All Physics
Formulae Panorama

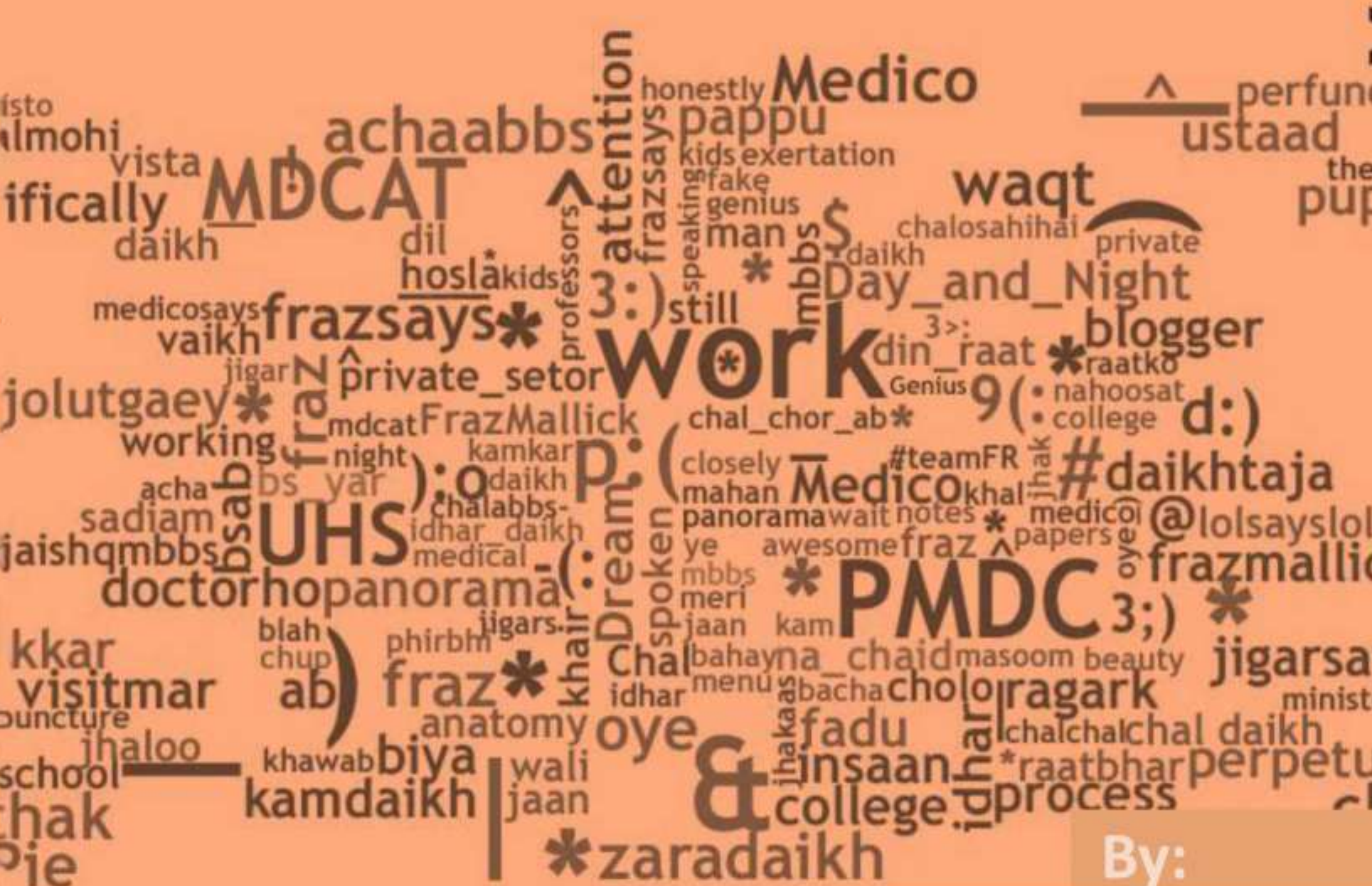

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Table of Content

All Physics Formulae Panorama

Part-I

Chapter-01

Measurements

Measurements

Steradian:

