Name :

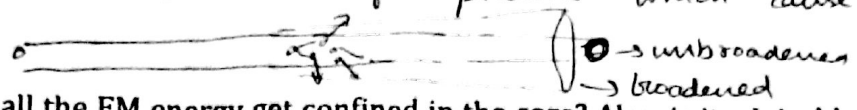
Entry Number :

ELL212 Minor1 [2x10=20 marks]

5

What do you understand by the term 'collisional broadening' of a light source?

Collisional broadening of light source means the beam of light will get broadened however collimated the beam is. This can be due to collision of photons which cause broadening of light spot



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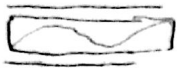
In an optical fiber, does all the EM energy get confined in the core? Also, is it advisable to sharply bend an optical fiber? Explain.

 ← core, Since EM waves propagate through core and gets internally reflected at boundary hence EM energy gets confiemed in core. Also there is loss in form in evanescent waves through coat.

2

If it is bent sharply then em wave can hit boundary ~~with~~ angle lesser than critical angle and EM wave can escape.

Why do humans find greenery so pleasing and relaxing?

Human eyes are more sensitive to green colours and it can be discriminated easily. Thus they are more soothing to human eyes. Also there wavelength ~~are~~ lies in middle of coloured spectrum ~~and~~ rods ~~in retina are mostly effective~~

2

The phase velocity of light in a waveguide can be larger than 'c'. Does this violate the special theory of relativity? Give reason.

Yes the phase velocity of light in a waveguide can be greater than 'c'. No this does not violate theory of relativity.

0

$$c_p = \frac{c}{\sqrt{\omega^2 - \beta^2}}$$

Can you store X-rays and gamma rays in a resonant cavity? Give reason.

We know, $K = \sqrt{\frac{\omega^2}{c^2} - [k_x^2 + k_y^2 + k_z^2]}$ $\left(k_x = \frac{\pi n}{a}\right)$ No.

0

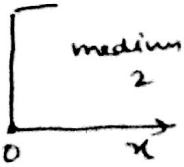
No we cannot store these high frequency rays in resonant cavity because there exist a maxima frequency for velocity which they cannot be stored.

If your friend told you that the permittivity of a non-dispersive material is not a constant but a delta function, would you agree with him/her? Give reason.

Yes it can't be considered as a delta function like

$$\epsilon_2(x) = |\epsilon_2|\,\delta(x)$$

0



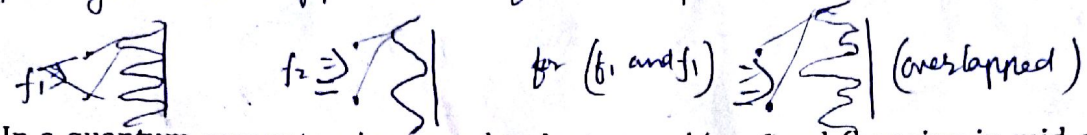
Since delta function assumes that at a particular x or at particular 't' it will have non zero value. If anyway it is considered then at other places speed of wave will have undefined speed.

What enables us to use single frequency analysis for solving Maxwell's equations?

(0) For solving Maxwell's equation, only single frequency is considered because different frequencies have different velocities and wavelength in different medium. Frequency is the only inherent attribute which does not changes

In the Young's double-slit experiment, what happens if we replace the monochromatic source by a source of white light?

(1) If the monochromatic source is replaced by white light we get 'overlapped interference pattern' of different wavelengths.



In a quantum computer, ions need to be trapped/confined (hanging in mid-air) by using electric and/or magnetic fields. Is this trapping possible just by using a static electric field? Give reason. [Hint : Think about the nature of solutions of Laplace equation in 2D]

(0) ~~No~~, it can be ~~passing~~ trapped using varying electric and magnetic field

Using Maxwell's equations, derive the relationship between conductivity and effective permittivity in 2-3 steps.

(0) Continuity equation $\Rightarrow \nabla \cdot \bar{J} = \frac{\partial \rho}{\partial t}$, $J = \sigma E$, $\nabla \cdot E = \frac{\rho}{\epsilon}$

Assuming variation of E as $E e^{i\omega t}$

we get $\nabla \cdot [\sigma E] = \epsilon \frac{d \nabla \cdot E}{dt}$

$\Rightarrow \tilde{\sigma} = \omega \tilde{\epsilon}$ [σ, ϵ can be complex)

You are standing in the middle of a large patch of barren land waiting for your friend. After sometime, you see a person approaching you from a distance. How close does that person have to come before you can recognize his/her face? Make reasonable assumptions. [Bonus]

(0) Assuming we have our fate point at infinity.