ELECTROSTATIC

1. Quantisation charge

   $Q = ne$

2. Coulomb's for between 2 charges

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

3. Coulomb's Constant

   $\frac{1}{4\pi\varepsilon_o} = 9 \times 10^9 \text{ Nm}^2\text{C}^{-2}$

4. Permittivity

   $\varepsilon_o = 8.85 \times 10^{-12} \text{ C}^2\text{N}^{-1}\text{m}^2$

5. Relative Permittivity or Dielectric Constant

   $\varepsilon_r \text{ or } K = \frac{\varepsilon}{\varepsilon_o}$

6. Force in any Medium

   $F_m = \frac{F_{air}}{k} \text{ or } \frac{F_{air}}{\varepsilon_r}$

7. Electric field intensity

   $E = F/q_o$

8. Electric field intensity at distance 'r' from a charge 'q'

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

9. Electric field intensity at a point on axialline

   $E = \frac{1}{4\pi\varepsilon_o} \cdot \frac{2\Pr}{(r^2 - a^2)^2}$

10. For short dipole

    $E = \frac{1}{4\pi\varepsilon_o} \cdot \frac{2\text{P}}{r^3}$

11. Electric field intensity at a point due to dipole

    $E = \frac{1}{4\pi\varepsilon_o} \cdot \frac{P}{r^3}\sqrt{1 + 3\cos^2\theta}$

12. Balanced of charge particle

    $qE = mg$

13. Electric field intensity at a point on equatorial line

    $E = \frac{1}{4\pi\varepsilon_o} \cdot \frac{P}{(r^2 + a^2)^{3/2}}$

    For short dipole $E = \frac{1}{4\pi\varepsilon_o} \cdot \frac{P}{r^3}$

14. Torque Experienced by dipole

    $\tau = \text{pE}\sin\theta$

15. Electric flux (ϕ)

    $\phi = \int \vec{E} \cdot \vec{ds}$

16. Gauss law

    $\phi = \frac{q}{\varepsilon_o}$

17. Electric flux due to infinite sheet

    $\phi = \frac{\sigma}{2\varepsilon_o}$ σ =surface charge density

18. Electric field due to line charge

    $E = \frac{\lambda}{2\pi\varepsilon_o r}$

    λ = Linear charge density

19. Electric field intensity on the surface of hollow spherical shell

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

20. Inside the shell

$$E = 0$$

ELECTRIC POTENTIAL

1. Electric Potential

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

2. Potential difference between 2 point

$V_A - V_B = W/q_o$ $\quad V_A > V_B$

3. Potential due to single point charge

$$V = \frac{1}{4\pi\varepsilon_o} \cdot \frac{q}{r}$$

4. Potential at a point due to dipole on a axialline

$$V = \frac{1}{4\pi\varepsilon_o} \cdot \frac{p}{r^2}$$

5. Potential on equatorial line

$$V = 0$$

6. Electric field and potential gradient

$$E = \frac{-dv}{dx}$$

7. Potential Energy bet^n 2 charge

$$U = \frac{1}{4\pi\varepsilon_o} \cdot \frac{q_1 q_2}{r}$$

8. Potential Energy of dipole

$$U = - PE \cos \theta$$

$$u = - \vec{p} . \vec{E}$$

9. Work done to rotate dipole in Electric field

$$W = -PE \ (\cos\theta_2 - \cos\theta_1)$$

10. Potential on or inside the spherical shell

$$V = \frac{1}{4\pi\varepsilon_o} \times \frac{q}{r}$$

CAPACITANCE

1. Capacitance

$$c = q/v$$

2. Capacitance of Isolated spherical conductor

$$c = 4\pi\varepsilon_o r$$

3. Capacitance of parallel plate capacitor

$$C = \frac{\varepsilon_o A}{d}$$

4. In presence of di-electric

$$C = \frac{\varepsilon_o A}{d - t + \frac{t}{k}}$$

5. In fully filled

$$C = \frac{\varepsilon_o A}{d}$$

6. $C_{med} = kxC_{air}$

7. In series

$$1/C = 1/C_1 + 1/C_2 + 1/C_3$$

8. In parallel

$$C = C_1 + C_2 + C_3$$

9. For equal Capacitance

$$Cs = c/n$$

$$Cp = nc$$

10. Energy stored in capacitor

$$u = \frac{1}{2}CV^2 = \frac{1}{2}QV = \frac{Q^2}{2c}$$

11. Common potential

$$V = \frac{C_1V_1 + C_2V_2}{C_1 + C_2}$$

CURRENT ELECTRICITY

1. Electric current

$$I = \frac{q}{t} = \frac{ne}{t}$$

$$I = \frac{dq}{dt}$$

2. Drift velocity

$$V_d = \frac{eV\tau}{ml}$$

3. Relation between current and drift velocity

$$I = nAV_de$$

4. Mobility

$$\mu = \frac{V_d}{E}$$

5. Ohm's law

$$V = IR$$

6. Resistance

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

[δ = Resistivity]