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

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

Chapter No. 02

Vectors and Equilibrium

Vector and Equilibrium

Addition of Vectors:

$$\boldsymbol{A} + \boldsymbol{B} = \boldsymbol{B} + \boldsymbol{A}$$

Unit Vector:

$$\boldsymbol{A} = A\hat{A}$$

Null Vector:

$$\boldsymbol{A} + (-\boldsymbol{A}) = \boldsymbol{0}$$

Rectangular Components of a Vector:

$$\boldsymbol{A} = A_x\,\hat{\imath} + A_y\hat{\jmath}$$

$$A_x = A\,cos\theta$$

$$A_y = A\,sin\theta$$

Determination of a Vector form from the Rectangular Components:

$$A^2 = A_x^2 + A_x^2$$

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

Position Vector:

$$\boldsymbol{r} = a\,\hat{\imath} + \mathrm{b}\,\hat{\jmath}$$

$$\boldsymbol{r} = \sqrt{a^2 - b^2}$$

$$\boldsymbol{r} = a\,\hat{\imath} + b\,\hat{\jmath} + c\,\hat{k}$$

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

Vector Addition by Rectangular Components:

$$R_x = A_x + B_x$$

$$R_y = A_y + B_y$$

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

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

$$r$$

$$R = \sqrt{(A_x + B_x + C_x + ..)^2 + \left(A_y + B_y + C_y + \cdots\right)^2}$$

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

$$z$$

PRODUCT OF TWO VECTORS

Scalar or Dot Product:

$$\boldsymbol{A} \cdot \boldsymbol{B} = ABcos\theta$$

$\hat{\imath} \cdot \hat{\jmath} = 0$	$\hat{\imath} \cdot \hat{\imath} = 1$
$\hat{\jmath} \cdot \hat{k} = 0$	$\hat{\jmath} \cdot \hat{\jmath} = 1$
$\hat{k} \cdot \hat{\imath} = 0$	$\hat{k} \cdot \hat{k} = 1$

$$cos\theta = \frac{(A_xB_x + A_yB_y + A_ZB_Z)}{AB}$$

Vector or Cross Product:

$$\boldsymbol{A} \times \boldsymbol{B} = ABsin\theta\,\hat{n}$$

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

Torque:

$$\tau = lF$$

$$\tau = (Fsin\theta)t = rFsin\theta$$

$$\tau = (rFsin\theta)\,\boldsymbol{\hat{n}B}$$

EQUILIBRIUM OF FORCES

First Condition of Equilibrium:

$$\sum F_x = 0$$

$$\sum F_y = 0$$

Second Condition of Equilibrium:

$$\sum \tau =$$

Chapter No. 03

Motion and Force

Motion and Force

Displacement:

$$\boldsymbol{d} = \boldsymbol{r_2} - \boldsymbol{r_1}$$

Velocity:

$$\boldsymbol{v_{av}} = \frac{\boldsymbol{d}}{\boldsymbol{t}}$$

Instantaneous Velocity:

$$\boldsymbol{v_{ins}} = \lim_{\Delta t \to 0} \frac{\Delta d}{\Delta t}$$

Acceleration:

$$a_{av} = \frac{v_2 - v_1}{\Delta t} = \frac{\Delta v}{\Delta t}$$

Instantaneous Acceleration:

$$a_{ins} = \lim_{\Delta t \to 0} \frac{\Delta v}{\Delta t}$$

Review of Equations of Uniformly Accelerated Motion:

$$v_f = v_i + at$$

$$S = \frac{v_i + v_f}{2} \times t$$

$$S = v_i t + \frac{1}{2} a t^2$$

$$vf^2 = v_i^2 + 2aS$$

NEWTON LAWS OF MOTION

Newton's Second law of Motion:

$$F = ma$$

Momentum:

$$p = mv$$

Momentum and Newton's Second Law of Motion:

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

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

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

$$\boldsymbol{F} \times t = m\boldsymbol{v_f} - m\boldsymbol{v_i}$$

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

Impulse:

$$impulse = \boldsymbol{F} \times t = m\boldsymbol{v_f} - m\boldsymbol{v_i}$$

Law of conservation of momentum:

$$(m_1\boldsymbol{v_1} + m_2\boldsymbol{v_2}) = (m_1\boldsymbol{v_1'} + m_2\boldsymbol{v_2'})$$

