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15/ENG04/047

ELECTRICAL/ELECTRONICS

ENG381

$= (1-x^2)\left(y^{(n+2)}\right) + y^{(n+1)}(-2xn - 2x) + y^{n}(-n(n-1) + 2n)$

when $x = 0$;

$= (1-(0)^2) y^{(n+2)} + y^{(n+1)}(-2(0)n - 2(0)) + y^{n}(-n^2 + n + 2n)$

$y^{(n+2)} + y^{n}(-n^2 + n + 2n)$ | $y^{(n+2)} = -y^{n}(-n^2 + n + 2n)$

Using Maclaurin's theorem

at $n = 0$

$y^{(0+2)} = -y^{(0)}(-(0)^2 + 0 + 2(0))$

$y^{n} = -y^{0}(-0 + 0 + 0)$

$y_0^2 = 0$;

at $n = 1$

$y^{(1+2)} = -y^{(1)}(-1(1)^2 + 1 + 2(1))$

$y_0^3 = -y^1(-1 + 1 + 2)$

$y_0^3 = -2y$

$n = 2$

$y^{(2+2)} = -y^{(2)}(-2^2 + 2 + 2(2))$

$y_0^4 = -y_0^2(-4 + 4 + 2)$

$y_0^4 = -2y_0^2$

2 (i) $3e^{-4t} - 5e^{4t}$

Sol

$3e^{-4t} - 5e^{4t}$

$= 3\left[\frac{1}{s+4}\right] - 5\left[\frac{1}{s-4}\right]$

$= \frac{3}{s+4} - \frac{5}{s-4} = \cancel{\frac{3(s+4) - 5(s+4)}{(s+4)(s-4)}}$

2(ii) $\sin 4t + \cos 4t$

Sol

$= \left[\frac{4}{s^2+4^2}\right] + \left[\frac{s}{s^2+4^2}\right]$

2(iii) $t^3 + 2t^2 - t + 4$

$= \left[\frac{3!}{s^{3+1}}\right] + 2\left[\frac{2!}{s^{2+1}}\right] - \left[\frac{1}{s^{1+1}}\right] + \left[\frac{4}{s}\right]$

$= \frac{6}{s^4} + \frac{4}{s^3} - \frac{1}{s^2} + \frac{4}{s}$

2(iv) $e^{-2t}\cos 5t = \left[\frac{s}{\ }\right]$

$L[\cos 5t] = \frac{s}{s^2-5^2}$

$L[e^{-2t}[\cos 5t]] = \frac{(s+2)}{(s+2)^2 - 5^2}$

2(v) $t \sin 3t$

$L(\sin 3t) = \frac{3}{s^2+3^2}$

$L[t \sin 3t] = \frac{3}{s^2+3^2}$

$= \frac{-d\left(\frac{2}{s^2+3^2}\right)}{ds} = 2\cdot[s^2+3^2]$

V(iii)

$e^{4t}\cos 2t$

Sol

$L[\cos 2t] = \frac{s}{s^2-2^2}$

$L[e^{4t}](\cos 2t) = \frac{s-4}{(s-4)^2 - 2^2}$

V(ii)

$t \sin 2t$

$L[\sin 2t] = \frac{2}{s^2+2^2}$

$L[t \sin 2t] = \frac{d}{ds}\left[\frac{2}{s^2+2^2}\right]$

$= \left[\frac{(s^2+2^2)0 - 2[2s]}{(s^2+2^2)^2}\right]$

$= \frac{4s}{(s^2+2^2)^2}$

(3)

i) $\dfrac{s-5}{(s-3)(s-4)}$

$$\frac{s-5}{(s-3)(s-4)} = \frac{A}{(s-3)} + \frac{B}{(s-4)}$$

$$s-5 = A(s-\cancel{4}) + B(s-3)$$

3^{-8} $\quad -A = -2$

$$A = 2$$

$2[2s]$

* ix

$e^{3t}\{t^2+4t\}$

$L\{t^2+4t\} = \frac{2!}{s^{2+1}} + \frac{4}{s}$

$= \frac{2!}{s^3} + \frac{4}{s}$

$L\{e^{3t}\{t^2+4t\}\} = \frac{2!}{(s-3)^3} + \frac{4}{(s-3)}$

(x)

