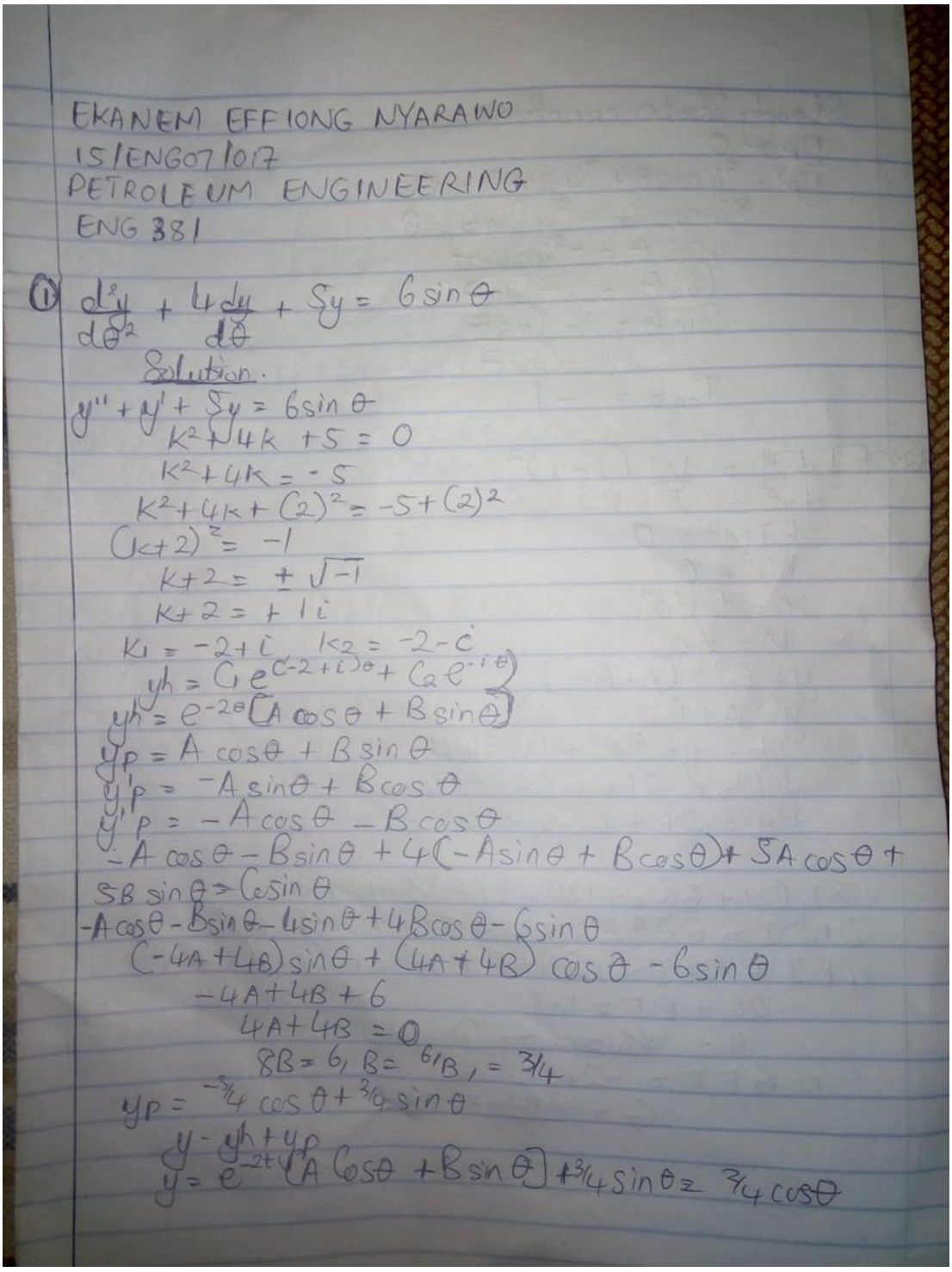


EKANEM EFFIONG NYARAWO
15/ENG07/017
PETROLEUM ENGINEERING
ENG 381

① $\frac{d^2y}{d\theta^2} + 4\frac{dy}{d\theta} + 5y = 6\sin\theta$

Solution.