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:

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

Momentum and Explosive Forces:

$$Mv' = -mv$$

Projectile Motion:

$$x = v_x \times t$$

$$y = \frac{1}{2}gt^2$$

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

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

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:

$$R = \frac{v_i^2}{g} sin2\theta$$

Chapter No. 04

Work and Energy

Work and Energy:

Work:

$$W = \boldsymbol{F}.\boldsymbol{d} = Fd\cos\theta$$

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:

$$\boldsymbol{P} = \boldsymbol{F}.\boldsymbol{v}$$

Energy:

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

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

$$P.E = mgh$$

Work-Energy Principle:

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

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

Absolute Potential Energy:

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

Escape Velocity:

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

Interconversion of Potential Energy and Kinetic Energy:

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

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

Chapter No. 05

Circular Motion

Circular Motion

Angular Displacement:

$$\theta = \frac{arc\ length}{radius} rad$$

$$\theta = \frac{S}{r} rad$$

$$S = r\theta$$

$$1\ revolution = 2\pi\ rad = 360°$$

$$1\ rad = \frac{360°}{2\pi} = 57.3°$$

Angular Velocity:

$$\omega_{av} = \frac{\Delta\theta}{\Delta t}$$

Instantaneous Angular Velocity:

$$\omega = \lim_{\Delta t \to 0} \frac{\Delta\theta}{\Delta t}$$

Angular Acceleration:

$$\alpha_{av} = \frac{\omega_t - \omega_i}{t_f - t_i} = \frac{\Delta\omega}{\Delta t}$$

Instantaneous Angular Acceleration:

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

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:

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

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

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:

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

Chapter No. 6

Fluid Dynamics

Fluid Dynamics

Drag Force:

$$F = 6\pi\eta r v$$

Terminal Velocity:

$$v_t = \frac{2gr^2\rho}{9\eta}$$

Equation of Continuity:

$$A_1 v_1 = A_2 v_2$$

Bernouli's Equation:

$$P = \frac{1}{2}\rho v^2 + \rho g h = Constant$$

Torricelli's Theorem:

$$v_2 = \sqrt{2g(h_1 - h_2)}$$

Relation between speed and pressure of the fluid:

$$P_A + \frac{1}{2}\rho V_A^2 = P_B + \frac{1}{2}\rho V_B^2$$

Venturi Relation:

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

Chapter No. 07

Oscillations

Oscillations

Frequency:

$$f = \frac{1}{T}$$

Angular Frequency:

$$\omega = \frac{2\pi}{T} = 2\pi f$$

Displacement:

$$x = x_o sin\omega t$$

Instantaneous Velocity:

$$v = \frac{x_o\omega}{x_o}\sqrt{{x_o}^2 - x^2} = \omega\sqrt{{x_o}^2 - x^2}$$

Acceleration in terms of ω:

$$\boldsymbol{a} = -\omega^2\boldsymbol{x}$$

Vibrational Angular Frequency:

$$\omega = \sqrt{\frac{k}{m}}$$

Time Period of the Mass:

$$T = \frac{2\pi}{\omega} = 2\pi\sqrt{\frac{m}{k}}$$

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:

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

Waves

Waves

The Speed of the Crest:

$$v = \frac{distance\ moved}{corresponding\ time\ interval}$$

$$v = \frac{\lambda}{T}$$

$$v = f\lambda$$

Speed of the Sound in Air:

$$v = \sqrt{\frac{E}{\rho}}$$

Laplace Correction:

$$v = \sqrt{\frac{\gamma P}{\rho}}$$

$$\gamma = 1.4$$

$$v = \sqrt{1.4} \times 280ms^{-1} = 333ms^{-1}$$

INTERFERENCE

Conditions for Constructive Interference:

$$\Delta S = n\lambda$$

Conditions for Destructive Interference:

$$\Delta S = (2n+1)\ \frac{\lambda}{2}$$

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:

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

Physical Optics

Physical Optics

YOUNG'S DOUBLE SLIT EXPERIMENT

Path Difference for bright fringe:

$$dsin\theta = m\lambda$$

Path Difference for dark fringe:

$$dsin\theta = \left(m + \frac{1}{2}\right)\lambda$$

Bright Fringe Position:

$$y = m\frac{\lambda L}{d}$$

Position of Dark Fringe:

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

DIFFRACTION DUE TO A NARROW SLIT

Equation for the first minimum:

$$dsin\theta = \lambda$$

$$dsin\theta = m\lambda$$

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

Diffraction Grating:

$$ab = dsin\theta$$

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

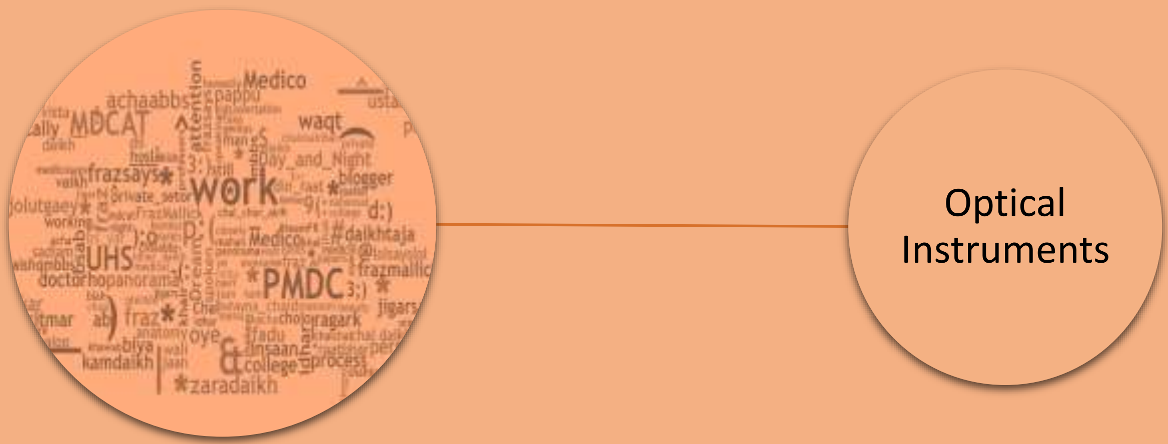
$$d\sin\theta = n\lambda$$

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

Diffraction of X-rays by Crystals:

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

Chapter No. 10



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 MIRCOSCOPE:

Magnification:

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

ASTRONOMICAL TELESCOPE:

Magnification:

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

Snell's Law:

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

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

Chapter No. 11

Heat
and
Thermodynamics

Heat and Thermodynamics

Pascal's Law:

$$P_x = P_y = P_z = \frac{\rho}{3} < v^2 >$$

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

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

$$P \propto < K.E. >$$

General Gas Equation:

$$PV = nRT$$

Boltzmann Constant:

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

$$k = 1.38 \times 10^{-23} JK^{-}$$

Boyle's Law:

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

$$P \propto < \frac{1}{V} >$$

Charles's Law:

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

$$V \propto T$$

Temperature Interpretation:

$$T = \frac{2}{3k} < \frac{1}{2}mv^2 >$$

Mean Square Velocity:

$$< v^2 > = \frac{3kT}{m}$$

$$< v > = \sqrt{\frac{3kT}{m}}$$

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:

$$W = -\Delta U$$

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

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:

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

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

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

Entropy:

$$\Delta S = \frac{\Delta Q}{T}$$

All

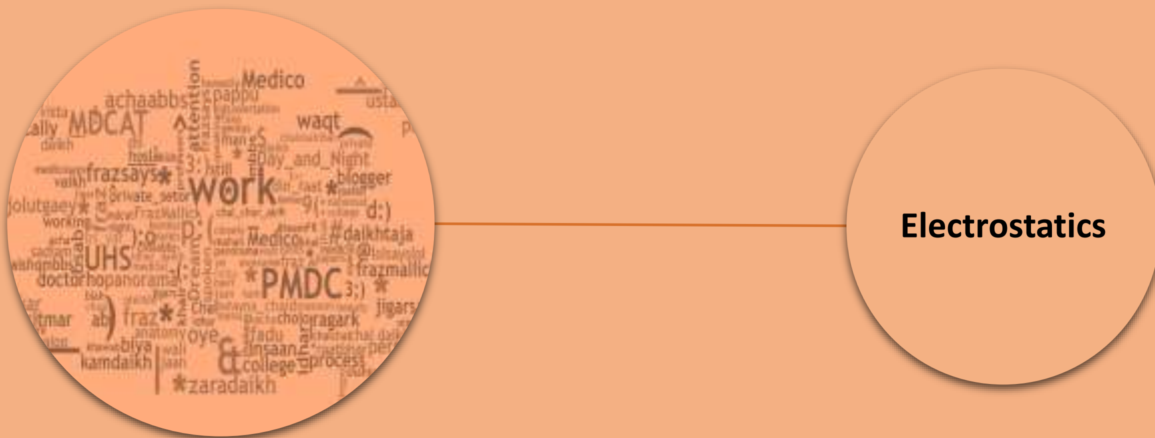
PHYSICS

Formulae

Panorama

Part-II

Chapter No. 012



Electrostatics

Coulomb's Force

For Free Space:

$$F = \frac{1}{4\pi\epsilon_o}\frac{q_1 q_2}{r^2}$$

In a Medium:

$$F' = \frac{F}{\epsilon_r}$$

$$F' = \frac{1}{4\pi\epsilon_o\epsilon_r}\frac{q_1 q_2}{r^2}$$

Relative Permittivity:

$$\epsilon_r = \frac{\epsilon}{\epsilon_o}$$

Electric Field Intensity:

$$\vec{E} = \frac{\vec{F}}{q}$$

Electric Flux:

$$\varphi_e = \vec{E}\,.\vec{A} = EAcos\theta$$

Electric Intensity due to a Point Charge:

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

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

$$\varphi_e = \frac{1}{\epsilon_o}Q$$

Electric Intensity of Field inside a Hollow Charged Sphere:

$$\vec{E} = 0$$

Electric Intensity due to infinite sheet of charge:

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

Surface charge density:

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

Electric intensity between two oppositely charged parallel plates:

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

Electric Potential Energy:

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

Volt:

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

Electric Potential:

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

Potential Gradient:

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

Electric Potential at a point due to a point charge:

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

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

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

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

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

Energy Stored in a Capacitor:

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

Energy Stored in an Electric Field:

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

Energy Density:

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

Chapter No. 13

Current Electricity

Current Electricity

Current:

$$I = \frac{\Delta Q}{\Delta t}$$

Heating Effect

$$energy = q\Delta V = (It)(IR)$$

$$H = I^2 Rt$$

Ohm's Law:

$$V = IR$$

Ohm:

$$1\ ohm = \frac{1\ volt}{1\ ampere}$$

Review of series and parallel combinations of resistors:

$$R_1 = R_1 + R_2 + R_3 + \ldots.$$

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

Resistance

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

Temperature coefficient of Resistance:

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

Temperature coefficient of Resistivity:

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

Electrical Power:

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

Power dissipation in resistors:

Power dissipated:

$$Power\ dissipated = I \times V$$

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

$$P = I^2 R$$

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:

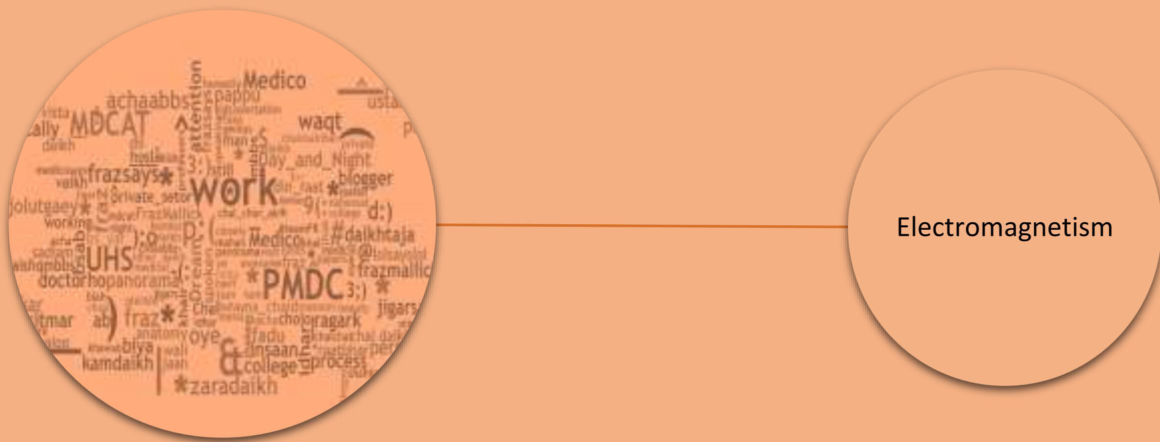
$$X = R_3 \times \frac{R_2}{R_1}$$

Potentiometer:

$$Ex = E \times \frac{I}{L}$$

$$\frac{E_1}{E_2} = \frac{I_1}{I_2}$$

Chapter No. 14



Electromagnetism

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

$$F = ILBsin\alpha$$

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

Magnetic flux:

$$\phi_B = \bar{B}.\bar{A} = BAcos\theta$$

Magnetic induction:

$$B = \frac{F}{ILsin\alpha}$$

Ampere's Law:

$$\sum_{(r=1)}^{N} (\bar{B}.\Delta\bar{L})_r = \mu_o I$$

Field due to a current carrying solenoid:

$$B = \mu_o nI$$

Force on a moving charge in a magnetic field:

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

Lorentz force:

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

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:

$$\tau = NIABcos\alpha$$

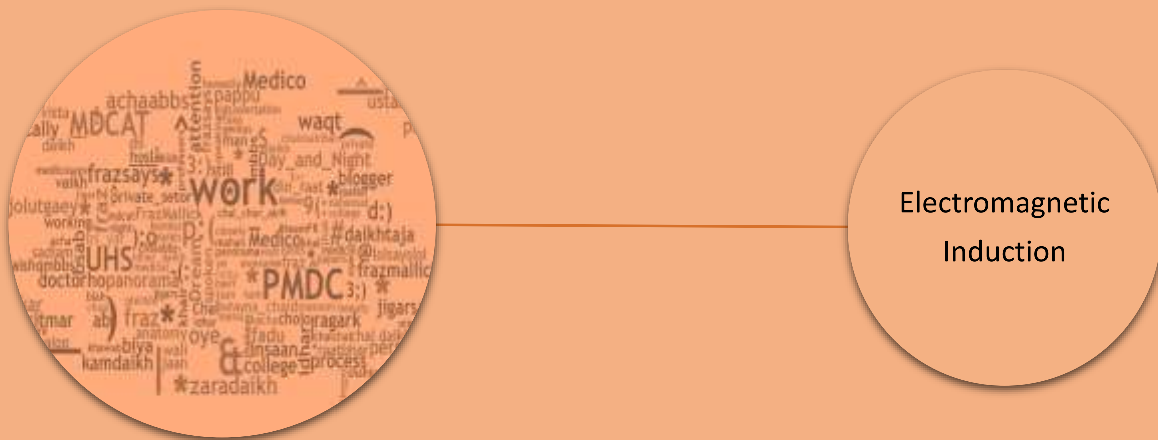
Shunt Resistance:

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

High Resistance

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

Chapter No. 15



Electromagnetic Induction

Motional emf:

$$\varepsilon = -vBLsin\theta$$

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 ($\vec{\boldsymbol{B}}$):

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

Energy density:

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

Alternating current generator:

$$\varepsilon = N\omega ABSin(\omega t)$$

$$\varepsilon_o = N\omega AB$$

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

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

$$\varepsilon = \varepsilon_o Sin(2\pi f t)$$

$$I = I_o Sin(2\pi f t)$$

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:

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

Chapter No. 16

Alternating Current

Alternating Current

Alternating Current:

$$V = V_{o}\sin\frac{2\pi}{T}\times t$$

Alternating Current through a resistor:

$$V = V_{o}\,sin\omega t$$

$$I = I_{o}\,sin\omega t$$

Alternating Current through a Capacitor:

$$V = V_{o}\,sin\omega t$$

$$q = CV_{o}\,sin\omega t$$

$$I = I_{o}\sin(90 + \omega t)$$

Reactance:

$$X_{c} = \frac{1}{\omega c} = \frac{1}{2\pi f c}$$

Alternating Current through an inductor:

$$I = I_{o}\,sin\omega t$$

$$V = V_{o}\sin(90 + \omega t)$$

Reactance:

$$X_{L} = 2\pi f L = \omega L$$

Impedance:

$$Z = \frac{V}{I}$$

R-C Series Circuit:

