Week 3 Assignment 3

The due date for submitting this assignment has passed. Due on 2018-09-05, 23:59 IST.

As per our records you have not submitted this assignment.

1) Which of the following is not true about the continuity of electromagnetic waves at a dielectric-dielectric interface?

- (A) normal components of \( \mathbf{D} \)
- (B) tangential components of \( \mathbf{E} \)
- (C) tangential components of \( \mathbf{H} \)
- (D) normal components of \( \mathbf{H} \)

No, the answer is incorrect.
Score: 0

Accepted Answers:
(D) normal components of \( \mathbf{H} \)

2) Which of the following is true about the \( s \)-polarised wave and \( p \)-polarised wave when both present for reflection at dielectric-dielectric interface?

- (A) at normal incidence, amplitude reflection coefficients \( r_s \) and \( r_p \) become approximately equal
- (B) for any angle of incidence, \( r_p \) is always greater that \( r_s \)
- (C)
- (D) at Brewster's angle of incidence, the \( p \)-polarised wave is transmitted through the interface and the \( s \)-polarised wave is both reflected and refracted at the same angle

No, the answer is incorrect.
Score: 0

Accepted Answers:
(A) at normal incidence, amplitude reflection coefficients \( r_s \) and \( r_p \) become approximately equal
(D) at Brewster's angle of incidence, the \( p \)-polarised wave is transmitted through the interface and the \( s \)-polarised wave is both reflected and refracted at the same angle

3)
A plane light wave travelling in \( xx' \) -plane in glass (RI: \( n_1 = 1.5 \)) hits the glass-air interface (\( yz' \)-plane). The incident plane light wave is given by the equation:

\[
\vec{E}_{\text{inc}} = 2.0 \, \vec{y} \, \exp\left[ i \left( \omega t - \frac{1}{2} k_1 x - \frac{\sqrt{3}}{2} k_1 z \right) \right] \, \text{V/m}
\]

The free space wavelength of this light is \( \lambda_0 = 0.6 \times 10^{-6} \, \text{meter} \). The free space propagation constant is \( k_0 \). Take RI of air \( n_2 = 1.0 \).

For the incident light wave (a) the angle of incidence at glass-air interface and (b) the polarization respectively

- (A) \( (i) \), 30°, (ii) \( s \)-wave
- (B) \( (i) \), 30°, (ii) \( p \)-wave
- (C) \( (i) \), 60°, (ii) \( p \)-wave
- (D) \( (i) \), 60°, (ii) \( s \)-wave

No, the answer is incorrect.

Score: 0

Accepted Answers:
- (D) \( (i) \), 60°, (ii) \( s \)-wave

4) At the glass-air interface, the light wave

- (A) has decaying transmitted field amplitude
- (B) has decaying reflected field amplitude
- (C) undergoes complete transmission
- (D) undergoes total internal reflection

No, the answer is incorrect.

Score: 0

Accepted Answers:
- (A) has decaying transmitted field amplitude
- (D) undergoes total internal reflection

5) Equation of the transmitted electric field takes the form (\( t \) is the amplitude transmission coefficient)

\[
\vec{E}_{t r} = 2.0 \, t \, \vec{y} \, e^{-\frac{\sqrt{3}}{4} k_0 z} \, e^{i \left( \omega t - \frac{3\sqrt{3}}{4} k_0 x \right)}
\]

- (A) \( \vec{E}_{t r} = 2.0 \, t \, \vec{y} \, e^{-\frac{\sqrt{3}}{2} k_0 z} \, e^{i \left( \omega t - \frac{3\sqrt{3}}{2} k_0 x \right)} \)
- (B) \( \vec{E}_{t r} = 2.0 \, t \, \vec{y} \, e^{-\frac{\sqrt{3}}{4} k_0 z} \, e^{i \left( \omega t - \frac{3\sqrt{3}}{4} k_0 x \right)} \)
- (C) \( \vec{E}_{t r} = 2.0 \, t \, \vec{x} \, e^{-\frac{\sqrt{3}}{2} k_0 z} \, e^{i \left( \omega t + \frac{3\sqrt{3}}{2} k_0 z \right)} \)
- (D) \( \vec{E}_{t r} = 2.0 \, t \, \vec{y} \, e^{\frac{\sqrt{3}}{2} k_0 z} \, e^{i \left( \omega t + \frac{3\sqrt{3}}{4} k_0 x \right)} \)

No, the answer is incorrect.