$y'' + y' + 5y = 6\sin\theta$

$k^2 + 4k + 5 = 0$

$k^2 + 4k = -5$

$k^2 + 4k + (2)^2 = -5 + (2)^2$

$(k+2)^2 = -1$

$k + 2 = \pm\sqrt{-1}$

$k + 2 = \pm i$

$k_1 = -2 + i \quad k_2 = -2 - i$

$y_h = C_1 e^{(-2+i)\theta} + C_2 e^{(-1\theta)}$

$y_h = e^{-2\theta}[A\cos\theta + B\sin\theta]$

$y_p = A\cos\theta + B\sin\theta$

$y'_p = -A\sin\theta + B\cos\theta$

$y''_p = -A\cos\theta - B\cos\theta$

$-A\cos\theta - B\sin\theta + 4(-A\sin\theta + B\cos\theta) + 5A\cos\theta + 5B\sin\theta = 6\sin\theta$

$-A\cos\theta - B\sin\theta - 4\sin\theta + 4B\cos\theta - 6\sin\theta$

$(-4A + 4B)\sin\theta + (4A + 4B)\cos\theta - 6\sin\theta$

$-4A + 4B + 6$

$4A + 4B = 0$

$8B = 6, \quad B = 6/8, = 3/4$

$y_p = -3/4\cos\theta + 3/4\sin\theta$

$y = y_h + y_p$

$y = e^{-2t}[A\cos\theta + B\sin\theta] + 3/4\sin\theta = 3/4\cos\theta$

EKANEM EFFIONG NYARAWO
15/ENG07/017
PETROLEUM ENGINEERING

Steady State equations

$y_p = 0$

$y_p' = \frac{3}{4}\cos\theta + \frac{3}{4}\sin\theta = 0$

$\frac{3}{4}\cos\theta + \frac{3}{4}\sin\theta = 0$

$\frac{3}{4}\cos\theta = -\frac{3}{4}\sin\theta$

$\cos\theta = -\sin\theta$

$\sin\theta = -\frac{\cos\theta}{\cos\theta}$

$\tan\theta = -1$

(2) $EI\frac{d^2y}{dx^2} = \frac{W}{I}(L-x)^2$

$EIM^2 = 0$

$M^2 = 0$

$M = \pm\sqrt{0}$