7. Conductance

$$G = \frac{1}{R}$$

8. Conductivity

$$\sigma = \frac{1}{\rho}$$

9. Relation between current density and Electric field

$$J = \sigma E$$

10. Current density

$$J = \frac{I}{A}$$

11. Series combination of Resistance

$$R = R_1 + R_2 + \ldots\ldots\ldots\ldots$$

12. Parallel Combination

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

13. E.m.f and P.D

$$E = V + Ir$$

R = Internal Resistance

14. $I = \dfrac{E}{R+r}$ [for a single cell]

15. $r = \left(\dfrac{E-V}{V}\right)R$

16. Cells in Series

$$I = \frac{nE}{R+nr}$$

17. Cells in parallel

$$I = \frac{E}{R + \frac{r}{n}}$$ [n cells parallel]

18. Mixed grouping

$$I = \frac{MnE}{R + \frac{nR}{m}}$$

19. Wheatstone bridge

$$\frac{P}{Q} = \frac{R}{S}$$ [s = unknown resistance]

20. Meter bridge

$$\frac{R}{S} = \frac{l}{100 - l}$$

21. Potentiometer Principle

$$V = Kl$$

where K = potential gradient

22. Internal resistance

$$r = \left(\frac{l_1}{l_2} - 1\right)R$$

23. Heat produced due to Electric current

$$H = \frac{I^2Rt}{4.2} = \frac{V^2t}{R \times 4.2} = \frac{VIt}{4.2}$$

24. Power

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

25. Consuming Power $= \frac{V^2}{R}$ (supply voltage)

26. Unit of Electricity

$$= \frac{Watt \times hour}{1000}$$

27. Resistance with temperature

$$R = R_0 (1 + \alpha \Delta T)$$

$$R_2 = R_1 (1 + \alpha (T_2 - T_1))$$

MAGNETIC EFFECT OF ELECTRIC CURRENT

1. Biot savat's law

$$db = \frac{\mu_o}{4\pi} \times \frac{Idl \sin\theta}{r^2}$$

2. Magnetic field due to long straight current carrying conductor

$$B = \frac{\mu_o I}{2\pi r}$$

3. Magnetic field due to circular current carrying conductor

$$B = \frac{\mu o I}{2r}$$

4. Magnetic field at a point on the axis of a circular current loop

$$B = \frac{\mu_o INR^2}{2(R^2 + x^2)^{3/2}}$$

5. Ampere's law

$$B = \mu_o I$$

6. Solenoid

$$B = \mu_o nI = \frac{\mu_o NI}{\ell}$$

7. Toroid

$$B = \mu_o nI = \frac{\mu_o NI}{2\pi r}$$

8. Lorentz Force

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

9. force on current carrying conductor

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

$F = IlB\sin\theta$

10. force between 2 parallel conducting wire

$F = \frac{\mu_o I_1 I_2}{2\pi d}$

11. Torque experienced by current carrying loop

$\tau = NIAB\cos\theta$

$\tau = NIAB\sin\alpha$

θ = Angle between plane of loop with magnetic field

α = Angle between normal to the loop with magnetic field

12. Magnetic moment

M = NIA

13. Galvanometer

$I = \frac{K}{NAB}\alpha$

G = Galvanometer constant

14. Current sensitivity

$I_s = \frac{\alpha}{I} = \frac{NAB}{K}$

15. Voltage sensitivity

$Vs = \frac{\alpha}{V} = \frac{\alpha}{IR} = \frac{NAB}{KR}$

16. Conversion of Galvanometer into ammeter

$S = \frac{I_g G}{I - I_g}$ (s = Shunt)

