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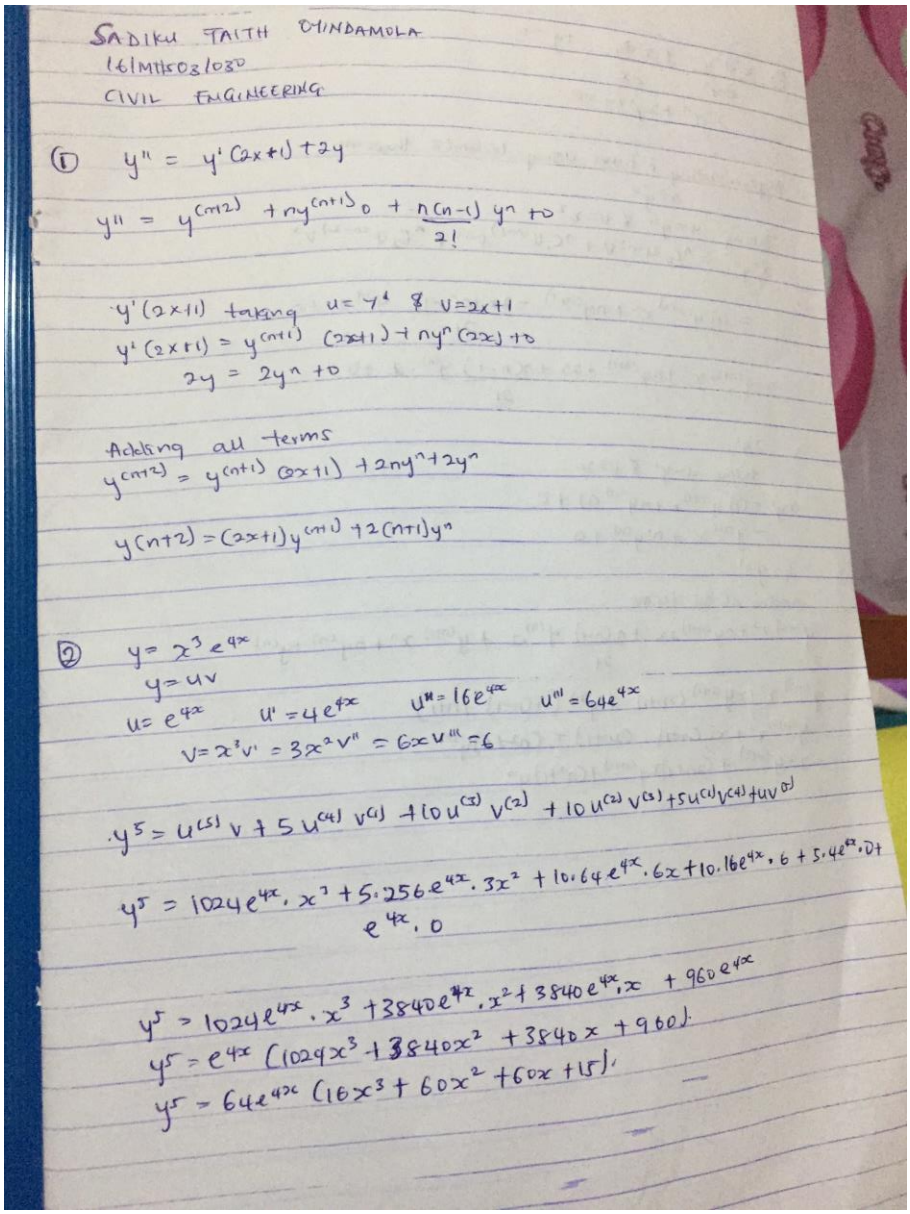
DEPARTMENT: CIVIL ENGINEERING

COURSE: ENG 381



(5) $\frac{x^2 d^2y}{dx^2} + \frac{x\,dy}{dx} + y = 0$

$x^2y'' + xy' + y = 0$

Differentiating n times using Leibnitz theorem

Taking x^2y''

Taking $u = y''$ & $v = x^2$

$x^2y'' = {}^nC_0\, u^{(n)} v + {}^nC_1 u^{(n-1)} v^{(1)} + {}^nC_2 u^{(n-2)} v^2$

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

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

xy'

taking $u = y'$ & $v = x$

$xy' = (1)\, y^{(n+1)} x + n y^{(n)} (1) + 0$

$= y^{n+1} x + n' y^{(n)} + 0$

$y = y^{(n)}$

Adding all the terms

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

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

$y^{(n+2)} x^2 + x y^{(n+1)} (2n+1) + (n^2+1) y^n$

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