$M = \pm 0$

$y = e^{0x}[A + Bx]$

$y = A + Bx$

$y_p = y = Fx^2 + Gx^3 + Hx^4$

$dy/dx = 2Fx + 3Gx^2 + 4Hx^3$

$\frac{d^2y}{dx^2} = 2F + 6Gx + 12Hx^2$

$EI[2F + 6Gx + 12Hx^2] + \frac{W}{2}(L-x)^2$

$2FEI + 6GEIx + 12HEIx^2 = \frac{W}{2}(L+x)^2$

$4EI + 12EIx + 24HEIx^2 = W(L - 2Lx + x^2)$

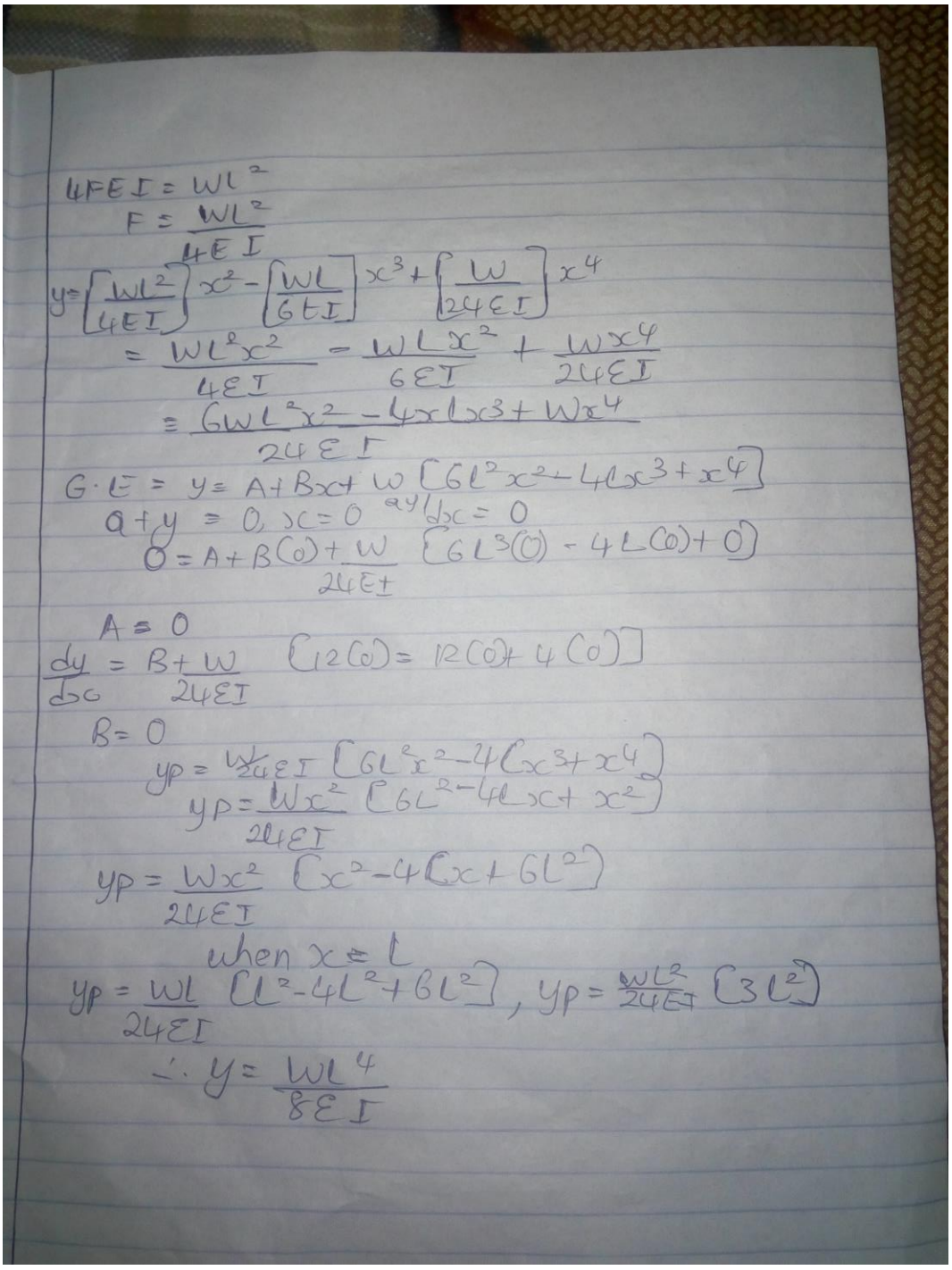
$24HEI = W$

$H = \frac{W}{24EI}$ — (1)

$12GEI = -2WL$

$G = \frac{-2WL}{12GI} = -\frac{WL}{6EI}$

EKANEM EFFIONG NYARAWO
15/ENG07/017
PETROLEUM ENGINEERING



$$4FEI = WL^2$$

$$F = \frac{WL^2}{4EI}$$

$$y = \left[\frac{WL^2}{4EI}\right]x^2 - \left[\frac{WL}{6EI}\right]x^3 + \left[\frac{W}{24EI}\right]x^4$$

$$= \frac{WL^2x^2}{4EI} - \frac{WLx^3}{6EI} + \frac{Wx^4}{24EI}$$

$$= \frac{6WL^2x^2 - 4xLx^3 + Wx^4}{24EI}$$

$$G.E = y = A + Bx + \frac{W}{24EI}[6L^2x^2 - 4Lx^3 + x^4]$$

$$a + y = 0,\ x = 0 \quad a\,dy/dx = 0$$

$$0 = A + B(0) + \frac{W}{24EI}[6L^3(0) - 4L(0) + 0]$$

$$A = 0$$

$$\frac{dy}{dx} = B + \frac{W}{24EI}[12(0) = 12(0) + 4(0)]$$

$$B = 0$$

$$yp = \frac{W}{24EI}[6L^2x^2 - 4(x^3 + x^4)]$$

$$yp = \frac{Wx^2}{24EI}[6L^2 - 4Lx + x^2]$$

$$yp = \frac{Wx^2}{24EI}[x^2 - 4(x + 6L^2)]$$

when $x = L$

$$yp = \frac{WL}{24EI}[L^2 - 4L^2 + 6L^2],\ yp = \frac{WL^2}{24EI}[3L^2]$$

$$\therefore y = \frac{WL^4}{8EI}$$