Diffraction.

① Grating

$$(a+b)\sin\theta = n\lambda$$

$(a+b)$: Grating element
θ = Angle of diffraction
n = Order of diffraction
λ = wavelength of wave getting diffracted.

② Grating Element

$$(a+b) = \frac{1}{N}$$

$(a+b)$ = Grating element
N = Number of lines per unit length of grating

③ Resolving power of Grating (R.P)

$$R.P. = \frac{\lambda}{d\lambda} = mN$$

N = Number of lines per unit length of grating.
m = order of diffraction.
λ = Mean wavelength of sources to be resolved.
$d\lambda$ = difference between wavelength of sources to be resolved.

Electrodynamics.

① Divergence of a vector.

$$(\vec{\nabla}\cdot\vec{A}) = \hat{i}\frac{\partial}{\partial x}A_x + \hat{j}\frac{\partial}{\partial y}A_y + \hat{k}\frac{\partial}{\partial z}A_z$$

$\vec{\nabla} = \hat{i}\frac{\partial}{\partial x} + \hat{j}\frac{\partial}{\partial y} + \hat{k}\frac{\partial}{\partial z}$ is the del operator.

$\vec{A}$ = Any arbitrary vector

$\vec{\nabla}\cdot\vec{A}$ = divergence of vector A.

② Curl of a vector

$$(\vec{\nabla}\times\vec{A}) = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ A_x & A_y & A_z \end{vmatrix}$$

$(\vec{\nabla}\times\vec{A})$ = Curl of a vector.

③ Gradient of a scalar function

$$\vec{\nabla} f(x,y,z) = \hat{i}\frac{\partial}{\partial x} f(x,y,z) + \hat{j}\frac{\partial}{\partial y} f(x,y,z) + \hat{k}\frac{\partial}{\partial z} f(x,y,z)$$

- $f(x,y,z)$ = Any arbitary function of x, y, z
- $\vec{\nabla} f(x,y,z)$ = Gradient of a function $f(x,y,z)$

④ Conversion of Cartesian coordinates to cylindrical.

$$r = \sqrt{x^2+y^2}$$

$$\phi = \tan^{-1}\left(\frac{y}{x}\right)$$

$$z = z$$

- r, ϕ, z = Cylindrical co-ordinates.
- x, y, z = Cartesian co-ordinates.

⑤ Conversion of Cartesian coordinates to spherical.

$$r = \sqrt{x^2+y^2+z^2}$$

$$\theta = \tan^{-1}\left(\frac{\sqrt{x^2+y^2}}{z}\right)$$

$$\phi = \tan^{-1}\left(\frac{y}{x}\right)$$

- r, θ, ϕ = Spherical co-ordinates.

Fiber Optics

(1) Numerical Aperature (N.A.)

$$N.A. = \sin\theta_0 = \sqrt{\mu_1^2 - \mu_2^2}$$

- θ_0 = Acceptance angle
- μ_1 = R.I. of core
- μ_2 = R.I of cladding

(2) Numerical Aperature (N.A.) of fibre in other medium.

$$N.A. = \sin\theta_0 = \frac{\sqrt{\mu_1^2 - \mu_2^2}}{\mu_0}$$

- μ_0 = R.I. of other outside medium.

(3) Fractional R.I (Δ)

$$\Delta = \frac{\mu_1 - \mu_2}{\mu_1}$$

(4) N.A. in terms of Δ

$$N.A. = \mu_1\sqrt{2\Delta}$$

(5) Critical angle at core cladding interface (θ_c)

$$\theta_c = \sin^{-1} \frac{\mu_2}{\mu_1}$$

(6) Normalized frequency (V)

$$V = \frac{2\pi a}{\lambda} \sqrt{\mu_1^2 - \mu_2^2}$$

- λ = wavelength travelling through the fiber
- a = Radius of the core.

(7) Number of modes (Nm)

SI

$$Nm = \frac{V^2}{2}$$

GRIN

$$Nm = \frac{V^2}{4}$$

Relativity

① Length Contraction

$$l = l_0 \sqrt{1 - \frac{v^2}{c^2}}$$

- l = length of object while its moving.
- l_0 = length of object when at rest
- v = Velocity ~~w~~ith which the object is moving.
- c = velocity of light.

② Time dilation

$$t = \frac{t_0}{\sqrt{1 - \frac{v^2}{c^2}}}$$

- t = time measured by clock which is moving.
- t_0 = time measured by clock at rest