Ernest Daronye Abali
16/ENG06/001
Mech Engineering

1.) Mechanical modelling.

This is the process of setting up a model, solving it mathematically, and interpreting the result in physical or in order items.

ii) Using balance law :- law of Conservation of mass, forming a differential equation from an existing algebraic equation of the system.

2.) $r = (t^2 + 3t)i - 2\sin 3t\, j + 3e^{2t} k$

$\frac{dr}{dt} = (2t + 3)i - 6\cos 3t\, j + 6e^{2t} k$

$\frac{d^2r}{dt^2} = \frac{d}{dt}\left(\frac{dr}{dt}\right)$

$\frac{d^2r}{dt^2} = 2i + 18\sin 3t\, j + 12e^{2t} k.$

$\frac{d^2r}{dt^2} = 2i + 18\sin 3(0) j + 12e^{2(0)} k.$

$2i + 18\sin 0\, j + 12e^{0} k$

$2i + 18 \times 0\, j + 12 \times 1k$

$= 2i + 12k$

iv) $\left|\frac{d^2r}{dt^2}\right| = |2i + 12k|$

$$\frac{d}{dx} \qquad\qquad \frac{}{dy}$$

$$\frac{\partial (3x^2y + xyz - 4y^2z^2 - 3)}{\partial z} k$$

$$\bar{\nabla}\phi = (6xy + yz)i + (3x^2 + xz - 8yz^2)j + (xy - 8y^2z)k$$

at point 1, 2, 1

$$\bar{\nabla}\phi = (6(1)(2) + (1)(1))i + (3(1^2) + (1)(1) - 8(2)(1)^2)j + ((1)(-2) - 8(2^2)(1))k$$

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

(1, 2, 1)

$\nabla \times B = 5x i - y j - 4z k$

$(1,2,1) = 5(1) i - (2) j - 4(1) k$

$= 5i - 2j - 4k$

v) grad. div A $= \bar{\nabla} \cdot \bar{\nabla} A$

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

recall $\bar{\nabla} A = 2xy + x + z + 2xz$

$\bar{\nabla} \cdot \bar{\nabla} A = \frac{\partial}{\partial x}(2xy + x + z + 2xz) \cdot i + \frac{\partial}{\partial y}(2(y) + x + z + 2xz) j + \frac{\partial}{\partial z}(2xy + x + z + 2xz) k$

$\bar{\nabla} \cdot \nabla A = (2y + 1 + 2z) \cdot i + (2x) j + (1 + 2x) k$

at point $(1, 2, 1)$

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

$+ 2 j + (1 + 2) k$

$\bar{\nabla} \cdot \bar{\nabla} A = 7i + 2j + 3k$

grad div $A = 7i + 2j + 3k$

$$\text{Curl } A = \begin{vmatrix} i & j & k \\ \partial/\partial x & \partial/\partial y & \partial/\partial z \\ x^2 y & (xy + yz) & x z^2 \end{vmatrix}$$

$$\text{Curl} A = i \begin{vmatrix} \partial/\partial y & \partial/\partial z \\ (xy + yz) & x z^2 \end{vmatrix} - j \begin{vmatrix} \partial/\partial z & \partial/\partial z \\ x^2 y & x z^2 \end{vmatrix} + k \begin{vmatrix} \partial/\partial x & \partial/\partial y \\ x^2 y & (xy + yz) \end{vmatrix}$$

Curl A

Scanned by CamScanner

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

$\text{Curl } A = -yi - z^2 j + (y-x^2)k$

$\text{curl } A = -yi - z^2 j + (y-x^2)k$

$$\text{Curl Curl } A = \begin{vmatrix} i & j & k \\ \partial/\partial x & \partial/\partial y & \partial/\partial z \\ -y & -z^2 & y-x^2 \end{vmatrix}$$

$$i\left(\frac{\partial}{\partial y}\cdot(y-x^2) - \frac{\partial}{\partial z}\cdot -z^2\right) - j\left(\frac{\partial}{\partial x}\cdot(y-x^2) - \frac{\partial}{\partial z}\cdot -y\right)$$

$$+k\left(\frac{\partial}{\partial x}\cdot z^2 - \frac{\partial}{\partial y}\cdot(-y)\right)$$

Curl Curl A

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

$\text{Curl Curl } A = (1+2z)i + 2xj + k$

$\text{Curl Curl } A = (1+2z)i + 2xj + k$

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

$= 3j + 2j + k = 3i + 2j + k$

$\text{curl curl } A = 3i + 2j + k.$