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Courses » Introduction to Non-linear Optics and its Applications

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Unit 6 - Week 4

Course outline

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- Lecture 16 : Nonlinear Maxwell's equation
- Lecture 17 : Theory of SHG
- Lecture 18 : Phase matching
- Lecture 19 : Phase matching of SHG, Gain band width calculation
- Lecture 20 : Manley-Rowe Relation, Energy conservation in SHG,

Week 4 Assignment

The due date for submitting this assignment has passed.

As per our records you have not submitted this assignment. **Due on 2018-09-05, 23:59 IST.**

1) 2 points

A certain crystal has an index of refraction of approximately 1.2 and $\chi^{(2)}$ is equal to 6 pm/V . A different material is discovered to have refractive index of 1.8. Use Miller's rule to estimate $\chi^{(2)}$ in the new material

(a) 0.79 nm/V (b) 0.79 pm/V (c) 0.50 nm/V (d) 0.50 pm/V

- (a)
- (b)
- (c)
- (d)

No, the answer is incorrect.

Score: 0

Accepted Answers:

(a)

2) 2 points

$\chi^{(2)}$ is measured for frequency doubling 1.064 to $0.532 \mu\text{m}$ to be 1.2 pm/V . The index of refraction changes from 1.654 to 1.672 . Use Miller's rule to estimate $\chi^{(2)}$ for SHG of 1.6 to $0.8 \mu\text{m}$. The index of refraction for this interaction is 1.646 for both the wavelengths.

(a) 1.5 pm/V (b) 0.7 pm/V (c) 1.07 pm/V (d) 1.7 pm/V

- (a)
- (b)

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(c)

3) 2 points

$\chi^{(2)}$ is measured for frequency doubling 1.064 to $0.532 \mu\text{m}$ to be 1.2 pm/V . The index of refraction changes from 1.654 to 1.672 . Use Miller's rule to estimate $\chi^{(2)}$ for SHG of 1.6 to $0.8 \mu\text{m}$. The index of refraction for this interaction changes from 1.646 to 1.681

(a) 1.5 pm/V (b) 0.7 pm/V (c) 1.07 pm/V (d) 1.14 pm/V

(a)

(b)

(c)

(d)

No, the answer is incorrect.
Score: 0

Accepted Answers:
 (d)

4) 2 points

A certain crystal has an index of refraction of approximately 1.6 and $\chi^{(2)}$ is equal to 4.4 pm/V . What will be the effective refractive index of the material if a DC electric field of $5 \times 10^{11} \text{ V/m}$ is applied.

(a) 1.52 (b) 2.63 (c) 1.77 (d) 1.65

(a)

(b)

(c)

(d)

No, the answer is incorrect.
Score: 0

Accepted Answers:
 (b)

5) 2 points

What will be the percentage change in the refractive index for Q4?

(a) 39% (b) 50% (c) 64% (d) 75%

(a)

(b)

(c)

(d)

No, the answer is incorrect.
Score: 0

Accepted Answers:
 (c)

6) 2 points

A phase-matching configuration is possible in beta-barium borate (BBO) in which two separate non-collinear beams at λ_1 generate a second harmonic beam at λ_2 . If the effective refractive indices at the two wavelengths are n_1 and n_2 , respectively, the angle between the two fundamental beams is

- (a) $\cos^{-1} \left\{ \frac{1}{2} \left(\frac{n_2 \lambda_1}{n_1 \lambda_2} \right)^2 + 1 \right\}$ (b) $\cos^{-1} \left\{ \frac{1}{2} \left(\frac{n_2 \lambda_1}{n_1 \lambda_2} \right)^2 - 1 \right\}$
 (c) $\cos^{-1} \left\{ \frac{1}{2} \left(\frac{n_1 \lambda_1}{n_2 \lambda_2} \right)^2 - 1 \right\}$ (d) $\cos^{-1} \left\{ \frac{1}{2} \left(\frac{n_1 \lambda_1}{n_2 \lambda_2} \right)^2 + 1 \right\}$

- (a)
 (b)
 (c)
 (d)

No, the answer is incorrect.

Score: 0

Accepted Answers:

(b)

7)

2 points

A phase-matching configuration is possible in beta-barium borate (BBO) in which two separate non-collinear beams at $1.064 \mu\text{m}$ generate a second harmonic beam at $0.532 \mu\text{m}$. If the effective refractive indices at the two wavelengths are 1.65500 and 1.55490 , respectively, the angle between the two fundamental beams is

- (a) 20.03° (b) 40.06° (c) 30.1° (d) 0°

- (a)
 (b)
 (c)
 (d)

No, the answer is incorrect.

Score: 0

Accepted Answers:

(b)

8)

2 points

For Q7, find the angle between the fundamental beam and the SHG beam.

- (a) 20.03° (b) 40.06° (c) 30.1° (d) 0°

- (a)
 (b)
 (c)
 (d)

No, the answer is incorrect.

Score: 0

Accepted Answers:

(a)

9)

2 points

Consider second harmonic generation in lithium niobate for a fundamental field whose (vacuum) wavelength is $1.064 \mu\text{m}$. If the effective refractive indices are 2.2339 and 2.2294 for the fundamental and second harmonic fields, respectively, find the coherence length.

- (a) $29.55 \mu\text{m}$ (b) $108.22 \mu\text{m}$ (c) $20.51 \mu\text{m}$ (d) $59.11 \mu\text{m}$

- (a)
 (b)
 (c)
 (d)

No, the answer is incorrect.

Score: 0

Accepted Answers:

(d)

10)

2 points

The refractive index change $\sqrt{1 + \chi^{(1)}}$ to $\sqrt{1 + \chi^{(1)} + 2\chi^{(2)}E_{DC}}$ is $\Delta n \cong$

- (a) $\chi^{(1)}E_{DC}/n$ (b) $\chi^{(1)}E_{DC}$ (c) $\chi^{(2)}E_{DC}/n$ (d) $\chi^{(2)}E_{DC}$

- (a)
 (b)
 (c)
 (d)

No, the answer is incorrect.

Score: 0

Accepted Answers:

(c)

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