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NPTEL

Unit 3 - Week 2

Assignment 2

The due date for submitting this assignment has passed. **Due on 2018-08-15, 23:59 IST.**
As per our records you have not submitted this assignment.

1) *1 point*

For a plane wave in an anisotropic non-magnetic medium, which of the following relations abou $\vec{E}, \vec{H}, \vec{D}$ and $\vec{k}$ is/are true?

(A) $\vec{H} = \frac{1}{\omega\mu_0}(\vec{k} \times \vec{E})$

(B) $\vec{D} = \frac{\mu_0}{\omega}(\vec{k} \times \vec{H})$

(C) $\vec{E} = \frac{1}{\omega^2\mu_0\varepsilon}(\vec{k} \times \vec{k} \times \vec{H})$

(D) $\vec{D} = -\frac{1}{\omega}(\vec{k} \times \vec{H})$

No, the answer is incorrect.
Score: 0

Accepted Answers:

$\vec{H} = \frac{1}{\omega\mu_0}(\vec{k} \times \vec{E})$

(A)

2) *1 point*

In a dielectric medium, the $\vec{E}$ field of a plane electromagnetic wave makes an angle of 120^0 witl direction of propagation given by $\vec{k}$. The angle between the direction of energy flow and that of propagation is then

(A) 60^0

(B) 30^0

(C) 90^0

(D) 0^0

(A) For a negative uniaxial crystal, extraordinary RI is greater than the ordinary RI, i.e., $n_e > n_o$

(B) For a positive uniaxial crystal, optic axis corresponds to the fast axis

(C) For a negative uniaxial crystal, along optic axis velocity of e-wave is greater than that of o-wave

(D) For a positive uniaxial crystal, wave polarised perpendicular to optic axis corresponds to o-wave

No, the answer is incorrect.
Score: 0

Accepted Answers:
(B) For a positive uniaxial crystal, optic axis corresponds to the fast axis
(D) For a positive uniaxial crystal, wave polarised perpendicular to optic axis corresponds to o-wave

4) A linearly polarized beam is incident on a half wave-plate making an angle of $\pi/4$ with the fast axis. Then the emergent beam from the half wave-plate is **1 point**

(A) *elliptically polarised*

(B) *circularly polarised*

(C) *linearly polarised*

(D) *unpolarised*

No, the answer is incorrect.
Score: 0

Accepted Answers:
(C) linearly polarised

5) About the index ellipsoid of an anisotropic medium, which of the following is/are true? **1 point**

(A) Half lengths of the ellipsoid axes represent the RI's in three mutually orthogonal directions (x,y,z)

(B) For a given direction of propagation, the ellipsoid yields two directions of polarisation of the wave

(C) For a given direction of propagation, the ellipsoid yields two RIs that correspond to the two orthogonal polarisations of the wave

(D) For a given direction of propagation, the ellipsoid yields two $\vec{D}$'s that corresponding to two possible polarization of the wave

No, the answer is incorrect.
Score: 0

Accepted Answers:
(A) Half lengths of the ellipsoid axes represent the RI's in three mutually orthogonal directions (x,y,z)
(B) For a given direction of propagation, the ellipsoid yields two directions of polarisation of the wave
(C) For a given direction of propagation, the ellipsoid yields two RIs that correspond to the two orthogonal polarisations of the wave
(D) For a given direction of propagation, the ellipsoid yields two $\vec{D}$'s that corresponding to two possible polarization of the wave

6) **1 point**

For an electromagnetic wave propagating along xz −plane making an angle of 30^0 with z −axis medium is uniaxial having $n_x = 1.5442, n_y = 1.5442$ and $n_z = 1.5533$. The two RI's seen b wave for polarization parallel and polarization perpendicular to xz − plane are respectively

(A) $n_1 = 1.5442$ *and* $n_2 \approx 1.5465$

(B) $n_1 = 1.5416$ *and* $n_2 \approx 1.5513$

(C) $n_1 = 1.5465$ *and* $n_2 \approx 1.5533$

(D) $n_1 = 1.5533$ *and* $n_2 \approx 1.5443$

No, the answer is incorrect.
Score: 0

Accepted Answers:

(A) $n_1 = 1.5442$ *and* $n_2 \approx 1.5465$

7) 1 point

The equation of an index ellipsoid is given by $Ax^2 + By^2 + Cz^2 + Dyz = 1$. It has across-term i
Thus, to transform the ellipsoid to principal axes system, a rotation of the coordinate axes about
required. What is the angle of rotation?