17. Conversion of galvanometer into voltmeter

$R = \frac{V}{Ig} - G$

18. Radius of charge particle

$r = \frac{mV}{qB}$

19. Time period

$T = \frac{2\pi r}{V} = \frac{2\pi m}{qB}$

20. Cyclotron frequency

$f = \frac{1}{2} = \frac{qB}{2\pi m}$

ELECTROMAGNETIC INDUCTION

1. Magnetic flux

$\phi = BA\cos\phi$

2. Faraday's law

$|E| = \frac{d\phi}{dt}$ or $E = \frac{-d\phi}{dt}$

3. In other form

$E = \frac{(\phi_2 - \phi_1)}{t}$ or $E = \frac{-N(\phi_2 - \phi_1)}{t}$

4. Motional E.m.f

E = BlV

5. Self induction

ϕ = LI

6. For 'n' turns

nϕ = LI

7. Self induced E.M.F

$E = -L\frac{dI}{dt}$

8. Natural induced E.M.F

$$E = -M\frac{dI}{dt}$$

9. Induced E.M.F in rotating coil

$$E = E_o \sin\omega t$$

$$E_o = NAB\omega$$

ALTERNATING CURRENT

1. Relation between mean value of AC and peak value

$$I_m = \frac{2Io}{\pi}$$

2. Relation between RMS value & peak value

$$I_{rms} = \frac{Io}{\sqrt{2}}$$

3. Instaneous current in AC circuit containing inductance only

$$I = I_o \sin\left(\omega t \frac{\pi}{2}\right)$$

4. Inductive Reactance

$$X_L = \omega L = 2\pi fL$$

5. Instanceous current in A.C circuit containing resistance only

$$I = I_o \sin(\omega t - \pi/2)$$

6. Capacitive Reactance

$$X_C = \frac{1}{\omega C} = \frac{1}{2\pi fC}$$

7. Impedance

$$Z = \sqrt{R^2 + (X_L - X_c)^2}$$

8. In LCR CKt

$$I_{rms} = \frac{E_{rms}}{Z}$$

9. Power factor

$$\cos\phi = \frac{R}{Z}$$

10. Average power in LCR

$$P_{avg} = \frac{E_o I_o}{2}.\cos\phi = E_v I_v \cos\phi$$

11. At resonance

$$X_L = X_C$$

$$Z = R$$

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

12. For Ideal transformer

$$E_p I_p = E_s I_s$$

$$\Rightarrow \frac{Es}{Ep} = \frac{Ip}{Is} = \frac{Ns}{Np}$$

13. Efficiency of transformer

$$\eta = \frac{output\ power}{input\ power} = \frac{E_S I_S}{E_P I_P}$$

REFLECTION

1. Relation between f and R

$$R = 2f$$

2. Mirror formula

$$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$$

3. Magnification

$$M = \frac{-v}{u} = \frac{h_2}{h_1}$$

4. $$M = \frac{f}{f-u} = \frac{f-v}{v}$$

5. The no. of image produced between two plane mirror inclined at an angle θ

$$n = \frac{360}{\theta} \text{ if } \frac{360}{\theta} \text{ is odd}$$

$$n = \frac{360}{\theta} - 1 \text{ if } \frac{360}{\theta} \text{ is even}$$

REFRACTION

1. Snell's law

$$\frac{\sin i}{\sin r} = {}^1\mu_2$$

light goes from 1 to 2

2. Refractive index

$$\mu = \frac{c}{V}$$

3. Relative refractive index

$${}^1\mu_2 = \frac{\mu_2}{\mu_1} = \frac{V_1}{V_2} = \frac{\lambda_1}{\lambda_2}$$

4. Critical angle and refractive index

$$\mu = \frac{1}{\sin C}$$

5. Sin C $= \frac{\mu_{Rarer}}{\mu_{denser}}$

6. Lens formula

$$\frac{1}{f} = \frac{1}{V} - \frac{1}{u}$$

7. Magnification :

$$M = \frac{V}{u} = \frac{h_2}{h_1}$$

$$M = \frac{f}{f+u} = \frac{f-V}{V}$$

8. Lens marker formula

In air

$$\frac{1}{f_a} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

9. Lens in only medium

$$\frac{1}{fm} = \left(\frac{\mu_{lens}}{\mu_{med}} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$R_1 \rightarrow +ve$, $R_2 \rightarrow -ve$ for convex

$R_1 \rightarrow -ve$, $R_2 \rightarrow +ve$ for concave

10. Power of lens

$$P = \frac{1}{f}\text{ (m)} = \frac{100}{f}\text{ (cm)}$$

11. Lens in combination

$$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$$

12. Prism formula

$$\mu = \frac{\sin\left(\frac{A+d_m}{2}\right)}{\sin\frac{A}{2}}$$

A = Prism angle

dm = minimum deviation

13. Deviation

$$d = i + e - A$$

14. $i = \frac{A+d_m}{2}$

incident angle and refracted angle

$r = \frac{A}{2}$

15. Deviation for thin prism

$d = (\mu - 1)A$

16. Angular dispersion

$\theta = d_V - d_R = (\mu_V - \mu_R)A$

17. Dispersive power

$\omega = \frac{d_V - d_R}{d} = \frac{\mu_V - \mu_R}{\mu - 1}$

18. Simple microscope magnifying power

$M = 1 + \frac{D}{f}$

19. Compound microscope

$M = \frac{V_o}{u_o}\left(1 + \frac{D}{fe}\right)$

$M = \frac{L}{f_o} = \left(1 + \frac{D}{fe}\right)$

20. Astronomical telescope

$M = \frac{f_o}{f_e}$ (Normal adjustment)

