Unit 8 - Week 7

Week 7 Assignment 7

The due date for submitting this assignment has passed. **Due on 2018-09-19, 23:59 IST.**
As per our records you have not submitted this assignment.

1) *1 point*

MULTIPLE correct option type (Q.1 – Q.2)

Which of the following is/are not true about KDP, KD*P, ADP (Crystal class 42m)

(A) Crystals possess one 4 - fold axis of symmetry, a rotation of the crystal about this axis axis) by $\frac{2\pi}{4}$ leaves it invariant

(B) Crystals possess 2 mutually orthogonal axes of symmetry (x, y) crystals exhibit invariance rotation of π

(C) In absence of field crystals are naturally isotropic

(D) In presence of the field crystals become anisotropic

- [ ] (A)
- [ ] (B)
- [ ] (C)
- [ ] (D)

No, the answer is incorrect.
Score: 0

Accepted Answers:
(C)

2) *1 point*

KDP (KH_2PO_4) is an important and widely used electrooptic crystal for light modulators. Which following is/are true about this crystal?

(A) It has only 6 non-zero electro-optic tensor elements

(B) In presence of an applied electric field the crystals becomes biaxial

(C) Crystal structure is cubic

(D) Optical transmission range is 200-1500nm

- [ ] (A)
- [ ] (B)
- [ ] (C)
- [ ] (D)

No, the answer is incorrect.
Score: 0

Accepted Answers:
(B)
(D)

3) *1 point*

Read the following paragraph and answer the following questions (Q.3 - Q.9).

MULTIPLE correct option type.

Consider **longitudinal configuration of KDP crystal** under an applied electric field E. The lengt crystal travelled by light is l, the relevant EO coefficient of **KDP** is r_{63}.

For above configuration of **KDP crystal**, what happens to RI's, birefringence and phase change **presence of applied E-field**?

(A) The new RI's become $n_{x'} = n_0 - \frac{n_0^3}{2} r_{63} E$ and $n_{z'} = n_e + \frac{n_0^3}{2} r_{63} E$

(B) Induced birefringence between x' and y' polarised light becomes $\Delta n_{x'y'} = \frac{1}{2} n_0^3 \, r_{63} \, E$

(C) Induced phase change between x' and y' polarised light becomes $\Delta \phi_{x'y'} = k_0 l \, n_0^3 \, r_{63} \, E$

(D) For equal excitation of x' and y' polarised input light, this configuration can be used as ar modulator

- [ ] (A)
- [ ] (B)
- [ ] (C)
- [ ] (D)

No, the answer is incorrect.
Score: 0

Accepted Answers:
(C)
(D)

4) *1 point*

For setting up amplitude modulation using this longitudinal configuration of **KDP crystal** whicl following is/are the key requirement/s?

(A) a linearly polarised light will be propagating through the crystal along the z-direction

(B) the input light will be polarised along x-axis or along y-axis (principal axes in absence of f

(C) the emergent light from crystal must pass through a crossed (w.r.t. input) polariser (analys

(D) a voltage of $V = \frac{\lambda}{2 n_0^3 \, r_{63}}$ has to be applied to make the output intensity of modulated optic **a minimum.**

- [ ] (A)
- [ ] (B)
- [ ] (C)
- [ ] (D)

No, the answer is incorrect.
Score: 0

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

5) *1 point*

Which of the following about the input light is/are the correct requirement/s so as to achieve **modulation**?

(A) a linearly polarised light will be propagating through the crystal along the z-direction

(B) the input light will be polarised making an angle of 45^0 with x-axis (old coordinate syste without electric field)

(C) the input light will be polarised along new x'-axis (in presence of electric field)

(D) the input light will be polarised along y-axis (old coordinate system without electric field)

- [ ] (A)
- [ ] (B)
- [ ] (C)
- [ ] (D)

No, the answer is incorrect.
Score: 0

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

6) *1 point*

In case of **phase modulation** of an optical beam using the above configuration of **KDP crystal**, one/ones is/are **not correct**?

(A) For a given applied voltage, the phase change of the optical beam is proportional to the le crystal travelled by optical beam
(B) For a given travel-length of light beam in the crystal, the phase change suffered by the out is linearly proportional to the **voltage** applied across the crystal
(C) The input light should be x' or y' polarized (i.e., along one of the new principal axes)
(D) The input light is $\boldsymbol{x}$ or $\boldsymbol{y}$ polarized (principal axes **without voltage**), *i.e.*, the polarization of light makes $\mathbf{45^0}$ with $\boldsymbol{x'}$ or $\boldsymbol{y'}$ (principal axes **in presence of applied voltage**)

- [ ] (A)
- [ ] (B)
- [ ] (C)
- [ ] (D)

No, the answer is incorrect.
Score: 0

Accepted Answers:
(A)
(D)

7) *1 point*

For **KDP crystal** in the longitudinal configuration having equal excitation of $\boldsymbol{x'}$ and $\boldsymbol{y'}$ polarise light, the modulator half voltage $\boldsymbol{V_\pi}$