Score: 0

Accepted Answers:
- (A) \( \vec{E}_{t r} = 2.0 \, t \, \vec{y} \, e^{-\frac{\sqrt{3}}{4} k_0 z} \, e^{i \left( \omega t - \frac{3\sqrt{3}}{4} k_0 x \right)} \)

6) The depth of penetration of light wave into air region is approximately (use \( \lambda_0 = 0.6 \times 10^{-6} \, \text{meter} \))

- (A) zero
- (B) 0.115 \( \mu \)m
- (C) 0.261 \( \mu \)m
- (D) 2.611 \( \mu \)m
7) If the direction of incident wave (y-polarised) is reversed, i.e., from air to glass at same angle of incidence, keeping everything same, then which of the following represent/represents the equi-polar incident electric field?

- (A) $\vec{E}_{\text{inc}} = 2.0 \hat{y} e^{i(\alpha x + \frac{1}{2} b_x - \frac{1}{2} k_x)}$
- (B) $\vec{E}_{\text{inc}} = 2.0 \hat{y} e^{i(\alpha x + \frac{1}{2} b_x + \frac{1}{2} k_x)}$
- (C) $\vec{E}_{\text{inc}} = 2.0 \hat{y} e^{i(\alpha x - \frac{1}{2} b_x + \frac{1}{2} k_x)}$
- (D) $\vec{E}_{\text{inc}} = 2.0 \hat{y} e^{i(\alpha x + \frac{1}{2} b_x + \frac{1}{2} k_x)}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
(A) 0.115 μm

8) Read the following paragraph and answer the questions? (Q8-Q12)
Consider a thin uniform glass sheet of RI $n_2$. An antireflection coating has to be deposited on it. The RI of the coating material is $n_3$ and the thickness is $d_2$. Outside medium is air $n_1 = 1.0$. Assume $d_2 = (2m + 1) \frac{\lambda_0}{4n_2}$ where $m$ is an integer and $\lambda_0$ is the wavelength of light.

For this two-layer sheet, light falling from air normally on the coated surface will have reflectivity (energy reflection coefficient)

- (A) $R = \left( \frac{n_1 - n_2}{n_1 + n_2} \right)^2$
- (B) $R = \left( \frac{n_3 - n_1}{n_2 + n_3} \right)^2$
- (C) $R = \left( \frac{n_1 n_3 - n_2}{n_1 n_2 + n_3} \right)^2$
- (D) $R = \left( \frac{n_1 n_3 - n_2}{n_1 n_2 + n_3} \right)^2$

No, the answer is incorrect.
Score: 0
Accepted Answers:
(D)

9) For the above coated glass sheet, if $n_3 = 1.62$ (RI of glass sheet), then the required value of $n_2$ (RI of coating material) for minimum reflection is (choose the best value from the following)

- (A) $n_2 \approx 1.732$
- (B) $n_2 \approx 1.437$
10. For the best value of $n_2$ chosen from above, obtain a thickness of the coating thickness so that the coated glass sheet acts as an antireflection element for light of wavelength $\lambda_0 = 0.55 \, \mu m$. Which of the following values of thickness $d_2$ gives minimum reflection?

(A) $d_2 = 0.3240 \, \mu m$

(B) $d_2 = 0.432 \, \mu m$

(C) $d_2 = 0.864 \, \mu m$

(D) $d_2 = 1.296 \, \mu m$

No, the answer is incorrect.

Score: 0

Accepted Answers:

(C) $n_2 \approx 1.273$

11. For the best value of $n_2$ chosen from above for the coated glass sheet, if a light of wavelength $\lambda_0 = 0.65 \, \mu m$ is used, then the minimum possible thickness and corresponding reflectivity are

(A) $d_2 \approx 0.0041 \, \mu m$ and $R \approx 0.1889$

(B) $d_2 \approx 0.0106 \, \mu m$ and $R \approx 0.0889$

(C) $d_2 \approx 0.046 \, \mu m$ and $R \approx 0.0188$

(D) $d_2 \approx 0.1277 \, \mu m$ and $R \approx 0.0034$

No, the answer is incorrect.

Score: 0

Accepted Answers:

(D) $d_2 \approx 0.1277 \, \mu m$ and $R \approx 0.0034$

12. For this two-layer sheet, if we choose the thickness of the film as $d_2 = \frac{\lambda_0}{2n_2}$, then the reflectivity of the element becomes

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

(B) $R = \left(\frac{n_2-n_0}{n_2+n_0}\right)^2$

(C) $R = \left(\frac{n_1n_2-n_0^2}{n_1n_2+n_0^2}\right)^2$

(D) independent of coating RI

No, the answer is incorrect.

Score: 0

Accepted Answers: