
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 14. $= \frac{1}{2} (e^{-it} - e^{it}) = \frac{1}{2} (-2i \sin t) = -i \sin t$
 15. $\frac{1}{\sqrt{1+s^2}} = \frac{1}{\sqrt{1+u^2}} \quad u=s \quad du=ds$
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