$= y^3 \ldots (1)$

$^{-1} = y^3, n = 3$

by y^3

$y^{-2} \cdot x^{-1} = 1 - (2)$

$z = y^{1-3}, y = y^{-2}$

$^{-3}\, dy/dx$

2 by $y^{1-n} = y^{-2}$

$[-2y^{-2}x^{-1}] = -2$

$y^{-2}x^{-1} = -2 \; -(4)$

and $d^2/dy =$

(4)

$= -2$

$= -2$

2

$I_f = e^{-2\ln x} = x^{-2}$

dx

^{-2}dx

$e^{-2}dx$

$^{-1} + c$

c

$\frac{c}{x^{-2}}$

x^2

(x)

$+ (x)$

$(x]$

e) $x^2 \, dy/dx = x^3 \sin 3x + 4$

$dy/dx = x \sin 3x + 4/x^2$

$\int dy/dx = \int x \sin 3x + \int 4x^{-2}$

$= 1/3 \cos 3x + \int 1/3 \cos 3x + \frac{4x^{-1}}{-1}$

$= \frac{-2\cos 3x}{3} + \frac{\sin 3x}{9} - 4x^{-1}$

$y = \frac{\sin 3x}{9} - \frac{x \cos 3x}{3} - \frac{4}{x}$

f) $(x^3 + xy^2)\, dy/dx = 2y^3$

$y = vx$

$dy/dx = v + x\, dy/dx$

$v + x\, dv/dx = \frac{2(vx)^3}{x^3 + v^2 x^3}$

$v + x\, dv/dx = \frac{x^3(2v^3)}{x^3(1+v^2)}$

$x\, dv/dx = \frac{2v^3}{1+v^2} - v$

$= \frac{2v^3}{1+v^2} - v$

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

$x\, dv/dx = \frac{2v^3 - v - v^3}{1+v^2}$

$= \frac{v^3 - v}{1+v^2}$

$dx/x = \frac{1+v^2}{v^3 - v}\, dv$

$\frac{v^3 - v^2(v)(v-1)}{(v+1)}$

$\therefore \frac{1+v^2}{v^3 - v^2} = \frac{A}{v} + \frac{B}{v-1} + \frac{C}{v+1}$

$1+v^2 = A(v-1)(v+1) + B(v)(v+1) + C(v)(v-1)$

$v = 1 \quad \therefore 1 + 1^2 = B(1)(2)$

$2 = B(2) \quad B = 1$

$\frac{v-1}{2} \quad v = -1 \quad 1 + (-1)^2 = C((-1)(-1))$

$2 = 2C \quad \therefore C = 1$

$v = 0$ so $1 + (0)^2 = A(0-1)(0+1)$

$\therefore 1 = -A \quad \therefore A = -1$

$\int \left[\frac{1}{v} + \frac{1}{v-1} + \frac{1}{v+1} \right] dv = \int \frac{1}{x}\, dx$

$= \int -\frac{1}{v}\, dv + \int \frac{1}{v-1}\, dv \int \frac{1}{v+1}\, dv = \int \frac{1}{x}\, dx$

$= -\ln v + \ln(v-1) + \ln(v+1) = \ln x + c$

$= -\ln v + \ln(v-1) + \ln(v+1) = \ln x + \ln A$

$\frac{v^2 - 1}{v} = Ax$

$\therefore y = vx \quad \therefore v = y/x$

$\frac{(y/x)^2 - 1}{y/x} = Ax$

$\therefore y^2/x^2 - 1 = \cancel{Ax \cdot y/x} \; \frac{Ax \cdot y}{x}$

$\frac{y - x^2}{x^2} = Ay$

$y^2 - x^2 = Ayx^2$

$y^2 = x^2(Ay + 1)$

LAWAL ADEOLA [illegible]

18/AG05/029

MECHATRONICS

a) $\frac{dy}{dx} + y\tanh x = 2\sinh x$

$P = \tanh x, \quad Q = 2\sinh x$

$\int P\,dx = \int \tanh x\,dx = \int \frac{\sinh x}{\cosh x}\,dx$

$= \ln\cosh x$

$IF = e^{\ln\cosh x} = \cosh x$

$y \cdot IF = \int Q \cdot IF\,dx$

$y \cdot \cosh x = \int 2\sinh x \cosh x\,dx$

$y \cdot \cosh x = 2\int \sinh x \cosh x\,dx$

$y \cdot \cosh x = 2\int \cosh x\,d(\sinh x)$

$= 2\left[\frac{\cosh^2 x}{2}\right] + c$

$y \cdot \cosh x = \cosh 2x + c$

$y = \cosh x + \frac{c}{\cosh x}$

b) $\frac{dy}{dx} + 2y = e^{3x}$

$P = 2 \quad Q = e^{3x}$

$\int P\,dx = \int 2\,dx = 2x$

$IF = e^{2x}$

$y \cdot IF = \int Q \cdot IF\,dx$

$y \cdot e^{2x} = \int e^{3x} \cdot e^{2x}\,dx$

$y \cdot e^{2x} = \int e^{5x}\,dx$

$y \cdot e^{2x} = \frac{e^{5x}}{5} + c$

$y = \frac{e^{3x}}{5} + \frac{c}{e^{2x}}$

$y = \frac{e^{3x}}{5} + Ce^{-2x}$

c) $x\,dy/dx = x^2 + 2x - 3$

$dy/dx = x^2/x + 2x/x - 3/x$

$dy/dx = x + 2 - 3/x$

$\int dy/dx = \int x + 2 - 3/x$

$\int dy = \int x + 2 - 3/x\,dx$

$y = x^2/2 + 2x - 3\ln x + c$

d) $dy/dx + y/x = y^3 \quad \text{---(i)}$

$dy/dx + y \cdot x^{-1} = y^3, \; n = 3$

Divide both by y^3

$y^{-3}\,dy/dx + y^{-2} \cdot x^{-1} = 1 \quad \text{---(2)}$

$z = y^{1-n}, \quad z = y^{1-3}, \; y = y$ [illegible]

$dz/dy = -2y^{-3}\,dy/dx$

multiply equ 2 by $y^{1-n} = y$ [illegible]

$-2y^{-3}\,dy/dx + [-2y^{-2}x^{-1}] = -2$

$-2y^{-3}\,dy/dx - 2y^{-2}x^{-1} = -2$

Put $z = y^{-2}$ and $dz/dy = -2y^{-3}\,dy/dx$ in (4)

$dz/dy - 2zx^{-1} = -2$

$dz/dy - 2z/x = -2$

$P = -2/x, \; Q = -2$

$\int P\,dx = -2\ln x \quad IF = e^{-2\ln x} = x^{-2}$

$z \cdot IF = \int Q \cdot IF\,dx$

$z \cdot x^{-2} = \int -2x^{-2}\,dx$

$z x^{-2} = -2\int x^{-2}\,dx$

$z \cdot x^{-2} = \frac{+2x^{-1}}{+1} + c$

$z \cdot x^{-2} = 2x^{-1} + c$

$z = \frac{2x^{-1}}{x^{-2}} + \frac{c}{x^{-2}}$

$z = 2x + Cx^2$

$z = x(2 + Cx)$

$z = y^{-2}$

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

$y^2 = \frac{1}{x}[2 + Cx]$

$y = \sqrt{\frac{1}{x(2+x)}}$