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NPTEL

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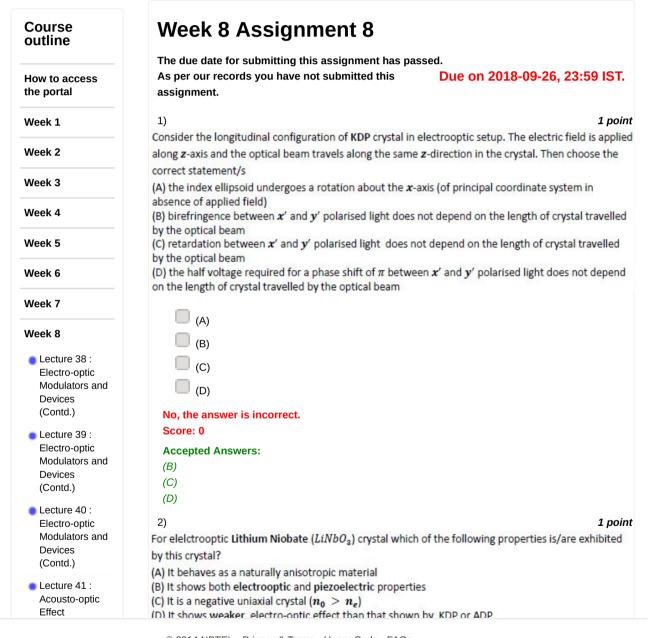**Courses** » **Modern Optics**   Announcements   **Course**   Ask a Question   Progress   Mentor   FAQ

Unit 9 - Week 8

Course outline

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● Lecture 38 : Electro-optic Modulators and Devices (Contd.)

● Lecture 39 : Electro-optic Modulators and Devices (Contd.)

● Lecture 40 : Electro-optic Modulators and Devices (Contd.)

● Lecture 41 : Acousto-optic Effect

Week 8 Assignment 8

The due date for submitting this assignment has passed.
As per our records you have not submitted this **Due on 2018-09-26, 23:59 IST.**
assignment.

1)   *1 point*

Consider the longitudinal configuration of **KDP** crystal in electrooptic setup. The electric field is applied along z-axis and the optical beam travels along the same z-direction in the crystal. Then choose the correct statement/s

(A) the index ellipsoid undergoes a rotation about the x-axis (of principal coordinate system in absence of applied field)
(B) birefringence between x' and y' polarised light does not depend on the length of crystal travelled by the optical beam
(C) retardation between x' and y' polarised light does not depend on the length of crystal travelled by the optical beam
(D) the half voltage required for a phase shift of π between x' and y' polarised light does not depend on the length of crystal travelled by the optical beam

☐ (A)

☐ (B)

☐ (C)

☐ (D)

No, the answer is incorrect.
Score: 0

Accepted Answers:
(B)
(C)
(D)

2)   *1 point*

For elelctrooptic **Lithium Niobate** ($LiNbO_3$) crystal which of the following properties is/are exhibited by this crystal?

(A) It behaves as a naturally anisotropic material
(B) It shows both **electrooptic** and **piezoelectric** properties
(C) It is a negative uniaxial crystal ($n_0 > n_e$)
(D) It shows weaker electro-optic effect than that shown by KDP or ADP

○ Feedback for
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Assignment Solution

No, the answer is incorrect.
Score: 0

Accepted Answers:
(A)
(B)
(C)

3)   *1 point*

An electric field is applied along the **z**-axis (crystal's principal axes) of a **Lithium Niobate** ($LiNbO_3$). By the electric field so applied, the index ellipsoid is influenced. Then about the old and new index ellipsoids which of the following is/are true?

(A) the index ellipsoid representing the principal RI's of the crystal does not rotate
(B) the new index ellipsoid equation in presence of electric field does not contain any cross-term
(C) the half-lengths of axes of the new index ellipsoid are all equal
(D) the index ellipsoid corresponding to the crystal undergoes a rotation about **z**-axis

☐ (A)

☐ (B)

☐ (C)

☐ (D)

No, the answer is incorrect.
Score: 0

Accepted Answers:
(A)
(B)

4)   *1 point*

Consider the **longitudinal configuration** of a **Lithium Niobate** ($LiNbO_3$) crystal. A light beam is propagating along the **z**-direction and an electric field is applied also along the **z**-axis of the crystal. In this orientation of the elelctrooptic setup

(A) the phase change of x' polarised light and phase change of y' polarised light at the exit of the crystal will be the same
(B) light of any polarisation (x' or y' or **both**) will undergo a phase modulation
(C) no **amplitude modulation** is possible
(D) for light polarised in xy-plane with 45^0 with y axis, electric field induced birefringence is zero

☐ (A)

☐ (B)

☐ (C)

☐ (D)

No, the answer is incorrect.
Score: 0

Accepted Answers:
(A)
(B)
(C)
(D)

