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NPTEL

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Courses » Introduction to Non-linear Optics and its Applications

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## Unit 12 - Week 10

## Course outline

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- Lecture 46 : Third Harmonic Generation (Cont.)

- Lecture 47 : Third Harmonic Generation (Cont.), Cross Phase Modulation (XPM)

- Lecture 48 : Cross Phase Modulation (Cont.), Nonlinear Absorption

- Lecture 49 : Four Wave Mixing

- Lecture 50 : Four Wave mixing (Cont)

- Feedback for Week 10

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## Assignment 10

The due date for submitting this assignment has passed.  
As per our records you have not submitted this assignment.

Due on 2018-10-10, 23:59 IST.

0 points

1)

The nonlinear phase change in a Kerr medium of cross section  $100 \mu\text{m}^2$  length 10 km due to an incident light of wavelength  $1 \mu\text{m}$  and power 1 wa (the Kerr coefficient  $n_2 = 3 \times 10^{20} \text{m}^2/\text{W}$  ; )

(a)  $12\pi$  (b)  $6\pi$  (c)  $2\pi$  (d)  $8\pi$ 

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

No, the answer is incorrect.

Score: 0

Accepted Answers:

(b)

2)

2 points

The nonlinear frequency shift due to self-phase modulation for an optical pulse has a Gaussian temporal profile given by  $I(\tau) = I_0 e^{-\frac{2\tau^2}{t_0^2}}$

(a)  $\frac{4n_2 I_0}{t_0^2} e^{-\frac{2\tau^2}{t_0^2}}$  (b)  $\frac{4n_2 I_0 k_0 z t}{t_0^2}$  (c)  $\frac{4n_2 I_0 k_0 z t}{t_0^2} e^{-\frac{2\tau^2}{t_0^2}}$  (d)  $\frac{2n_2 I_0}{t_0^2}$ 

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

No, the answer is incorrect.

Score: 0

Accepted Answers:

(c)

3)

2 points

Follow the above question (Q.2), the maximum wavelength shift per meter wi (where  $T_0 = 100 \text{fs}$ ,  $I_0 = 1 \text{GW}/\text{cm}^2$ ,  $n_2 = 10^{-16} \text{cm}^2/\text{W}$  and the central wavele of the incident radiation is  $1550 \text{nm}$ .)

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- (c)  
 (d)

No, the answer is incorrect.

Score: 0

Accepted Answers:

(d)

4)

2 points

The nonlinear polarization for Centrosymmetric molecule is  $P_{NL} = \epsilon_0 \chi^{(3)} E^3$ . Consider the electric field as  $E = E_0 \cos(\omega t)$ . The no of frequencies in the output will be

- (a) 1                      (b) 3                      (c) 4                      (d) 2

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

No, the answer is incorrect.

Score: 0

Accepted Answers:

(d)

5)

2 points

The change in refractive index ( $\Delta n$ ) due to cross phase modulation when a laser beam with 1W power falls on a medium of cross-sectional area  $1\text{mm}^2$  ( $n_2 = 10^{-18}\text{m}^2/\text{W}$ )

- (a)  $6 \times 10^{-14}$                       (b)  $16 \times 10^{-12}$                       (c)  $12 \times 10^{-12}$                       (d)  $3 \times 10^{-13}$

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

No, the answer is incorrect.

Score: 0

Accepted Answers:

(c)

6)

2 points

For centrosymmetric material (invariant under inversion) which of the following is correct (Hint: consider the transformation operation corresponding to a  $45^\circ$  rotation about the z-axis)

(a)  $\chi_{xxxx}^{(3)} = \chi_{xxyy}^{(3)} + \chi_{xyyx}^{(3)} + \chi_{xyxy}^{(3)}$

(b)  $\chi_{xxxx}^{(3)} = \chi_{xxyy}^{(3)} + \chi_{xyyx}^{(3)}$

(c)  $\chi_{xxxx}^{(3)} = \chi_{xxyy}^{(3)} + \chi_{xyxy}^{(3)}$

- (a)  
 (b)  
 (c)

No, the answer is incorrect.

Score: 0

Accepted Answers:

(a)

7)

2 points

If  $\chi^{(3)}$  is complex, then the nonlinear absorption coefficient  $\beta$  in terms of imaginary part of  $\chi^{(3)}$  is

(a)  $\frac{3\omega}{2\epsilon_0 n^2 c^2} \text{Im}[\chi^{(3)}]$

(b)  $\frac{3\omega}{4\epsilon_0 n^2 c^2} \text{Im}[\chi^{(3)}]$

(c)  $\frac{3\omega}{\epsilon_0 n^2 c^2} \text{Im}[\chi^{(3)}$

- (a)  
 (b)  
 (c)

No, the answer is incorrect.

Score: 0

Accepted Answers:

(a)

8)

2 points

Following from the Q7 the value of  $\beta$  for silicon at 1550 nm is ( $n = 3.5$ ;  $\text{Im}[\chi^{(3)} = 3 \times 10^{-20} \text{ m}^2/\text{V}^2$ )

(a)  $4.6 \times 10^{-12} \text{ m/W}$

(b)  $6.6 \times 10^{-13} \text{ m/W}$

(c)  $5.6 \times 10^{-12} \text{ m/l}$

- (a)  
 (b)  
 (c)

No, the answer is incorrect.

Score: 0

Accepted Answers:

(c)

9)

2 points

Following from Q 8 if a light of intensity  $I_0 = 5 \text{ GW/cm}^2$  incidents on a medium of length 1 m what will be the intensity at the output

(a)  $1.78 \times 10^{11} \text{ W/m}^2$

(b)  $2.82 \times 10^{10} \text{ W/m}^2$

(c)  $1.78 \times 10^{12} \text{ W/m}^2$

- (a)  
 (b)  
 (c)

No, the answer is incorrect.

Score: 0

Accepted Answers:

(a)

10)

2 points

The self-focussing phenomenon is governed by

(a)  $n_2^I$

(b)  $\beta_{TPA}$

(c)  $n_0$

- (a)  
 (b)  
 (c)

No, the answer is incorrect.

Score: 0

Accepted Answers:

(a)

