$$\frac{\partial T}{\partial t} + \vec{v}.\nabla T = \alpha \nabla^2 T + S \qquad (Energy)$$

$$\frac{\partial C_A}{\partial t} + \vec{v}.\nabla C_A = D\nabla^2 C_A - (-r_A) \qquad (Material)$$

$$\frac{\partial \vec{v}}{\partial t} + (\vec{v}.\nabla)\vec{v} = \nu \nabla^2 \vec{v} - \frac{1}{\rho}\nabla p + \vec{g} \qquad (Momentum)$$

$$\vec{v}.\nabla T = v_x \frac{\partial T}{\partial x} + v_y \frac{\partial T}{\partial y} + v_z \frac{\partial T}{\partial z} \qquad (Cartesian)$$

$$= v_r \frac{\partial T}{\partial r} + \frac{v_\theta}{r}\frac{\partial T}{\partial \theta} + v_z \frac{\partial T}{\partial z} \qquad (Cylindrical)$$

$$= v_r \frac{\partial T}{\partial r} + \frac{v_\theta}{r}\frac{\partial T}{\partial \theta} + \frac{v_\phi}{r\sin\theta}\frac{\partial T}{\partial \phi} \qquad (Spherical)$$

$$\nabla^2 T = \frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2} + \frac{\partial^2 T}{\partial z^2} \qquad (Cartesian)$$

$$= \frac{1}{r}\frac{\partial}{\partial r}\left(r\frac{\partial T}{\partial r}\right) + \frac{1}{r^2}\frac{\partial^2 T}{\partial \theta^2} + \frac{\partial^2 T}{\partial z^2} \qquad (Cylindrical)$$

$$= \frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2\frac{\partial T}{\partial r}\right) + \frac{1}{r^2\sin\theta}\frac{\partial}{\partial \theta}\left(\sin\theta\frac{\partial T}{\partial \theta}\right) + \frac{1}{r^2\sin^2\theta}\frac{\partial^2 T}{\partial \phi^2} \qquad (Spherical)$$

Note : ρ, c_p, k, D, μ *are constants*

$\nu = \mu/\rho$ = *Kinematic viscosity*, $\vec{g}$ = *Gravitational acceleration*

$-r_A$ = *Reaction term e.g.* $-r_A = kC_A$ *for first order reaction*

S = *Heat generation term* = $Q/(\rho c_p)$ *where Q is heat generation*/(*volume.time*)

$\alpha = k/(\rho c_p)$, *Thermal diffusivity*

D = *diffusivity*