Name : ; Entry Number : ELL212 Minor2 [2x10=20 marks]

If a plane wave is incident on a metal surface, can it excite surface plasmons? Give reason.

(0) Surface Plasmon will only taken place when $\epsilon_1 < 0$ and $|\epsilon_2| < |\epsilon_1|$ and $\theta_i > \theta_c$. Moreover for surface plasmons, the resonance frequency must be present in the incident wave.

When does group velocity become larger than phase velocity? Show mathematically in 3-4 steps.

(2) V_g becomes greater than V_p in anomalous region of dispersion

$$Re\left(\frac{\epsilon}{\epsilon_0}\right) = 1 + \frac{Nq^2}{m}\frac{(\omega-\omega_0)^2}{(\omega-\omega_0)^2+\gamma^2\omega^2}, \quad Im\left(\frac{\epsilon}{\epsilon_0}\right) = \frac{Nq^2}{m}\frac{\gamma\omega}{(\omega-\omega_0)^2+\gamma^2\omega^2}$$

$V_p = \frac{\omega}{k} = \frac{1}{\sqrt{\mu\epsilon}}$ $\quad V = \frac{d\omega}{dk}$ | Now in anomalous region $\frac{d\epsilon}{d\omega}$ = negative

$k = \omega\sqrt{\epsilon\mu}$

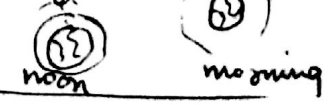
$\frac{dk}{d\omega} = \sqrt{\epsilon\mu} + \frac{\sqrt{\mu}}{2\sqrt{\epsilon}}\frac{d\epsilon}{d\omega} = \sqrt{\epsilon\mu} - b$ | $\frac{d\omega}{dk} = \frac{1}{\sqrt{\epsilon\mu}-b}$ $\gtrless \frac{1}{\sqrt{\epsilon\mu}}$

What role does special relativity play in determining the color of gold?

(2) In gold the outer electron is tightly bound and its speed is nearly equal to speed of light. Thus due to relativity contraction of orbital happens and the spectrum of light which it absorbs lies in the (visible region) region, and appears complementary to that colour i.e Gold.

Why does the sun appear to be red during evening and early morning but not during noon?

(0) During morning and evening the sun rays has to cross larger distance in the atmosphere than in noon and also the phenomenon of rayleigh scattering takes place and particles in atmosphere are of order of wavelength of red light and scatter red light more.



What is LSPR and how can you use it to design a sensor?

(1) LSPR - Localised Surface Plasmon Resonance.

LSPR is a phenomenon of Surface Plasmon resonance with the use of nanoparticles which are order of wavelength of electric field. Due to if EM waves (broad band) are used and shined on the nano particles, a certain frequency will be absorbed and will be absent in output wave. That frequency is very sensitive to geometry, distance, size, type of nanoparticles and hence can sense their presence

State two differences between reflection and scattering.

(2) Reflection is the bouncing back of wave in a single direction whereas in scattering the wave is bounced back or emitted in all directions.

Due to Reflection a shining attribute is found but in scattering dullness of colour appears, Reflection happens due to smooth surface while ~~scatting~~ scattering happens in rough surface

We usually neglect magnetic field effects in Paul traps but do not do so in Penning trap. Why?

(0) Force acting on charged particle is proportional ~~of~~ to velocity of particle. Since in paul traps the speed of particle is ~~not~~ low compared to the speed of light, the force can be neglected but in Penning traps the account of force due to magnetic field is taken due to ~~speed~~ high speed

Consider a 1D plasma device where the plasma density is $n = n_0 e^{-x^2/\delta^2}$. If we now shine an EM wave on this plasma, under what conditions will the reflection be significant?

(0) ~~We know wp α n~~ We know in plasma $w_p \propto n$ thus if delta'δ' is ~~so~~ large the incoming wave will be reflected near the junction. Thus for significant reflection the δ must be very large so that incoming em wave does not penetrate the plasma largely.

Some people fear that spending money on ITER Project (nuclear fusion) is very dangerous as it might have ill effects like chernobyl or fukushima. Radiations in such disaster will take years to decay. Are these fears rational?

(2) No the fears are absurd since ill effects are due to nuclear wastes like plutonium or uranium ~~radiations~~ but in ITER, energy required for fusion is done by accelerating particles ~~via~~ or hailing them via lasers, NBI, fermi acceleration not in the nuclear fission. ~~There are no~~ No nuclear wastes are generated in ITER project.

You have an apple in one hand and a banana in the other. If I suddenly switch off all lights in the room and switch on only a red bulb, what will be the color of these fruits? Give reason.

(1) We see Colour of an object because light containing ~~visible~~ ~~wavelength~~ spectrum is a

An object absorbs the light complementary to its colour or only reflects the colour of light which we see ~~colour~~ and hence it appears as of that colour. But Poor Fellow due to absence of visible spectrum source apple will appear red only but Banana will appear 'reddish' yello..