(A) does not depend on the **length** of the crystal travelled by optical beam
(B) does not depends on the **transverse width** of the crystal modulator
(C) corresponds to a phase change of $\boldsymbol{\pi/2}$
(D) is such that the **KDP crystal** behaves as a $\boldsymbol{\lambda/4}$ wave plate

- ( ) (A)
- ( ) (B)
- ( ) (C)
- ( ) (D)

No, the answer is incorrect.
Score: 0

Accepted Answers:
(B)

8) *1 point*

If a sinusoidal modulating voltage $\boldsymbol{V = V_0 \sin \omega_m t}$ is applied to the **KDP crystal** in this configu for **phase modulation**, then the output light

(A) varies sinusoidally with peak value $\boldsymbol{p}$ that is proportional to the peak value of applied volt
(B) consists of light at fundamental frequency $\boldsymbol{\omega}$ with amplitude $\boldsymbol{J_0(p)}$
(C) has a phase modulation index that is independent of applied peak voltage $\boldsymbol{V_0}$
(D) contains various side-bands at frequencies $\boldsymbol{\omega \pm \omega_m, \omega \pm 2\omega_m}$ ... with respective amplitu $\boldsymbol{J_1(p), J_2(p), J_3(p)}$ ....

- [ ] (A)
- [ ] (B)
- [ ] (C)
- [ ] (D)

No, the answer is incorrect.
Score: 0

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

9) *1 point*

Assume typical values for KDP crystal: $r_{63} = 10.5 \times 10^{-12}\ m/V$, $n_0 = 1.512$. In the longi configuration , an optical beam at operating wavelength $\lambda = 0.5\ \mu m$ and polarized along y-d travels a length $l = 1\ cm$ of the crystal under an applied voltage of $V = 10\ \text{kV}$

(A) The induced birefringence between x' and y' polarised light $\approx 2 \times 10^{-5}$

(B) Between x' and y' polarised light a phase change $\approx 0.8\pi$ is developed

(C) At applied voltage $\approx 8.3\ \text{kV}$, the KDP crystal under this condition for light of $\lambda = 0.6\ \mu m$ as a quarter-wave plate

(D) under exactly same configuration, if the crystal is replaced by KD*P (KD_2PO_4) with $r_{63} = 2$ $10^{-12}\ m/V$ for light of $\lambda = 0.6\ \mu m$, the required half voltage is $\approx 4.3\ \text{kV}$

- [ ] (A)
- [ ] (B)
- [ ] (C)
- [ ] (D)

No, the answer is incorrect.
Score: 0

Accepted Answers:
(A)
(B)

10) *1 point*

Read the following paragraph and answer the following questions (Q. 10 - Q. 12).

MULTIPLE correct option type.

Consider **transverse configuration of KDP crystal.** Under an applied electric field E **applied al** light beam propagates along y'-axis (principal axis in **presence** of field). The length of the crys travelled by light is l, and the width of crystal is d across which the voltage is applied; the rele coefficient of **KDP** is r_{63}. Also n_0 is the RI of polarisation parallel to xy plane (ordinary RI's).

Which of the following correspond/s to an amplitude modulation setup using this transverse configuration of **KDP crystal**?

(A) Incident light should be polarised at 45^0 to x' in $x'z$ plane

(B) The emergent light from crystal must pass through an analyser which will be at crossed po w.r.t. the input polariser.

(C) the net birefringence between the x'**and** z polarized light at the output of the crystal will $\frac{1}{2} n_0^3\, r_{63}\, E$

(D) The principal RI of the z-polarised light (in presence of electric field) should be electric fiel dependent

- [ ] (A)
- [ ] (B)
- [ ] (C)
- [ ] (D)

No, the answer is incorrect.
Score: 0

Accepted Answers:
(A)
(B)

11) *1 point*

In the above transverse configuration of **KDP crystal** as an amplitude modulator of light

(A) in absence of applied electric field, the two components along x' (x) and z travelling thro crystal will see RI's: $n_{x'} = n_o$ and $n_z = n_e$

(B) in presence of applied electric field, the two components along x' and z travelling through crystal will see RI's : $n_{x'} = n_o$ and $n_{z'} = n_e - \frac{n_0^3}{2} r_{63} E$

(C) even in absence of any applied electric field, there is always a phase delay between the x' polarized light

(D) the modulator under this configuration operates in the linear region

- [ ] (A)
- [ ] (B)
- [ ] (C)

(D)

No, the answer is incorrect.
Score: 0

Accepted Answers:
(A)
(C)

12) *1 point*

In amplitude modulation setup using this transverse configuration of **KDP crystal**
(A) the half-voltage is inversely proportional to width d of the crystal
(B) for high performance of the transverse modulator, d should be linearly proportional to l
(C) the half-voltage for transverse modulator is much greater than that for longitudinal modul
(D) a voltage of $V = \frac{\lambda}{n_0^3 r_{63}}(d/l)$ is needed to make the output intensity of modulated optical **maximum**

(A)
(B)
(C)
(D)

No, the answer is incorrect.
Score: 0

Accepted Answers:
(D)

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