$L\{t^3+4t^2+5\}$

$= \frac{3!}{s^{3+1}} + 4\left[\frac{2!}{s^{2+1}}\right] + \frac{5}{s}$

$= \frac{6}{s^4} + \frac{6}{s^3} + \frac{5}{s}$

xi

$t^2 \cos t$

$L[\cos t] = \frac{s}{s^2-1}$

$L[t^2 \cos t] = \frac{d}{ds}\left[\frac{s}{s^2-1}\right] = \frac{\{(s^2-1)\cdot 1 - \{s\}(2s)\}}{(s^2-1)^2}$

$= \frac{[(s^2-1) - 2s^2]}{(s^2-1)^2} = \frac{-s^2-1}{(s^2-1)^2}$

$= -(s^2+1)$

$$= \frac{s+2-2}{(s+2)^2+4^2} - \frac{5}{(s+2)^2+4^2}$$

$$= \frac{s+2}{(s+2)^2+4^2} - \frac{7}{(s+2)^2+4^2}$$

$$x(t) = e^{-2t}\cos 4t - \frac{7}{4}e^{-2t}\sin 4t$$

$$\frac{5s-8}{s(s-4)} = \frac{2}{s} + \frac{3}{(s-4)}$$

$$= 2 + 3(e^{4t})$$

(iv)

$$L\left\{\frac{s^2-3s-4}{(s-3)(s-1)^2}\right\} = \frac{A}{s-3} + \frac{B}{(s-1)} + \frac{C}{(s-1)^2}$$

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

$$s^2-3s-4 = A(s-1)^2 + B(s-3)$$

$$3^2 - 3(3) - 4 = A(3-1)^2$$

$$9 - 9 - 4 = A(4)$$

$$A = -1$$

let $s = 1$

$$\frac{s^2-3s-4}{(s-3)(s-1)^2} = \frac{-1}{(s-3)} + \frac{-1}{(s-1)^2}$$

$$x(t) = e^{3t} + te^{t}$$

(v)

$$\frac{s-5}{s^2+4s+20} = \frac{s-5}{(s+2)^2+16}$$

$$= \frac{s}{(s+2)^2+16} - \frac{5}{(s+2)^2+16}$$

$B = -1$

$$\frac{s-5}{(s-3)(s-4)} = \frac{2}{(s-3)} + \frac{-1}{(s-4)}$$

$$= 2e^{3t} - e^{4t}$$

(ii)

$$L\left[\frac{2s-6}{(s-2)(s-4)}\right] = \frac{A}{s-2} + \frac{B}{(s-4)}$$

$$2s-6 = A(s-4) + B(s-2)$$

$$-2A = -2$$

$$A = 1$$

$$2B = 2$$

$$B = 1$$

$$\frac{2s-6}{(s-2)(s-4)} = \frac{1}{s-2} + \frac{1}{s-4}$$

$$= e^{2t} + e^{4t}$$

(iii)

$$L\left[\frac{5s-8}{s(s-4)}\right] = \frac{A}{s} + \frac{B}{(s-4)}$$

$$5s-8 = A(s-4) + Bs$$

$$-4A = -8$$

$$A = 2$$

$$4B = 12$$

$$B = \frac{12}{4} = 3$$

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(1) $(1-x^2)\frac{d^2y}{dx^2} - 2x\frac{dy}{dx}$

$y^n = u^n v + nu^{(n-1)}v' + \frac{n(n-1)}{2!}u^{(n-2)}v^2 + \frac{n(n-1)(n-2)}{3!}v^3 \ldots$

$= (1-x^2)y^{(n+2)} - 2x \cdot ny^{(n+1)} - \frac{n(n-1)}{2 \times 1}y^n = 0$

$= (1-x^2)y^{(n+2)} - 2xny^{(n+1)} - \frac{n(n-1)}{2}y^n$

$\therefore (1-x^2)\frac{d^2y}{dx^2} = (1-x^2)y^{(n+2)} - 2xny^{(n+1)} - n(n-1)y^n$

For $2x\frac{dy}{dx}$; $v = 2x$, $v' = 2$, $v^2 = 0$

$u = \frac{dy}{dx} = y'$; $u^n = (y^{(n+1)})$

using leibnitz theorem

$y^n = u^n v + nu^{(n-1)}v' + \frac{n(n-1)}{2!}u^{(n-2)}v^2$

$= y^{(n+1)} \cdot 2x + ny^{(n+1-1)} \cdot 2 + \frac{n(n-1)}{2!}y^{(n+1-2)} \times 0$

$= 2xy^{(n+1)} + 2ny^{(n)}$

$2x\frac{dy}{dx} = 2xy^{(n+1)} + 2ny^{(n)}$

For $2y$; $v = 2$, $v' = 0$