INCOMPRESSIBLE FLUID

CONSERVATION OF MASS

$$\partial U/\partial x + \partial V/\partial y + \partial W/\partial z = 0$$

CONSERVATION OF MOMENTUM

$$\rho\ (\partial U/\partial t + U\partial U/\partial x + V\partial U/\partial y + W\partial U/\partial z) = -\ \partial P/\partial x$$

$$+\ \mu\ (\partial^2 U/\partial x^2 + \partial^2 U/\partial y^2 + \partial^2 U/\partial z^2)$$

$$\rho\ (\partial V/\partial t + U\partial V/\partial x + V\partial V/\partial y + W\partial V/\partial z) = -\ \partial P/\partial y$$

$$+\ \mu\ (\partial^2 V/\partial x^2 + \partial^2 V/\partial y^2 + \partial^2 V/\partial z^2)$$

$$\rho\ (\partial W/\partial t + U\partial W/\partial x + V\partial W/\partial y + W\partial W/\partial z) = -\ \partial P/\partial z - \rho g$$

$$+\ \mu\ (\partial^2 W/\partial x^2 + \partial^2 W/\partial y^2 + \partial^2 W/\partial z^2)$$

CONSERVATION OF ENERGY

$$\rho C\ (\partial T/\partial t + U\partial T/\partial x + V\partial T/\partial y + W\partial T/\partial z) = \mu\ \Phi$$

$$+\ \partial/\partial x\ (k\partial T/\partial x) + \partial/\partial y\ (k\partial T/\partial y) + \partial/\partial z\ (k\partial T/\partial z)$$

COMPRESSIBLE FLUID

CONSERVATION OF MASS

$$\partial\rho/\partial t + U\partial\rho/\partial x + V\partial\rho/\partial y + W\partial\rho/\partial z$$
$$+ \rho(\partial U/\partial x + \partial V/\partial y + \partial W/\partial z) = 0$$

CONSERVATION OF MOMENTUM

$$\rho\ (\partial U/\partial t + U\partial U/\partial x + V\partial U/\partial y + W\partial U/\partial z) = - \partial P/\partial x$$
$$+ \partial/\partial x\ (\lambda\ [\partial U/\partial x + \partial V/\partial y + \partial W/\partial z]) + \partial/\partial x\ (\mu\ [\partial U/\partial x + \partial U/\partial x])$$
$$+ \partial/\partial y\ (\mu\ [\partial V/\partial x + \partial U/\partial y]) + \partial/\partial z\ (\mu\ [\partial W/\partial x + \partial U/\partial z])$$

$$\rho\ (\partial V/\partial t + U\partial V/\partial x + V\partial V/\partial y + W\partial V/\partial z) = - \partial P/\partial y$$
$$+ \partial/\partial y\ (\lambda\ [\partial U/\partial x + \partial V/\partial y + \partial W/\partial z]) + \partial/\partial x\ (\mu\ [\partial V/\partial x + \partial U/\partial y])$$
$$+ \partial/\partial y\ (\mu\ [\partial V/\partial y + \partial V/\partial y]) + \partial/\partial z\ (\mu\ [\partial W/\partial y + \partial V/\partial z])$$

$$\rho\ (\partial W/\partial t + U\partial W/\partial x + V\partial W/\partial y + W\partial W/\partial z) = - \partial P/\partial z - \rho g$$
$$+ \partial/\partial z\ (\lambda\ [\partial U/\partial x + \partial V/\partial y + \partial W/\partial z]) + \partial/\partial x\ (\mu\ [\partial W/\partial x + \partial U/\partial z])$$
$$+ \partial/\partial y\ (\mu\ [\partial V/\partial z + \partial W/\partial y]) + \partial/\partial z\ (\mu\ [\partial W/\partial z + \partial W/\partial z])$$

CONSERVATION OF ENERGY

$$\rho C_v\ (\partial T/\partial t + U\partial T/\partial x + V\partial T/\partial y + W\partial T/\partial z) =$$
$$\mu\ \Phi - P\ (\partial U/\partial x + \partial V/\partial y + \partial W/\partial z)$$
$$+ \partial/\partial x\ (k\partial T/\partial x) + \partial/\partial y\ (k\partial T/\partial y) + \partial/\partial z\ (k\partial T/\partial z)$$

CONSERVATION OF MASS

$$\frac{D}{Dt} \int_{V(t)} \rho \, dV = 0$$

$$\int_{V(t)} \left[\partial\rho/\partial t + \nabla . (\rho\mathbf{v}) \right] dV = 0$$

CONSERVATION OF MOMENTUM

$$\frac{D}{Dt} \int_{V(t)} \rho\mathbf{v} \, dV = \int_{S(t)} \boldsymbol{\sigma} \, dS + \int_{V(t)} \rho\mathbf{b} \, dV$$

$$\int_{V(t)} \left[\partial(\rho\mathbf{v})/\partial t + \nabla . (\rho\mathbf{v}\mathbf{v}) \right] dV = \int_{S(t)} \boldsymbol{\sigma} \, dS + \int_{V(t)} \rho\mathbf{b} \, dV$$

CONSERVATION OF ENERGY

$$\frac{D}{Dt} \int_{V(t)} \rho e \, dV = - \int_{S(t)} \mathbf{q}.\mathbf{n} \, dS + \int_{S(t)} \mathbf{v}.\boldsymbol{\sigma} \, dS$$

$$e = u + \mathbf{v}.\mathbf{v}/2 + gz$$

$$\int_{V(t)} \left[\partial(\rho e)/\partial t + \nabla . (\rho e\mathbf{v}) \right] dV = - \int_{S(t)} \mathbf{q}.\mathbf{n} \, dS + \int_{S(t)} \mathbf{v}.\boldsymbol{\sigma} \, dS$$