(A) $\pi/4$

(B) $\frac{\pi}{4} + \frac{1}{2}\cot^{-1}\frac{B+C}{D}$

(C) $\frac{\pi}{4} - \frac{1}{2}\cot^{-1}\frac{D}{B+C}$

(D) $\frac{1}{2}\tan^{-1}\frac{D}{B-C}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
(D) $\frac{1}{2}\tan^{-1}\frac{D}{B-C}$

8) 1 point

The equation of an index ellipsoid for a medium at some wavelength is given by:

$\frac{x^2}{2.28} + \frac{y^2}{2.25} + \frac{z^2}{2.19} + 0.0211yz = 1.$

To transform to principal axes system, the ellipsoid axes requires a rotation about x. The angle
rotation in this case is approximately (in **radian**)

(A) 0.5237

(B) 0.7853

(C) 1.0471

(D) 0.3925

No, the answer is incorrect.
Score: 0

Accepted Answers:
(A) *0.5237*

9) 1 point

The permittivity tensor of the above medium (question no.**8**) is given by:

$$\begin{pmatrix} 2.28 & 0 & 0 \\ 0 & 2.25 & -0.05196 \\ 0 & -0.05196 & 2.19 \end{pmatrix}$$

Then he principal RI's of the medium are (you may use rotation of coordinate axes or matrix diagonalisation)

(A) $n_x = \sqrt{2.28}, n_y = \sqrt{2.28}, n_z = \sqrt{2.16}$

(B) $n_x = \sqrt{2.01}, n_y = \sqrt{2.81}, n_z = \sqrt{1.19}$

(C) $n_x = \sqrt{2.11}, n_y = \sqrt{2.01}, n_z = \sqrt{2.19}$

(D) $n_x = \sqrt{2.08}, n_y = \sqrt{2.19}, n_z = \sqrt{1.61}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
(A) $n_x = \sqrt{2.28}, n_y = \sqrt{2.28}, n_z = \sqrt{2.16}$

10)In a uniaxial crystal, one sees double refraction or two images of a point object. This happens due to splitting of an incident wave into an ordinary wave and an extraordinary wave, i.e., o-wave and e-wave. In this context, what is true about the o-wave and e-wave? ***1 point***

- (A) both follow Snell's law
- (B) only o-ray follows Snell's law
- (C) e-ray in positive crystal follows Snell's law
- (D) e-ray in negative crystal follows Snell's law

No, the answer is incorrect.
Score: 0

Accepted Answers:
(B) only o-ray follows Snell's law

11) ***1 point***

Plane polarized light is incident on a piece of quartz crystal cut parallel to its axis. Find out tl thickness for which the **o**-wave and **e**-wave combine to form a plane polarized light. Given $n_o = 1.5442$ and $n_e = 1.5533$ for $\lambda = 0.5 \times 10^{-6}\, meter$.

- (A) 2.7 μm
- (B) 27.5 μm
- (C) 7.52 μm
- (D) 75.2 μm

No, the answer is incorrect.
Score: 0

Accepted Answers:
(B) 27.5 μm

12) ***1 point***

A plane electromagnetic wave is propagating in the xz −plane in a uniaxial crystal with $n_x = n_y$ n_z . the direction of propagation of the wave, $\hat{k}$ makes an angle of $\pi/4$ with the x-axis and is polarized along y. Then which of the following is/are true about the directions of $\vec{E}, \vec{H}, \vec{D}, \vec{k}, \vec{S}$?

- (A) $\vec{k}$ *is inclined at* 45^0 *with the direction of* $\vec{S}$
- (B) $\vec{D}$ *and* $\vec{E}$ *are parallel to each other*
- (C) $\vec{D}$ *makes an angle of* 45^0 *with the direction of* $\vec{E}$
- (D) $\vec{k}$ *and* $\vec{H}$ *are at right angles to each other*

No, the answer is incorrect.
Score: 0

Accepted Answers:
(A) $\vec{k}$ *is inclined at* 45^0 *with the direction of* $\vec{S}$
(C) $\vec{D}$ *makes an angle of* 45^0 *with the direction of* $\vec{E}$
(D) $\vec{k}$ *and* $\vec{H}$ *are at right angles to each other*

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