WAVE OPTICS

1. Maxima amplitude

$A_{max} = (a_1 + a_2)^2$

2. Minima amplitude

$A_{min} = (a_1 - a_2)^2$

3. $\frac{I_{max}}{I_{min}} = \frac{(a_1 + a_2)^2}{(a_1 - a_2)^2} = \frac{\left(\frac{a_1}{a_2} + 1\right)^2}{\left(\frac{a_1}{a_2} - 1\right)^2} = \frac{(r+1)^2}{(r-1)^2}$

4. Result and amplitude

$A = \sqrt{a_1^2 + a_2^2 + 2a_1a_2\cos\phi}$

5. Result and intensity

$I = I_1 + I_2 + 2\sqrt{I_1}\sqrt{I_2}\cos\phi$

6. If $I_1 = I_2 = I_o$

$I = 2I_o(1 + \cos\phi)$

7. $\frac{I_1}{I_2} = \frac{W_1}{W_2} = \frac{a_1^2}{a_2^2}$

$W_1 = W_2$ = Width of Slit

8. Distance of nth Bright fringe

$\beta = \frac{n\lambda D}{d}$

9. Distance of nth dark fringe

$\beta = \frac{(2n-1)\lambda D}{2d}$

10. Fringe width

$\beta = \frac{\lambda D}{d}$

11. Fringe width in other medium

$\beta^1 = \frac{\beta}{\mu}$

12. Condition for constructive interface

$\phi = 2n\pi$ (Even multiple of π)

$x = 2n\lambda/2$ (Even multiple of $\lambda/2$)

13.Condition for destructive interference

$$\phi = (2n-1)\pi$$
$$x = (2n-1)\lambda/2$$

14.Condition for minima in diffraction

path difference

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

15.Condition for maxima in diffraction
path difference

$$d\sin\theta = (2n+1)\frac{\lambda}{2}$$

16.Central width of central maxima

$$x = \frac{2\lambda D}{d}$$

17.Distance of 'n'th minima from central

maxima

$$y = \frac{n\lambda D}{d}$$

18.Distance of 'n'th secondary maxima
from central maxima

$$y = \frac{(2n+1)\lambda D}{2d}$$

19.Brewster's law

$$\mu = \tan i_p$$

i = polarising angle

20. Law of malus

$$I = I_0\cos^2\theta$$

ATOMIC PHYSICS

1. Distance of closest approach

$$\frac{1}{2}mv^2 = \frac{2kze^2}{r_o}$$

r_o = Distance of closest approach

2. Radius of circular orbit

$$r = \frac{n^2h^2}{4\pi^2kze^2m}$$
$$r = 0.53 \times \frac{n^2}{z} A^o$$

3. Velocity of electron

$$V = \frac{2\pi kze^2m}{nh}$$
$$V = 2.18 \times 10^6 m/s$$

4. Energy of Electron

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

$$E = -13.6 \times \frac{z^2}{n^2} ev$$

5. Wave length

$$\frac{1}{\lambda} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

Dual nature of Radiation matter

1. $E = hv = \dfrac{hc}{\lambda}$

2. Einstein's photo electric emission

$$\frac{1}{2}mv^2_{max} = hv - hv_o$$
$$\frac{1}{2}mv^2_{max} = \frac{hv}{\lambda} - \frac{hv}{\lambda_o}$$

3. Work function

$\phi_o = h\nu_o = \frac{hc}{\lambda_o}$

4. $\frac{1}{2}mv^2{}_{max} = eV_o$ (V_o = stopping potential)

5. Debroglie wave length

$\lambda = \frac{h}{p} = \frac{h}{\sqrt{2mE}}$

6. Debrogle wave length of electron in 'v' volt

$\lambda = \frac{h}{\sqrt{2meV}} = \frac{12.27}{\sqrt{V}} A^o$

NUCLEAR PHYSICS

1. Size of nucleolus

$R = R_o A^{1/3}$

2. Mass defect

$\Delta m = Zm_p + (Zm_n) - M$

3. Binding Energy

B.E = $\Delta m \times c^2$

4. If mass defect in amu

B.E = $\Delta m \times 931 MeV$

5. Decay law

$N = No\ e^{-\lambda t}$

6. $\frac{N}{No} = \left(\frac{1}{2}\right)^n$

n = no of half life = $\frac{t}{t_{1/2}}$

7. $t_{1/2} = \frac{0.693}{\lambda}$

8. $t_{avg} = \frac{1}{\lambda}$ $t_{avg} = 1.44\, t\frac{1}{2}$

SEMI CONDUCTOR DEVICE

1. current amplification factor in common base

$\alpha = \frac{I_c}{I_e}$

2. current amplification factor In common emitter

$\beta = \frac{I_c}{I_b}$

3. Relation between α & β

$\alpha = \frac{\beta}{1+\beta}$

$\beta = \frac{\alpha}{1-\alpha}$

By Padhi sir