5)   *1 point*

Consider **transverse configuration** of $LiNbO_3$. Electric field is along **z**-direction. Light beam is propagating along **y**-axis or the light beam is propagating along **x**-axis. Note that the old and new x and y axes are the same. Then
(A) the RI's seen by the x- and z-polarised light in **absence** of applied field are different
(B) the new RI's seen by the x- and z polarised light in presence of applied field are the same
(C) phase difference between the x- and z-polarised light in presence of electric field is zero
(D) the phase difference between the x- and z-polarised light in **absence** of electric field is **non-zero**

☐ (A)

☐ (B)

☐ (C)

☐ (D)

No, the answer is incorrect.
Score: 0

Accepted Answers:
(A)
(D)

6)   *1 point*

To use $LiNbO_3$ crystal as an amplitude modulator in the **transverse configuration,** an electric field is applied along z-direction and the light beam propagates along y-direction. The input polarisation makes $45°$ with x-axis. Then
(A) there is an intrinsic birefringence between the x- and z-polarised light in **absence** of applied field
(B) in this configuration, the modulator setup requires an optical bias or a voltage bias to operate at linear region
(C) phase difference between the x- and z-polarised light in presence of electric field is zero
(D) the field induced retardation leads to a half voltage V_π that is proportional to width of the crystal across which the voltage is applied

☐ (A)

☐ (B)

☐ (C)

☐ (D)

No, the answer is incorrect.
Score: 0

Accepted Answers:
(A)
(B)
(D)

7)   *1 point*

Electrooptic (EO) modulators find wide range of uses in optical communications, signal processing a many areas of optics and photonics. Which of the following function/s is/are **not** performed by electrooptic modulator?
(A) EO modulator is used to **amplify light signal** in a communication system
(B) EO modulator is used to **control the coupling** ratio between the two parallel waveguide of a directional coupler
(C) EO modulator is used to **modulate light intensity** at different spatial position by a given factor
(D) EO modulator is used to electrically control the birefringence and retardation as a **dynamic wave retarder**

○ (A)

○ (B)

○ (C)

○ (D)

No, the answer is incorrect.
Score: 0

Accepted Answers:
(A)

8)   *1 point*

Acousto-optic effect is the changes in optical properties of the medium caused by the elastic deformation produced by an acoustic wave in the medium. Which one of the following is/are **correct** about this deformation? elastic deformation
(A) by an acoustic wave in the medium produces strain that is **periodic in time**
(B) by an acoustic wave in the medium generates a periodic RI grating in the medium
(C) by a travelling acoustic wave in the medium forms a *stationary* grating
(D) by a standing acoustic wave in the medium forms a *travelling* grating

☐ (A)

☐ (B)

☐ (C)

☐ (D)

No, the answer is incorrect.
Score: 0

Accepted Answers:
(A)
(B)

9) Any elastic deformation and corresponding **mechanical strain**   **1 point**
    (A) modifies the optical properties (RI's) of a medium
    (B) modifies RI's regardless of whether a medium is isotropic or an anisotropic
    (C) in an isotropic medium, modifies the RI's uniformly along all directions
    (D) an isotropic medium may become anisotropic

☐ (A)

☐ (B)

☐ (C)

☐ (D)

No, the answer is incorrect.
Score: 0

Accepted Answers:
(A)
(B)
(D)

10)   **1 point**
For any given direction of propagation of an acoustic wave in a medium, there are three orthogonal normal modes of polarization. Regarding the modes of acoustic wave propagation in a medium in general, which of the following is/are true?
(A) In an isotropic medium two transverse modes of acoustic waves are degenerate that travels with same velocity
(B) In anisotropic crystal all three modes are in general degenerate
(C) In isotropic medium the two transverse modes are degenerate with the longitudinal mode
(D) For both isotropic and anisotropic media, acoustic wave in general generates two purely transverse modes and one purely longitudinal mode

☐ (A)

☐ (B)

☐ (C)

☐ (D)

No, the answer is incorrect.
Score: 0

Accepted Answers:
(A)
(D)

11)   *1 point*

An elastic deformation in a medium is described by a strain tensor and a rotation tensor both are represented by 3 × 3 matrices.
(A) The strain tensor is a symmetric one
(B) The rotation tensor is an antisymmetric one
(C) Diagonal elements of strain tensor corresponds to shear strain
(D) Off-diagonal elements of strain tensor corresponds to tensile strain

☐ (A)

☐ (B)

☐ (C)

☐ (D)

No, the answer is incorrect.
Score: 0

Accepted Answers:
(A)
(B)

12)   *1 point*

The acoustic wave in an isotropic medium corresponds to elastic deformation and mechanical strain in the medium. Choose the **correct** statement from the following.
(A) Shear strain corresponds to change in the displacement in the same direction as that of force
(B) Shear strain is caused by transverse acoustic wave
(C) Tensile strain corresponds to change in the displacement in a direction perpendicular to that of force
(D) Tensile strain is caused by longitudinal acoustic wave

☐ (A)

☐ (B)

☐ (C)

☐ (D)

No, the answer is incorrect.
Score: 0

Accepted Answers:
(B)
(D)

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