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Chapter-01



Measurements

Steradian:

$$\text{steradian} = \frac{\text{area of path}}{r^2}$$

Further Details from this Chapter are at the end of this shortbook.

Vectors and Equilibrium

$$A + B = B + A$$
$$A = A\hat{A}$$
$$A + (-A) = \mathbf{0}$$
$$\mathbf{A} = A_x \hat{i} + A_y \hat{j}$$
$$A_x = A \cos \theta$$
$$A_y = A \sin \theta$$
$$A^2 = A_x^2 + A_y^2$$
$$\theta = \tan^{-1} \frac{A_y}{A_x}$$
$$\mathbf{r} = a \hat{\mathbf{i}} + b \hat{\mathbf{j}}$$
$$r = \sqrt{a^2 - b^2}$$

$$\mathbf{r} = a \hat{i} + b \hat{j} + c \hat{k}$$

$$r = \sqrt{a^2 + b^2 + c^2}$$

Vector Addition by Rectangular Components:

$$R_x = A_x + B_x$$

$$R_y = A_y + B_y$$

$$R = \sqrt{(A_x + B_x)^2 + (A_y + B_y)^2}$$

$$\theta = \tan^{-1} \frac{A_y + B_y}{A_x + B_x}$$

$$R = \sqrt{(A_x + B_x + C_x + \dots)^2 + (A_y + B_y + C_y + \dots)^2}$$

$$\theta = \tan^{-1} \frac{A_y + B_y + C_y + \dots}{A_x + B_x + C_x + \dots}$$

PRODUCT OF TWO VECTORS

Scalar or Dot Product:

$$\mathbf{A} \cdot \mathbf{B} = AB \cos \theta$$

$\hat{i} \cdot \hat{j} = 0$	$\hat{i} \cdot \hat{i} = 1$
$\hat{j} \cdot \hat{k} = 0$	$\hat{j} \cdot \hat{j} = 1$
$\hat{k} \cdot \hat{i} = 0$	$\hat{k} \cdot \hat{k} = 1$

$$\cos \theta = \frac{(A_x B_x + A_y B_y + A_z B_z)}{AB}$$

Vector or Cross Product:

$$\mathbf{A} \times \mathbf{B} = AB \sin \theta \hat{n}$$

$$\mathbf{A} \times \mathbf{B} = \mathbf{B} \times \mathbf{A}$$

Torque:

$$\tau = lF$$

$$\tau = (F \sin \theta) t = r F \sin \theta$$

$$\tau = (r F \sin \theta) \hat{n} \mathbf{B}$$

EQUILIBRIUM OF FORCES

First Condition of Equilibrium:

$$\Sigma F_x = 0$$

$$\Sigma F_y = 0$$

Second Condition of Equilibrium:

$$\Sigma \tau =$$

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Motion and Force

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NEWTON LAWS OF MOTION

Newton's Second law of Motion:

$$F = ma$$

Momentum:

$$p = mv$$

Momentum and Newton's Second Law of Motion:

$$a = \frac{v_f - v_i}{t}$$

$$a = \frac{F}{m}$$

$$\frac{F}{m} = \frac{v_f - v_i}{t}$$

$$F \times t = mv_f - mv_i$$

$$F = \frac{mv_f - mv_i}{t}$$

Impulse:

$$\text{impulse} = F \times t = mv_f - mv_i$$

Law of conservation of momentum:

$$(m_1 v_1 + m_2 v_2) = (m_1 v'_1 + m_2 v'_2)$$

Elastic Collision in One Dimension:

$$v'_1 = \frac{m_1 - m_2}{m_1 + m_2} v_1 + \frac{2m_2}{m_1 + m_2} v_2$$

$$v'_2 = \frac{2m_1}{m_1 + m_2} v_1 + \frac{m_2 + m_1}{m_1 + m_2} v_2$$

Force due to water flow:

$$F = - \left(-\frac{m}{v} \right) = \frac{m}{t} v$$

Momentum and Explosive Forces:

$$Mv' = -mv$$

Projectile Motion:

$$x = v_x \times t$$

$$y = \frac{1}{2} g t^2$$

$$v_{fy} = v_i \sin \theta - gt$$

$$\tan \theta = \frac{V_{fy}}{V_{fyx}}$$

Height of Projectile:

$$2aS = v_f^2 - v_i^2$$

$$h = \frac{v_i^2 \sin^2 \theta}{2g}$$

Time of flight:

$$t = \frac{2v_i \sin \theta}{g}$$

Range of the Projectile:

$$R = \frac{v_i^2}{g} \sin 2\theta$$

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Work and Energy

Work and Energy:

Work:

$$W = \mathbf{F} \cdot \mathbf{d} = Fd\cos\theta$$

Work done by a variable force:

$$W_{total} = \sum_{i=1}^n F_i \cos \theta_i \Delta d_i$$

Power:

$$P_{av} = \frac{\Delta W}{\Delta t}$$

Power and Velocity:

$$P = F \cdot v$$

Energy:

$$K.E. = \frac{1}{2}mv^2$$

$$K.E. = \frac{1}{2} \frac{P^2}{m}$$

$$P.E = mgh$$

Work-Energy Principle:

$$d = \frac{1}{2a}(v_f^2 - v_i^2)$$

$$Fd = \frac{1}{2}mv_f^2 - \frac{1}{2}m_i^2$$

Absolute Potential Energy:

$$U_g = -\frac{GMm}{R}$$

Escape Velocity:

$$V_{esc} = \sqrt{\frac{2GM}{R}}$$

Interconversion of Potential Energy and Kinetic Energy:

$$mg(h_1 - h_2) = \frac{1}{2}m(v_2^2 - v_1^2)$$

$$mgh = \frac{1}{2}mv^2 + fh$$

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Circular Motion

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$$\alpha = \lim_{\Delta t \rightarrow 0} \frac{\Delta \omega}{\Delta t}$$

