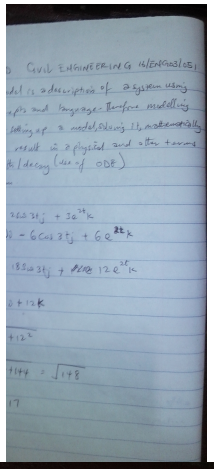


Civil ENGINEERING 16/EN4083/0531

del is a description of a system using
ps and language. Further modelling
ining of a model, solving it, mathematically
result in a physical and other terms
le / decay (use of ODE)

$3\cos 3tj + 3e^{2t}k$

$-6\cos 3tj + 6e^{2t}k$

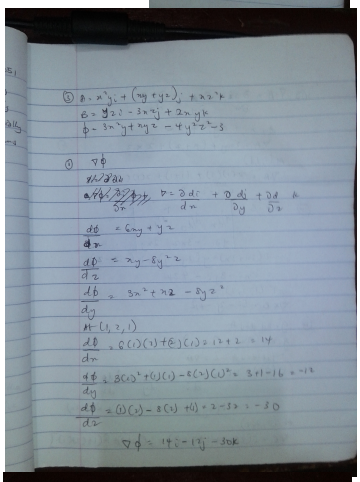
$18\sin 3tj + 12e^{2t}k$

$+12k$

$+12^2$

$144 = \sqrt{148}$

17



(5) $\phi = xy^2z + (xy+yz)j + xz^2k$

$\phi = y^2z - 3x^2zj + 2xyk$

$\phi = 3x^2y + xyz - 4y^2z^2 - 3$

(6) $\nabla\phi$

$\frac{\partial}{\partial x}\frac{\partial}{\partial y}\frac{\partial}{\partial z}$

$\nabla = \frac{\partial}{\partial x}i + \frac{\partial}{\partial y}j + \frac{\partial}{\partial z}k$

$\frac{d\phi}{dx} = 6xy + yz$

$\frac{d\phi}{dz} = xy - 8yz^{-2}$

$\frac{d\phi}{dz} = 3x^2 + xz - 8yz^{-3}$

dy

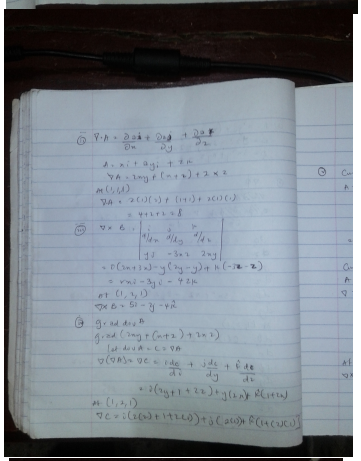
$A(1,2,1)$

$\frac{d\phi}{dx} = 6(1)(2) + (2)(1) = 12 + 2 = 14$

$\frac{d\phi}{dy} = 3(1)^2 + (1)(1) - 8(2)(1)^2 = 3 + 1 - 16 = -12$

$\frac{d\phi}{dz} = (1)(2) - 8(2)(1) = 2 - 32 = -30$

$\nabla\phi = 14i - 12j - 30k$



(7) $\nabla \cdot A = \frac{\partial}{\partial x}\frac{\partial}{\partial y}\frac{\partial}{\partial z}$

$A = xi + 2yj + xk$

$\nabla A = 1 + 2y + (x+x)$

$A(1,1,1)$

$\nabla A = 2(1)(1) + (1+1) + x(1)(1)$

$= 4 + 1 + 1 = 6$

(8) $\nabla \times G = \begin{vmatrix} i & j & k \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ 1 & -3x^2 & 2xy \end{vmatrix}$

$= i(3x^2 + x) - j(2y - y) + k(-6x - x)$

$= 4x^2i - 3yj - 7xk$

$at\ (1,1,1)$

$\nabla \times G = 5i - j - 7k$

(9) $g \cdot \nabla A$

$g \cdot \nabla(3xyi + (x+z)j + 2xk)$

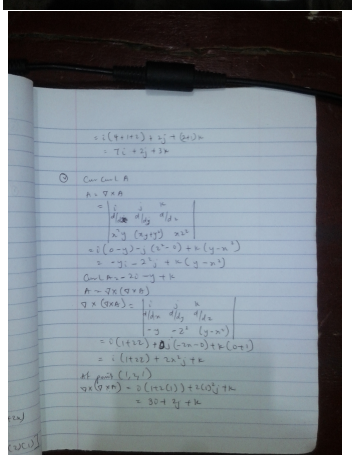
$let\ \nabla \cdot A = C = \nabla A$

$\nabla(\nabla A) = \nabla C = i\frac{dc}{dx} + j\frac{dc}{dy} + k\frac{dc}{dz}$

$= i(3y + 1 + 2z) + y(2x)j + k(1+2x)$

$A(1,2,1)$

$\nabla C = i(2(2)) + 1 + 2(2)) + j(2(1)) + k((1+2)(1))$



$= i(4+1+2) + 2j + (2+1)k$

$= 7i + 2j + 3k$

(10) Curl Curl A

$A \cdot \nabla \times A$

$= \begin{vmatrix} i & j & k \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ x^2y & (x+yz) & xz^2 \end{vmatrix}$

$= i(0-y) - j(z^2 - 0) + k(y - x^2)$

$= -yi - z^2j + k(y - x^2)$

$Curl\ A = -2i - j + k$

$A \sim \nabla \times (\nabla \times B)$

$\nabla \times (\nabla \times B) = \begin{vmatrix} i & j & k \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ -y & -z^2 & (y - x^2) \end{vmatrix}$

$= i(1+2z) + j(-2x - 0) + k(0+1)$

$= i(1+2z) + 2xj + k$

$at\ point\ (1,1,1)$

$\nabla \times (\nabla \times B) = i(1+2(1)) + 2(1)j + k$

$= 3i + 2j + k$