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Mechatronics Engineering

$$\int \frac{11-3x}{x^2+2x-3} dx$$

$$\int \frac{11-3x}{(x+1)(x-3)} dx$$

$$= \frac{A}{(x+1)} + \frac{B}{(x-3)}$$
$$= \frac{A(x-3) + B(x+1)}{(x+1)(x-3)}$$

$$\Rightarrow 11-3x = A(x-3) + B(x+1)$$

at $x=3$

$$11-3(3) = A(3-3) + B(3+1)$$

$$11-9 = 4B$$

$$\frac{2}{4} = \frac{4B}{4}$$

$$B = \frac{1}{2}$$

at $x=-1$

$$11-3(-1) = A(-1-3) + B(-1+1)$$

$$11+3 = -4A$$

$$\frac{14}{-4} = \frac{-4A}{-4}$$

$$A = -\frac{7}{2}$$

$$\therefore = \int \frac{-7/2}{(x+1)} dx + \int \frac{1/2}{(x-3)} dx$$

$$\int \frac{-7}{2(x+1)} dx + \int \frac{1}{2(x-3)} dx$$

$$\int \frac{-7}{2(x+1)} + \frac{1}{2(x-3)} dx$$

$$-\frac{7}{2} \left[\ln u \right] + \frac{1}{2} \left[\ln u \right]$$

$$= \left[\frac{1}{2} \ln(x-3) - \frac{7}{2} \ln(x+1) \right] + C$$

$$2) \int \frac{2x^2 + 9x - 35}{(x+1)(x-2)(x+3)} dx$$

$$\frac{A}{(x+1)} + \frac{B}{(x-2)} + \frac{C}{(x+3)}$$

$$= A(x-2)(x+3) + B(x+1)(x+3) + C(x+1)(x-2)$$

$$2x^2 + 9x - 35 = A(x-2)(x+3) + B(x+1)(x+3) + C(x+1)(x-2)$$

$$2x^2 + 9x - 35 = A(x^2 + x - 6) + B(x^2 + 4x + 3) + C(x^2 - x - 2)$$

$$2x^2 + 9x - 35 = Ax^2 + Ax - 6A + Bx^2 + 4Bx + 3B + Cx^2 - Cx - 2C$$

$$2x^2 + 9x - 35 = Ax^2 + Bx^2 + Cx^2 + Ax + 4Bx - Cx - 6A + 3B - 2C$$

$$A + B + C = 2 \quad (i)$$

$$A + 4B - C = 9 \quad (ii)$$

$$-6A + 3B - 2C = -35 \quad (iii)$$

From eqn (i) $A = 2 - B - C$

Sub in eq (ii) & (iii)

$$(2 - B - C) + 4B - C = 9 \quad (iv)$$

$$-6(2 - B - C) + 3B - 2C = -35 \quad (v)$$

$$(2 - B - C) + 4B - C = 9$$

$$2 - B - C + 4B - C = 9$$

$$3B - 2C = 7 \quad (vi)$$

$$-6(2 - B - C) + 3B - 2C = -35$$

$$-12 + 6B + 6C + 3B - 2C = -35$$

$$9B - 4C = -35 + 12$$

$$9B - 4C = -23 \quad (vii)$$

$$\therefore 9B - 4C = -23 \quad 3B - 2C = 7$$

$$9B - 4C = -23$$

$$3(3B - 2C) = 7(3)$$

$$1(9B - 4C) = -23$$

$$9B - 2C = 21$$

$$9B - 4C = -23$$

$$\frac{2C = 44}{2} \quad \frac{2}{2}$$

$$C = 22$$

Sub C in eqn (i) & eqn (ii).

$$(2 - B - 22) + 4B - 22 = 9$$

$$2 + 3B - 44 = 9$$

$$3B = 44 + 9 - 2$$

$$3B = 44 + 7$$

$$\frac{3B = 51}{3} \quad \frac{3}{3}$$

$$B = 17$$

Sub B and C in eqn (i) $A = 2 - B - C$

$$(2 - 17 - 22) = A$$

$$A = -37$$

$$\therefore \int \frac{-37}{(x+1)} dx + \frac{17}{(x+2)} \frac{17}{(x-2)} dx + \frac{22}{(x+3)} dx$$

$$-37 \left| \ln(x+1) \right| + 17 \left| \ln(x-2) \right| + 22 \left| \ln(x+3) \right| + C$$

$$-37 \ln(x+1) + 17 \ln(x-2) + 22 \ln(x+3) + C$$

$$3) \int \frac{11}{x^2 + 11} dx \quad \int \frac{1}{x^2 + 11^2} dx$$

$$x = 11 \tan \theta$$

$$\frac{dx}{d\theta} = 11 \sec^2 \theta$$

$$dx = 11 \sec^2 \theta d\theta$$

$$\begin{aligned} x^2 + 11^2 &= 11^2 \tan^2 \theta + 11^2 \\ &= 11 (\tan^2 \theta + 1) \\ &= 11^2 \sec^2 \theta \end{aligned}$$

$$\Rightarrow \int \frac{1 \cdot \sec^2 \theta}{1^2 \sec^2 \theta} d\theta = \int \frac{d\theta}{1}$$

$$= \frac{1}{1} \int d\theta$$

$$= \frac{1}{1} [\theta] + C$$

$$= \frac{1}{1} \left[\frac{\tan^{-1} x}{1} \right] + C$$