國立中正大學
113 學年度碩士班招生考試
試 題

［第 2 節］

| 科目名稱	電磁學
系所組別	機械工程學系光機電整合工程

1. (10%) The work function of a metal is 3.0 eV. To release photoelectrons from this metal, the wavelength of the incident light needs to be shorter than what wavelength?

   (1) $4.133*10^{-6}$, (2) $4.133*10^{-7}$, (3) $4.133*10^{-8}$, (4) $4.133*10^{-9}$ m.

2. (10%) The power of a laser light source with a wavelength of 200nm is 3.0W. It is known that the Planck constant is $6.626*10^{-34}$ J*s, what is the energy of each photon emitted by this light source?

   (1) $9.92*10^{-18}$, (2) $9.92*10^{-19}$, (3) $4.96*10^{-18}$, (4) $4.96*10^{-19}$ J.

3. (30%) Evaluate Brewster's angle and the polarization characteristics? (refractive index of air = 1 and refractive index of PMMA = 1.49)

Incident ray(unpolarised)   Reflected ray (???)

N_1 Air

θ_B

PMMA

N_2 θ_t
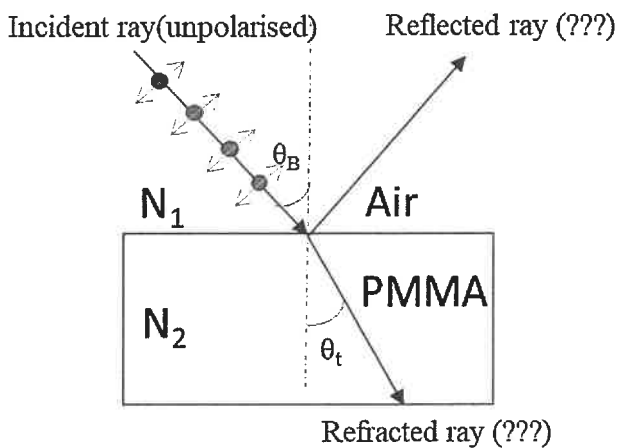
Refracted ray (???)

   (a) What is the Brewster's angle degree? (10%)

   (b) What are the polarization characteristics of <u>Reflected ray</u> and <u>Refracted ray</u>? (10%) (Polarized or slightly Polarized)

   (c) A ray of light incidents in PMMA the surface from air making an angle of 10 ° with the normal to the surface. What is the refraction angle θ_t? (10%)

4. (15%) When a uniform plane wave:

$$\vec{E}_i(x,z) = \vec{E}_{i0}e^{-jk_{1x}x}e^{-jk_{1z}z}$$

in medium 1 having a refractive index n_1 is incident on a plane interface at $z = 0$ with medium 2 having a refractive index $n_2 (<n_1)$ at an angle θ_i greater than the critical angle θ_c, the reflected wave (in medium 1) and the transmitted wave (in medium 2) can respectively be described as:

$$\vec{E}_r(x,z)\vec{E}_r = \vec{E}_{r0}e^{-jk_{1x}x}e^{+jk_{1z}z}$$

and

$$\vec{E}_t(x,z) = \vec{E}_{t0}e^{-jk_{1x}x}e^{-\alpha_2 z}$$

where $k_{1x} = k_1 \sin\theta_i$, and $\alpha_2 = \sqrt{k_{1x}^2 - k_2^2}$, and k_1, k_2 are wavenumbers in medium 1 and 2,

respectively. If these $\vec{E}$ fields are perpendicular to the plane of incidence, i.e., $\vec{E} = \hat{a}_y E_y$, show that the reflection coefficient $\Gamma_\perp$ is given as:

$$\Gamma_\perp = \frac{k_{1z} + j\alpha_2}{k_{1z} - j\alpha_2} = e^{j2\phi}$$

where

$$\phi = \tan^{-1}\frac{\alpha_2}{k_{1z}}$$

(It can be easily seen that the reflected power from the interface is equal to the incident power.)

5. (10%) Consider a plane visiable lightwave obliquely incidents toward the interfaces of two flat, dielectric media. The reflection of the wave is drastic different between the TE- and the TM-polarized light. Which case can show a zero reflection? Explain clearly the reasons in your answer.

6. (10%) An electromagnetic wave is incident on a slab of dielectric material that has parallel surfaces. If the wave is incident on the front surface at Brewster's angle, show that the refracted wave is incident on the rear surface at Brewster's angle also.

7. (15%) A lossless transmission line of characteristic impedance 75Ω is terminated by a load impedance $Z_L = 40 + j30$. Find:
(1) reflection coefficient at the load.
(2) SWR on the line.
(3) line impedance at $\ell = 0.07\lambda$ from the load.