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

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

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

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

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

Physics of Solids

Stress:

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

Strain:

$$Strain = \frac{Change\ in\ length}{Orignal\ length}$$

Elastic Constants:

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

Young's Modulus:

$$Young'sModulus = \frac{F}{A} \times \frac{I}{\Delta I}$$

Bulk Modulus:

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

Shear Modulus:

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

Shear Modulus:

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

Strain energy in deformation materials:

$$Work\ done = \frac{1}{2} l_1 \times F_1$$

$$Work\ done = \frac{1}{2}\left[\frac{EA \times l_1^2}{L}\right]$$

Chapter No. 18

Elecronics

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):

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

Exclusive NOR Gate (XNOR):

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

Chapter No. 19

Dawn of Modern Physics

Dawn of Modern Physics

SPECIAL THEORY OF RELATIVITY

Time Dilation:

$$t = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$$

Length contraction:

$$l = l_o \sqrt{1 - \frac{V^2}{c^2}}$$

Mass variation:

$$m = \frac{m_o}{\sqrt{1 - \frac{V^2}{c^2}}}$$

Energy-Mass Relation:

$$E = mc^2$$

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

Blackbody Radiation:

$$T\lambda m = constant$$

$$E = \sigma T^4$$

Plank's Constant:

$$E = hf$$

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

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

Photoelectric Effect:

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

Work Function:

$$\varphi = hf_o$$

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

Compton Effect:

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

Pair Production:

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

Annihilation of Matter:

$$e^- + e^+ \rightarrow Y + Y$$

Wave nature f particles:

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

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

Uncertainty Principle:

$$\Delta x.\Delta P \approx \lambda\left(\frac{h}{\lambda}\right) \approx h$$

$$\Delta E.\Delta t \approx h$$

Chapter No. 19

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:

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

Brackett 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:

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

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

$$r_n = n^2r_1$$

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

Quantized Velocity:

$$v_n = \frac{2\pi ke^2}{nh}$$

Quantized Energies:

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

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

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

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

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:

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

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

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

$$0..693 = \lambda T_{\frac{1}{2}}$$

Absorbed dose:

$$1\ Gy = 1\ Jkg^{-1}$$

$$1\ rad = 0.01Gy$$

Equivalent dose:

$$D_e = D \times RBE$$

$$1\ Sv = 1\ Gy \times RBE$$

$$1\ rem = 0.01\ Sv$$

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	Kgm^2s^{-2}
Energy	J	Kgm^2s^{-2}
Work	$W = F \times d$	
K.E	$\frac{1}{2}mv^2$	kgm^2s^{-2}
P.E	$\frac{1}{2}mgh$	kgm^2s^{-2}
Modulus of Elasiticiy		
Modulus of Elasticity	$\frac{Stress}{Strain}$	Dimensionless
Elastic Modulus	$E = \frac{F}{A}$	$kgm^{-1}s^{-2}$
Young's Modulus	Y	
Bulk Modulus	K	
Shear Modulus	G	
Stress	$\frac{F}{A}$	$\frac{kgms^{-2}}{m^2}$
Strain	$\frac{\Delta l}{l}$	Dimensionless
Linear Momentum	$P, P = mv$	mv
Molar specific heat		$JK^{-1}mol^{-1}$

Quantity	$Symbol$	Being Derived From	Final Equation
Permittivity	ε_o	$F = \frac{1}{4\pi\varepsilon_o}\left(\frac{q_1 q_2}{r^2}\right)$	$\varepsilon_o = \frac{q_1 q_2}{F \times r}$
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

Relative Biological Effectiveness	Dimensionless
Angular Displacement	Dimensionless
Strain	Dimensionless

Best of Luck to you from #teamFR

-frazmallick

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