Relation between Angular and Linear Velocity:

$$v = r\omega$$

Relation between Linear and Angular Acceleration:

$$a_i = r\alpha$$

EQUATIONS OF LINEAR AND ANGULAR MOTION

Linear Motion	Angular Motion
$v_f = v_i + at$	$\omega_f = \omega_i + \alpha t$
$2aS = v_f^2 - v_i^2$	$2\alpha\theta = \omega_f^2 - \omega_i^2$
$S = v_i t + \frac{1}{2}at^2$	$\theta = \omega_i t + \frac{1}{2}\alpha t^2$

Centripetal Force:

$$F_c = mr\omega^2$$

$$a = \frac{v^2}{r}$$

Momentum of Inertia:

$$I = \sum_{i=1}^n m_i r_i^2$$

Angular Momentum:

$$L = \mathbf{r} \times \mathbf{p}$$

$$L = \left(\sum_{i=1}^n m_i r_i^2 \right) \omega = I\omega$$

Law of Conservation of Momentum:

$$I_1\omega_1 = I_2\omega_2$$

Rotational Kinetic Energy:

$$K.E_{rot} = \frac{1}{2}I\omega^2$$

Real and Apparent weight:

$$F = ma$$

At Rest:

$$T - w = ma$$

$$a = 0$$

$$T = w$$

Moving Up with Acceleration:

$$T = w + ma$$

Moving downward with an Acceleration:

$$T = w - ma$$

Orbital Velocity:

$$v = \sqrt{\frac{GM}{r}}$$

Artificial Gravity:

$$f = \frac{1}{2} \sqrt{\frac{g}{R}}$$

Radius of Geostationary Orbit:

$$r = \left(\frac{GMT^2}{4\pi^2} \right)^{\frac{1}{3}}$$

Fluid Dynamics

$$P_1 - P_2 = \frac{1}{2} \rho V_2^2$$

Oscillations

$$f = \frac{1}{T}$$
$$\omega = \frac{2\pi}{T} = 2\pi f$$
$$x = x_0 \sin \omega t$$
$$v = \frac{x_o \omega}{x_o} \sqrt{x_o^2 - x^2} = \omega \sqrt{x_o^2 - x^2}$$
$$a = -\omega^2 x$$
$$\omega = \sqrt{\frac{k}{m}}$$
$$T = \frac{2\pi}{\omega} = 2\pi \sqrt{\frac{m}{k}}$$

Instantaneous Displacement:

$$x = x_o \sin \sqrt{\frac{k}{m}} t$$

Instantaneous Velocity:

$$v = x_o \sqrt{\frac{k}{m} \left(1 - \frac{x^2}{x_o^2} \right)}$$

Time Period of a Pendulum:

$$T = 2\pi \sqrt{\frac{l}{g}}$$

Energy Conservation:

$$\text{Total Energy} = \frac{1}{2} k x_o^2$$

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STATIONARY WAVES**Speed v of the waves in the string:**

$$v = \sqrt{\frac{F}{m}}$$

$$f_1 = \frac{v}{\lambda_1} = \frac{v}{2l}$$

$$f_1 = \frac{1}{2} \sqrt{\frac{F}{m}}$$

Frequency of Stationary Waves having n loops:

$$f_n = nf_1$$

Wavelength of Stationary Waves having n loops:

$$\lambda_n = \frac{2}{n} l$$

STATIONARY WAVES IN AIR COLUMN**When pipe is open at both ends:**

$$\lambda_n = \frac{2l}{n}$$

$$f_n = \frac{v}{\lambda_n} = \frac{nv}{2l}$$

$$f_n = nf_1$$

DOPPLER'S EFFECT**If the Observer moves towards the Stationary Source:**

$$f_A = f \left(\frac{v + u_o}{v} \right)$$

If the Observer moves away from the Stationary Source:

$$f_B = f \left(\frac{v - u_o}{v} \right)$$

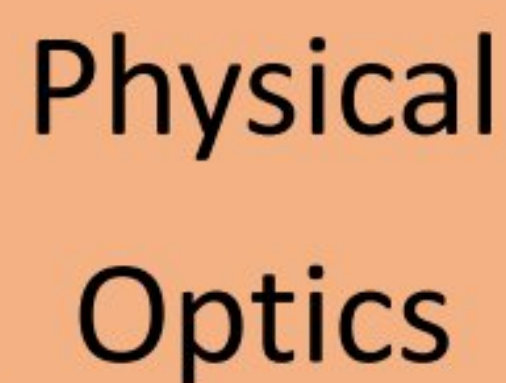
If the Source moves towards the Observer:

$$f_c = \frac{v}{\lambda_c} = \left(\frac{v}{v - u_s} \right) f$$

And If the Source moves away from the Observer:

$$f_D = \frac{v}{\lambda_D} = \left(\frac{v}{v + u_s} \right) f$$

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YOUNG'S DOUBLE SLIT EXPERIMENT

$$d \sin \theta = m \lambda$$
$$d \sin \theta = \left(m + \frac{1}{2}\right) \lambda$$
$$y = m \frac{\lambda L}{d}$$
$$y_{m+1} = \left(m + \frac{1}{2}\right) \frac{\lambda L}{d}$$
$$d\sin\theta = \lambda$$

$$d \sin \theta = m \lambda$$

$$ab = d \sin \theta$$

$$d \sin \theta = \lambda$$

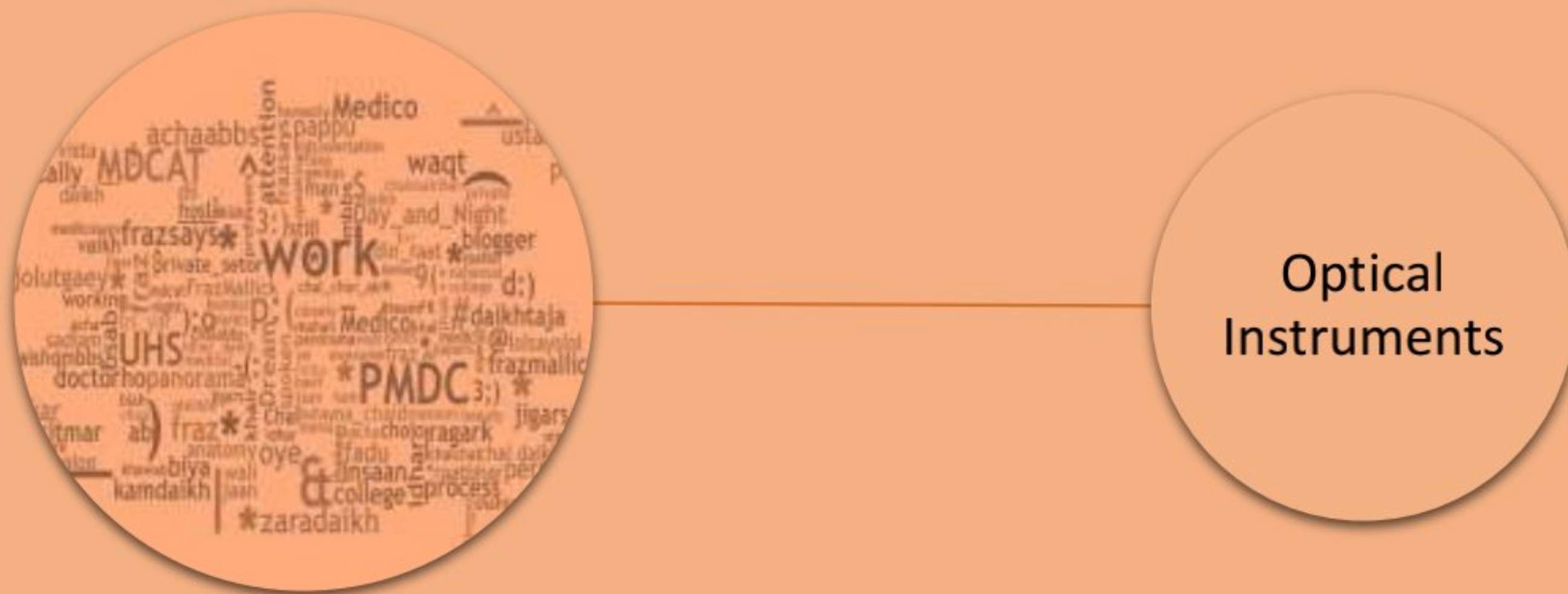
$$d \sin \theta = n \lambda$$

where, $n = \pm (1, 2, 3, \dots)$

Diffraction of X-rays by Crystals:

$$2d \sin \theta = n \lambda$$

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Optical Instruments

Resolving Power:

$$R = \frac{1}{\alpha_{\min}} = \frac{D}{1.22\lambda}$$

$$R = N \times m$$

Magnification of Simple Microscope:

$$M = \frac{\beta}{\alpha}$$

Angular Magnification:

$$M = \frac{q}{p} = \frac{d}{p}$$

Lens Formula for Virtual Image:

$$\frac{1}{f} = \frac{1}{p} - \frac{1}{q}$$

$$\frac{1}{f} = \frac{1}{p} - \frac{1}{d}$$

$$\frac{d}{p} = 1 + \frac{d}{f}$$

$$M = \frac{d}{p} = 1 + \frac{d}{f}$$

COMPOUND MICROSCOPE:

Magnification:

$$M = \frac{q}{p} \left(1 + \frac{d}{f_e} \right)$$

ASTRONOMICAL TELESCOPE:**Magnification:**

$$M = \frac{f_o}{f_e}$$

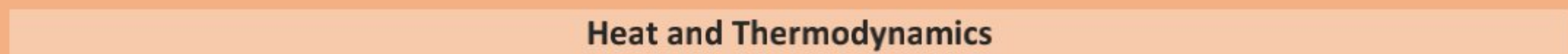
Snell's Law:

$$n_1 \sin \theta_1 = n_2 \sin \theta_2$$

$$\sin \theta_c = \frac{n_2}{n_1}$$

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Chapter No. 11


$$P_x = P_y = P_z = \frac{\rho}{3} \langle v^2 \rangle$$

$$P = \frac{1}{3} \rho \langle v^2 \rangle$$

$$P = \frac{2}{3} N_o < \frac{1}{2} m v^2 >$$

$$P \propto \langle K.E. \rangle$$

$$PV = nRT$$
$$k = \frac{R}{N_A}$$

$$k = 1.38 \times 10^{-23} J K^{-1}$$

$$PV = \frac{2}{3}N < \frac{1}{2}mv^2 >$$

$$P \propto \left\langle \frac{1}{V} \right\rangle$$

$$V = \frac{2N}{3P} \left\langle \frac{1}{2} m v^2 \right\rangle$$

$$V \propto T$$

Temperature Interpretation:

$$T = \frac{2}{3k} \left\langle \frac{1}{2}mv^2 \right\rangle$$

Mean Square Velocity:

$$\langle v^2 \rangle = \frac{3kT}{m}$$

$$\langle v \rangle = \sqrt{\frac{3kT}{m}}$$

Work and Heat:

$$W = P\Delta V$$

First Law of Thermodynamics:

$$Q = \Delta U + W$$

Isothermal Process:

$$P_1V_1 = P_2V_2$$

Adiabatic Process:

$$W = -\Delta U$$

$$PV^\gamma = \text{Constant}$$

Molar Specific Heat at Constant Volume:

$$C_V\Delta T = \Delta U + 0$$

$$\Delta U = C_v\Delta T$$

Molar Specific Heat at Constant Pressure:

$$Q_p = C_p\Delta T$$

Universal Gas Law Constant:

$$C_p - C_v = R$$

Efficiency of an Engine:

$$\eta = \frac{\text{Output (Work)}}{\text{Input (Energy)}}$$

$$\eta = 1 - \frac{Q_2}{Q_1}$$

$$\eta = 1 - \frac{T_2}{T_1}$$

$$E = \frac{1}{4\pi\epsilon} \frac{q}{r^2}$$

Electric Flux through Closed Surface (Gauss's Law):

$$\phi_e = \frac{1}{\epsilon_0} Q$$

Electric Intensity of Field inside a Hollow Charged Sphere:

$$\vec{E} = 0$$

Electric Intensity due to infinite sheet of charge:

$$\vec{E} = \frac{\sigma}{2\epsilon_0} \hat{r}$$

Surface charge density:

$$\sigma = \frac{Q}{A}$$

Electric intensity between two oppositely charged parallel plates:

$$\vec{E} = \frac{\sigma}{\epsilon_0} \hat{r}$$

Electric Potential Energy:

$$\Delta V = V_B - V_A = \frac{W_{AB}}{q_0} = \frac{\Delta U}{q_0}$$

Volt:

$$1\text{Volt} = \frac{1 \text{ joule}}{1 \text{ coulomb}}$$

Electric Potential:

$$V = \frac{W}{q}$$

Potential Gradient:

$$E = \frac{\Delta V}{\Delta r}$$

Electric Potential at a point due to a point charge:

$$V_r = \frac{1}{4\pi\epsilon_0} \frac{q}{r}$$

Charge on an electron by Milikan's Method:

$$q = \frac{mgd}{V}$$

$$r = \frac{\sqrt{9\eta V_t}}{2\rho g}$$

Capacitor

$$Q = CV$$

Capacitance

$$C_{vac} = \frac{A\epsilon_0}{d}$$

$$C_{med} = \frac{A\epsilon_0\epsilon_r}{d}$$

$$\frac{C_{med}}{C_{vac}} = \epsilon_r$$

Energy Stored in a Capacitor:

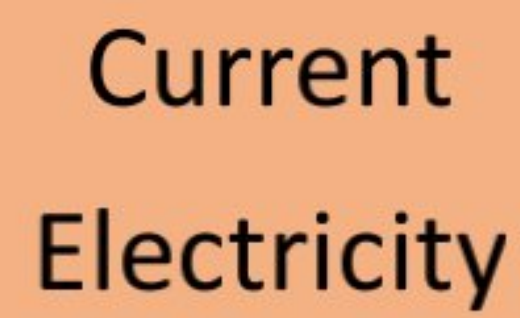
$$Energy = \frac{1}{2}CV^2$$

Energy Stored in an Electric Field:

$$U = \frac{1}{2}(\epsilon_0\epsilon_r E^2)(Ad)$$

Energy Density:

$$Energy\ density = \frac{Energy}{Volume}$$


$$I = \frac{\Delta Q}{\Delta t}$$
$$energy = q\Delta V = (It)(IR)$$

$$H = I^2 R t$$

$$V = IR$$
$$1 \text{ ohm} = \frac{1 \text{ volt}}{1 \text{ ampere}}$$
$$R_1 = R_1 + R_2 + R_3 + \dots$$

$$\frac{1}{R_e} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots$$

$$R = \rho \frac{L}{A}$$

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$$\alpha = \frac{R_t - R_o}{R_o t}$$

Temperature coefficient of Resistivity:

$$\alpha = \frac{\rho_t - \rho_o}{\rho_o t}$$

Electrical Power:

$$\text{Electrical power} = \frac{\text{Energy supplied}}{\text{Time taken}}$$

Power dissipation in resistors:

Power dissipated:

$$\text{Power dissipated} = I \times V$$

$$P = \frac{V^2}{R}$$

$$P = I^2 R$$

Electromotive force (emf):

$$E = \frac{\Delta W}{\Delta Q}$$

Terminal potential difference:

$$V = E - Ir$$

Maximum power output:

$$P_{outmax} = \frac{E^2}{4r}$$

Kirchhoff's first rule:

$$\sum I = 0$$

Kirchhoff's second rule:

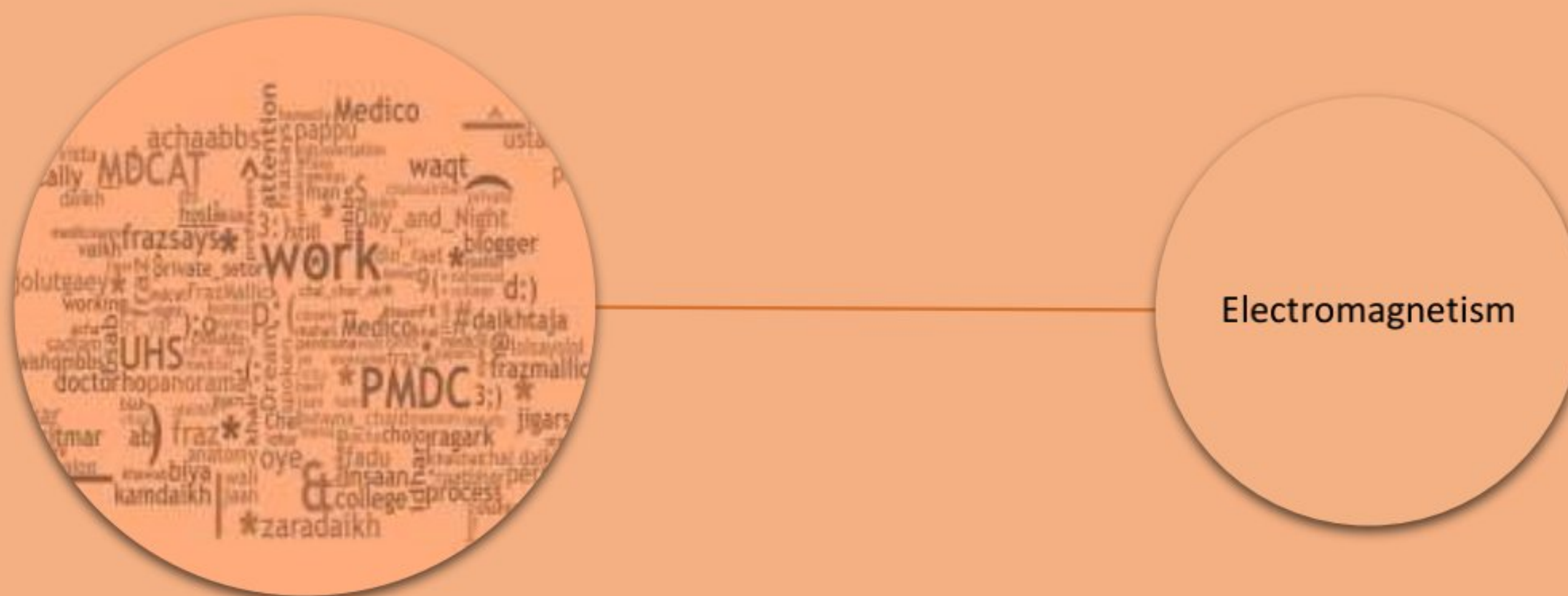
$$\sum V = 0$$

Wheatstone bridge:

$$\frac{R_1}{R_2} = \frac{R_3}{R_4}$$

To find the unknown resistance:

$$X = R_3 \times \frac{R_2}{R_1}$$



Electromagnetism

Force on a current carrying conductor in a uniform magnetic field:

$$F = ILB\sin\alpha$$

$$\vec{F} = I(\vec{L} \times \vec{B})$$

Magnetic flux:

$$\phi_B = \vec{B} \cdot \vec{A} = BA\cos\theta$$

Magnetic induction:

$$B = \frac{F}{IL\sin\alpha}$$

Ampere's Law:

$$\sum_{(r=1)}^N (\vec{B} \cdot \Delta\vec{L})_r = \mu_0 I$$

Field due to a current carrying solenoid:

$$B = \mu_0 nI$$

Force on a moving charge in a magnetic field:

$$\vec{F} = q(\vec{V} \times \vec{B})$$

Lorentz force:

$$F = q\vec{E} + q(\vec{V} \times \vec{B})$$

e/m of an electron:

$$\frac{e}{m} = \frac{v}{Br}$$

$$\frac{e}{m} = \frac{2V_o}{B^2 r^2}$$

Torque on a current carrying coil:

$$\tau = NIAB\cos\alpha$$

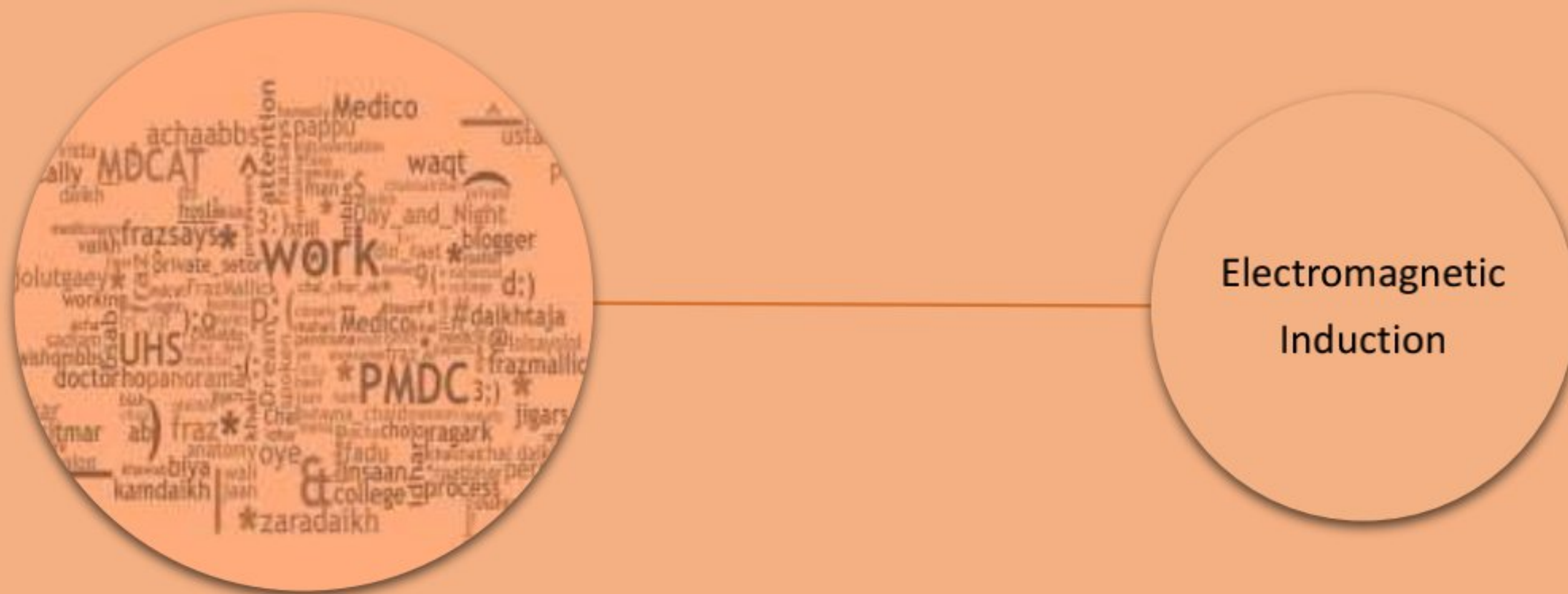
Shunt Resistance:

$$R_s = \frac{I_g R_g}{I - I_g}$$

High Resistance

$$R_h = \frac{V}{I_g} - R_g$$

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Electromagnetic Induction

Motional emf:

$$\varepsilon = -vBL\sin\theta$$

Faraday's Law:

$$\varepsilon = -N \frac{\Delta \varphi}{\Delta t}$$

Mutual Induction:

$$\varepsilon_s = -M \frac{\Delta I_p}{\Delta t}$$

Self Induction:

$$\varepsilon_L = -L \frac{\Delta I}{\Delta t}$$

Energy stored in an inductor:

$$U_m = \frac{1}{2} LI^2$$

Energy in terms of magnetic field (\vec{B}):

$$U_m = \frac{1}{2} \frac{B^2}{\mu_0} \quad (AI)$$

Energy density:

$$U_m = \frac{1}{2} \frac{B^2}{\mu_0}$$

Alternating current generator:

$$\varepsilon = N\omega A B \sin(\omega t)$$

$$\varepsilon_o = N\omega AB$$

$$\varepsilon = \varepsilon_o \sin(\omega t)$$

$$I = I_o \sin(\omega t)$$

$$\varepsilon = \varepsilon_o \sin(2\pi ft)$$

$$I = I_o \sin(2\pi ft)$$

Back emf effect in motors:

$$V = \varepsilon + IR$$

Transformer:

$$\frac{V_s}{V_p} = \frac{N_s}{N_p}$$

$$\frac{V_s}{V_p} = \frac{I_p}{I_s}$$

Efficiency of a transformer:

$$E = \frac{\text{Output power}}{\text{Input power}} \times 100$$


$$V = V_o \sin \frac{2\pi}{T} \times t$$
$$V = V_o \sin \omega t$$

$$I = I_o \sin \omega t$$

$$V = V_o \sin \omega t$$

$$q = CV_o \sin \omega t$$

$$I = I_o \sin(90 + \omega t)$$

$$X_c = \frac{1}{\omega c} = \frac{1}{2\pi f c}$$
$$I = I_o \sin \omega t$$

$$V = V_o \sin(90 + \omega t)$$

$$X_L = 2\pi fL = \omega L$$
$$Z = \frac{V}{I}$$

R-C Series Circuit:

$$V = \sqrt{V_R^2 + V_C^2}$$

$$Z = \sqrt{R^2 + \left(\frac{1}{\omega C}\right)^2}$$

$$\tan\theta = \frac{X_C}{R}$$

$$\theta = \tan^{-1}\left(\frac{X_C}{R}\right) = \tan^{-1}\left(\frac{1}{\omega CR}\right)$$

R-L Series Circuit:

$$Z = \sqrt{R^2 + (\omega L)^2}$$

$$\tan\theta = \frac{X_L}{R}$$

$$\theta = \tan^{-1}\left(\frac{X_L}{R}\right) = \tan^{-1}\left(\frac{\omega L}{R}\right)$$

Power in AC circuits:

$$P = I \times V \cos\theta$$

Series resonance circuit:

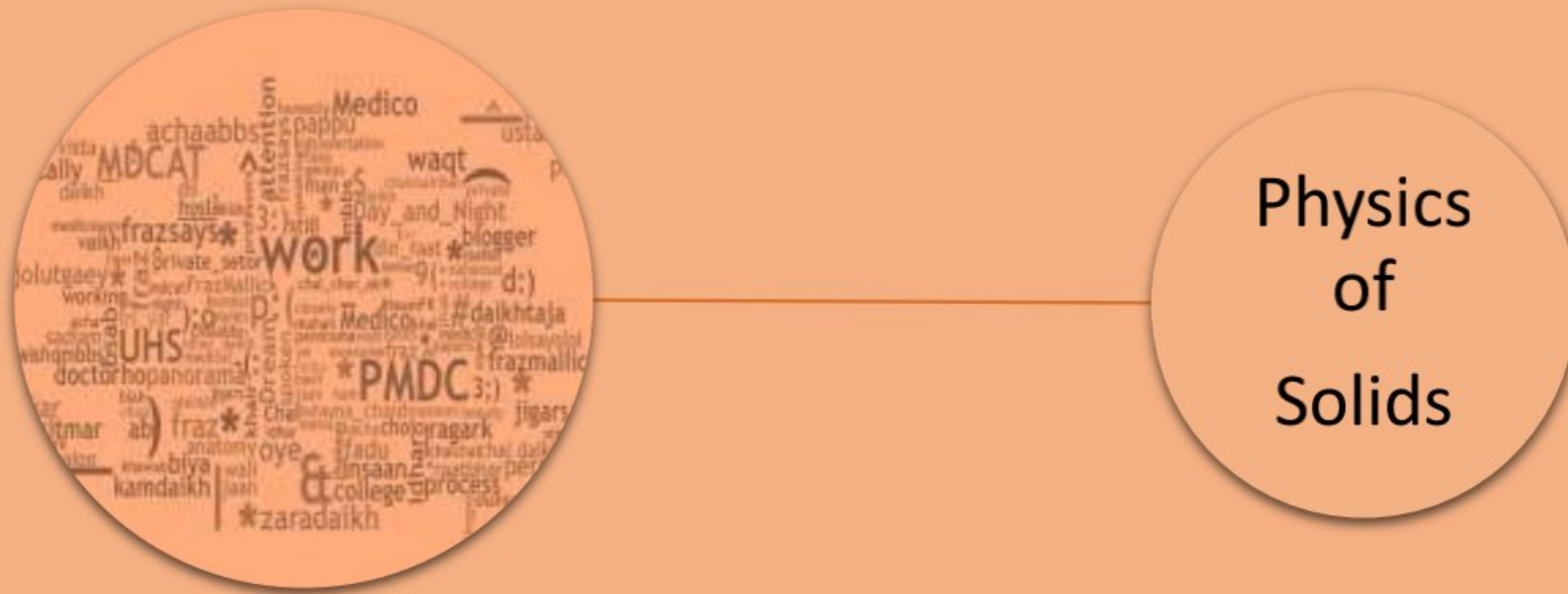
$$X_L = X_C$$

$$f_r = \frac{1}{2\pi\sqrt{LC}}$$

Electromagnetic waves:

$$C = f\lambda$$

Chapter No. 17



Physics of Solids

Stress:

$$\text{Stress} = \frac{\text{Force}}{\text{Area}}$$

Strain:

$$\text{Strain} = \frac{\text{Change in length}}{\text{Original length}}$$

Elastic Constants:

$$\text{Modulus of Elasticity} = \frac{\text{Stress}}{\text{Strain}}$$

Young's Modulus:

$$Young's Modulus = \frac{F}{A} \times \frac{l}{\Delta l}$$

Bulk Modulus:

$$\text{Bulk Modulus} = \frac{F}{A} \times \frac{\Delta V}{V}$$

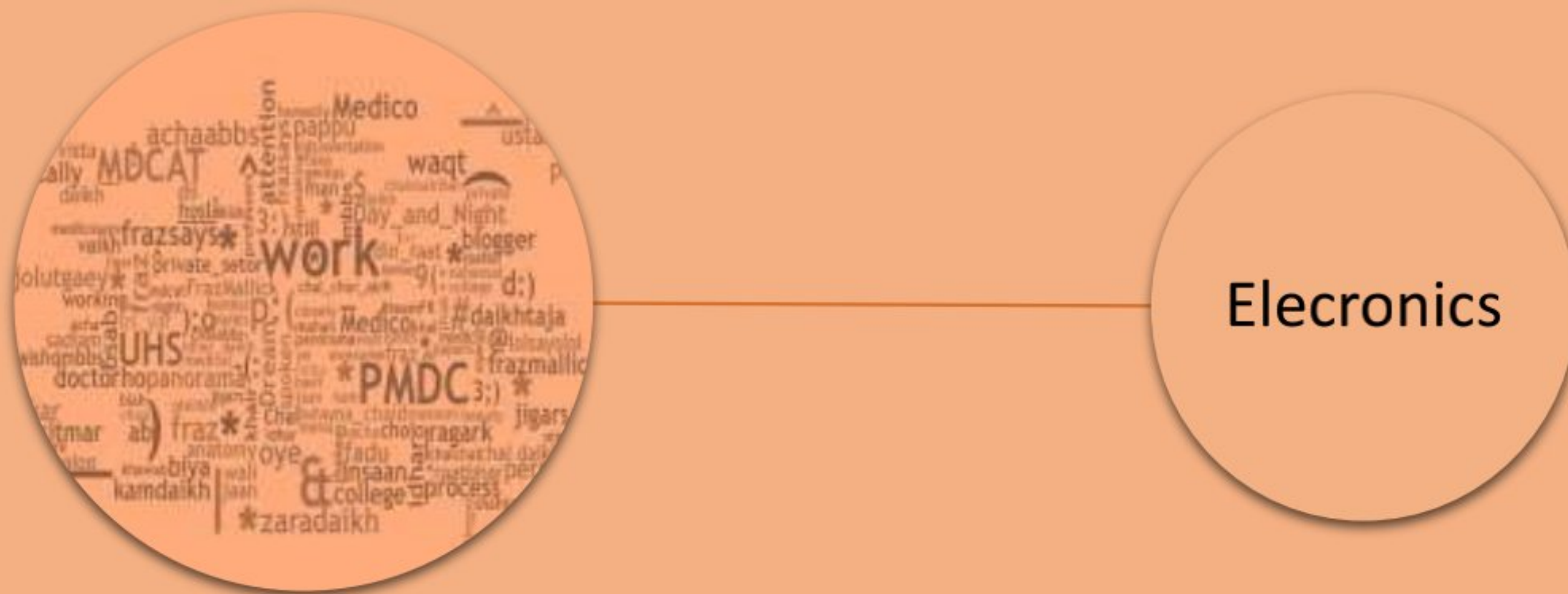
Shear Modulus:

$$\text{Shear Modulus} = \frac{F/A}{\Delta V/V}$$

Shear Modulus:

$$\text{Shear Modulus} = \frac{F/A}{\tan\theta}$$

Strain energy in deformation materials:



Electronics

Current flow in transistor:

$$I_E = I_B + I_C$$

$$\beta = \frac{I_C}{I_B}$$

TRANSISTOR AS AN AMPLIFIER

Voltage gain:

$$\frac{\Delta V_o}{\Delta V_{in}} = \beta \frac{R_c}{r_{ie}}$$

OPERATIONAL AMPLIFIER

Open loop gain:

$$A_{OL} = \frac{V_o}{V_+ - V_-} = \frac{V_o}{V_i}$$

Op-amp as an inverting amplifier:

$$G = \frac{V_o}{V_i} = \frac{R_2}{R_1}$$

Op-amp as non-inverting amplifier:

$$Gain = G = \frac{V_o}{V_i} = 1 + \frac{R_2}{R_1}$$

LOGIC GATES

OR gate:

$$X = A + B$$

AND Gate:

$$X = A \cdot B$$

NOT Gate:

$$X = \bar{A}$$

NOR Gate:

$$X = \overline{A + B}$$

NAND Gate:

$$X = \overline{A \cdot B}$$

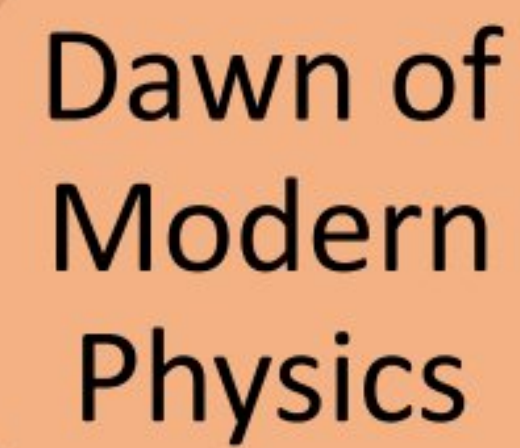
Exclusive OR Gate (XOR):

$$X = \overline{AB} + \overline{A}\overline{B}$$

Exclusive NOR Gate (XNOR):

$$X = \overline{A \cdot \bar{B} + \bar{A} \cdot B}$$

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SPECIAL THEORY OF RELATIVITY

$$t = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$$
$$l = l_o \sqrt{1 - \frac{V^2}{c^2}}$$
$$m = \frac{m_0}{\sqrt{1 - \frac{V^2}{c^2}}}$$
$$E = mc^2$$

$$\Delta m = \frac{\Delta E}{c^2}$$

$$T\lambda m = \text{constant}$$

$$E = \sigma T^4$$

$$E = hf$$

$$E = \frac{hc}{\lambda}$$

$$P = \frac{hf}{c}$$

Photoelectric Effect:

$$\frac{1}{2}mV_{\max}^2 = V_0 e$$

Work Function:

$$\phi = hf_0$$

$$hf = \phi + \left(\frac{1}{2}mv^2\right)$$

Compton Effect:

$$\Delta\lambda = \frac{h}{m_0 c} (1 - \cos\theta)$$

Pair Production:

$$hf = 2m_0 c^2 + (K.E)_{e^-} + (K.E)_{e^-}$$

Annihilation of Matter:

$$e^- + e^+ \rightarrow \gamma + \gamma$$

Wave nature of particles:

$$\lambda = \frac{h}{p} = \frac{h}{mv}$$

$$\lambda = \frac{h}{\sqrt{2mVe}}$$

Uncertainty Principle:

$$\Delta x \cdot \Delta p \approx \lambda \left(\frac{h}{\lambda}\right) \approx h$$

$$\Delta E \cdot \Delta t \approx h$$



Atomic Spectra

Atomic Spectra

Lyman Series:

$$\frac{1}{\lambda} = R_H \left(\frac{1}{1^2} - \frac{1}{n^2} \right)$$

Balmer Series:

$$\frac{1}{\lambda} = R_H \left(\frac{1}{2^2} - \frac{1}{n^2} \right)$$

Paschen Series:

$$\frac{1}{\lambda} = R_H \left(\frac{1}{3^2} - \frac{1}{n^2} \right)$$

Brckett Series:

$$\frac{1}{\lambda} = R_H \left(\frac{1}{4^2} - \frac{1}{n^2} \right)$$

Pfund Series:

$$\frac{1}{\lambda} = R_H \left(\frac{1}{5^2} - \frac{1}{n^2} \right)$$

Second Postulate of Bohr's Theory:

$$mv_n r_n = n \left(\frac{h}{2\pi} \right)$$

Third Postulate of Bohr's Theory:

$$hf = E_n - E_p$$

X-Rays:

$$hf_{k\alpha} = E_L - E_K$$

$$hf_{k\beta} = E_M - E_K$$

Quantized Radii:

$$r_n = \frac{n^2 h^2}{4\pi m e^2 k}$$

$$r_1 = \frac{h^2}{4\pi m e^2 k}$$

$$r_n = n^2 r_1$$

$$r_n = r_1, 4r_1, 9r_1, 16r_1, \dots$$

Quantized Velocity:

$$v_n = \frac{2\pi k e^2}{nh}$$

Quantized Energies:

$$E_n = \frac{1}{n^2} \left(\frac{2\pi^2 m k^2 e^4}{h^2} \right)$$

$$E_o = \left(\frac{2\pi^2 m k^2 e^4}{h^2} \right)$$

$$E_n = -\frac{E_o}{n^2}$$

$$E_n = -\frac{13.6}{n^2} \text{ eV for } n = 1, 2, 3, 4, 5, 6, \dots$$

Hydrogen Emission Spectrum:

$$\frac{1}{\lambda} = R_H \left(\frac{1}{\rho} - \frac{1}{n^2} \right)$$

Chapter No.21:



Nuclear Physics

Nuclear Physics

Mass Spectrograph:

$$v = \sqrt{\frac{2Ve}{m}}$$

$$\frac{Ber}{v} = m$$

$$m = \left(\frac{er^2}{2V} \right) B^2$$

Mass defect and binding energy:

$$\Delta m = Zm_p + (A - Z)m_n - m_{nucleus}$$

$$B.E. = (\Delta m)c^2$$

$$B.E. = \frac{Zm_p + (A - Z)m_n - m_{nucleus}}{A}$$

Half Life of a radioactive element:

$$\lambda = -\frac{\frac{\Delta N}{N}}{\Delta t}$$

$$N = N_0 e^{-\lambda t}$$

$$N = \frac{1}{2^n} N_o$$

$$0.693 = \lambda T_{\frac{1}{2}}$$

Absorbed dose:

Basic Units

Physical Quantity	Unit	Symbol
Force	newton	N
Work	joule	J
Power	watt	W
Pressure	pascal	Pa
Electric charge	coulomb	C

Quantity		Base unit
Focal length	m	m
Displacement	x	m
Force	N	Kgms^{-2}
Velocity	V	ms^{-1}
Acceleration	a	ms^{-2}
Angular Velocity	ω	s^{-1}
Angular Displacement	θ	Units: radian degrees revolution But still, it's Dimensionless
Angular Acceleration	α	s^{-2}
Torque	τ	Kgms^{-2}
Energy	J	Kgms^{-2}
Work	$W = F \times d$	
K.E	$\frac{1}{2}mv^2$	$\text{kgm}^2\text{s}^{-2}$
P.E	$\frac{1}{2}mgh$	$\text{kgm}^2\text{s}^{-2}$
Modulus of Elasticity		
Modulus of Elasticity	$\frac{\text{Stress}}{\text{Strain}}$	Dimensionless
Elastic Modulus	$E = \frac{F}{A}$	$\text{kgm}^{-1}\text{s}^{-2}$
Young's Modulus	Y	
Bulk Modulus	K	
Shear Modulus	G	
Stress	$\frac{F}{A}$	$\frac{\text{kgms}^{-2}}{\text{m}^2}$
Strain	$\frac{\Delta l}{l}$	Dimensionless
Linear Momentum	$P, P = mv$	mv
Molar specific heat		$\text{JK}^{-1}\text{mol}^{-1}$

Quantity	Symbol	Being Derived From	Final Equation
Permittivity	ϵ_0	$F = \frac{1}{4\pi\epsilon_0} \left(\frac{q_1 q_2}{r^2} \right)$	$\epsilon_0 = \frac{q_1 q_2}{F \times r}$
Gravitational Constant	G	$F = G \frac{m_1 m_2}{r^2}$	
Spring Constant	k	$F \propto x$	$F \propto x$ $F = kx$ $k = \frac{F}{x}$
Plank's Constant	h	$E = hf$	$E = hf$ $h = \frac{E}{f}$

Quantities having same Base Units or dimensions	
Heat	kgm^2s^{-2}
Energy	kgm^2s^{-2}
K.E	kgm^2s^{-2}
P.E	kgm^2s^{-2}
Work	kgm^2s^{-2}
Decay Constant	s^{-1}
Frequency	s^{-1}
Ang. Velocity	s^{-1}
Boltzmann constant	
Entropy	
Time	s
	s
$\frac{1}{f}$	s
$\frac{1}{\omega}$	s
RC	s
$\frac{L}{R}$	s
$\sqrt{\frac{l}{g}}$	s
$\sqrt{\frac{m}{k}}$	s
$\sqrt{\frac{x}{g}}$	s



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