

**Newton's Law of cooling/warming equation**

$$\frac{dT}{dt} = k(T - T_m)$$

**Salt Solution**

$$\frac{dA}{dt} = (\text{input\_rate\_of\_salt}) - (\text{output\_rate\_of\_salt})$$

**Logistic equation**

$$P(t) = \frac{aP_0}{bP_0 + (a - bP_0)e^{-at}} \text{ where}$$

$$P_0 = P(0)$$

**spring – mass system**

$$mx''(t) + \beta x'(t) + kx(t) = F(t),$$

$F(t) = \text{applied force}$

$$g = 9.8 \frac{m}{s^2}, \text{ or } g = 32 \frac{ft}{s^2}$$

$$1 \text{ slug} = 1 \frac{lb}{ft/s^2}$$

$$1 \text{ dyne} = 1 \text{ g} \cdot \text{cm} / \text{s}^2$$

$$\text{Frequency and period: } \omega = \frac{2\pi}{T}$$

**Alternative forms of x(t)**

$$x(t) = e^{-\lambda t} (c_1 \cos \omega_d t + c_2 \sin \omega_d t)$$

Or

$$x(t) = Ae^{-\lambda t} \sin(\omega_d t + \phi)$$

Where  $A = \sqrt{c_1^2 + c_2^2}$

And

$$\phi = \arctan\left(\frac{c_1}{c_2}\right)$$

**Series RLC Electric Circuit**

Differential Equation for Charge

$$L \frac{d^2Q}{dt^2} + R \frac{dQ}{dt} + \frac{1}{C} Q = E(t)$$

- $Q$  = charge (coulomb C),
- $L$  = inductance (henries H),
- $R$  = resistance (ohms  $\Omega$ ),
- $C$  = capacitance (farads F).
- $E(t)$  = applied voltage

Current

$$I(t) = \frac{dQ}{dt}$$