

Course outline

How does an NPTEL online course work?

Week 1

Week 2

Atomic Lineshape Function, $g(\nu)$

Amplification by Stimulated Emission

Line Broadening Mechanisms

Line Broadening Mechanisms - 2

Week 2 Feedback Form

Quiz : Assignment 2

Week 3

Week 4

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Week 12

Assignment Solutions

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Assignment 2

The due date for submitting this assignment has passed.

Due on 2021-02-07, 23:59 IST.

As per our records you have not submitted this assignment.

Instructions:

1. Answer all questions; all questions carry equal mark.
2. All symbols have their usual meanings.
3. Only one of the options is correct.
4. Take care of the units in numericals, to match with the units given in the options (of MCQs), and the units in which answers have to be entered (in fill in the blank type of questions).
5. In the fill in the blank type of questions, only the numerical values have to be entered.

NOTE: You can see the correct answers after the last date of submission. Marks obtained in this quiz will be counted towards your final score. You can take the quiz and submit it any number of times, and the latest submitted answers will be taken as your final submission.

1) A low-power beam of monochromatic light passes through a laser medium of length 10 cm. If the optical power of the beam at the output is 4 times the input power, then the small signal gain coefficient of the laser medium is ____ m^{-1} . (Enter the answer up to one decimal place)

No, the answer is incorrect. Score: 0

Accepted Answers: (Type: Range) 13.7,14.0

1 point

2) The absorption cross section of a laser gain medium is more than the emission cross section at a particular wavelength λ_0 . Which one of the following statements regarding the medium is correct?

- Amplification would occur at λ_0 if population inversion is present.
- Amplification may or may not occur at λ_0 if population inversion is present.
- Amplification would not occur at λ_0 regardless of population inversion.

No, the answer is incorrect. Score: 0

Accepted Answers: Amplification may or may not occur at λ_0 if population inversion is present.

1 point

3) An amplifying medium has a small signal gain coefficient γ_0 . When the light intensity increases to I_v , the gain coefficient of the medium reduces to $\gamma_0/4$. The saturation intensity of the medium is

- $I_v / 2$
- $I_v / 3$
- $I_v / 4$
- $I_v / 6$

No, the answer is incorrect. Score: 0

Accepted Answers: $I_v / 3$

1 point

4) Two amplifying mediums P and Q are such that $\gamma_0^P = 2\gamma_0^Q, I_s^P = \frac{I_s^Q}{3}$, where γ_0 is the small signal gain coefficient and I_s is the saturation intensity (the superscripts P and Q correspond to the two mediums). At a particular intensity I_v , both the amplifying mediums have the same value of gain coefficient. The intensity I_v (in terms of the saturation intensity I_s^P) is:

- I_s^P
- $2I_s^P$
- $3I_s^P$
- $4I_s^P$

No, the answer is incorrect. Score: 0

Accepted Answers: $3I_s^P$

1 point

5) The atomic lineshape function due to collision broadening is a

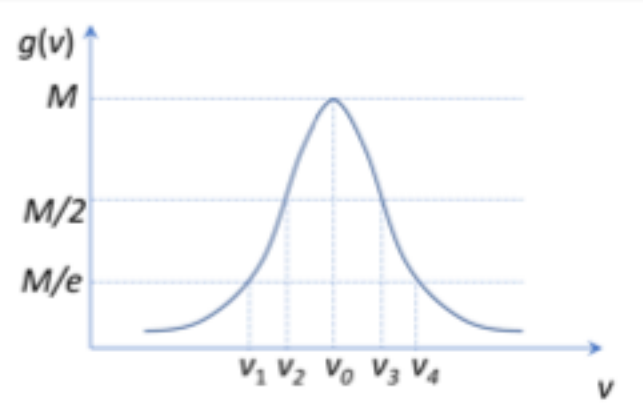
- Gaussian function
- Lorentzian function
- Delta function
- Exponential function

No, the answer is incorrect. Score: 0

Accepted Answers: Lorentzian function

1 point

6) The lineshape function $g(\nu)$ of an atomic system is shown below, where M is the maximum value of the function. The linewidth ($\Delta\nu$) is:



- $(\nu_4 - \nu_1)$
- $(\nu_3 - \nu_0)$
- $(\nu_3 - \nu_2)$
- $(\nu_0 - \nu_1)$

No, the answer is incorrect. Score: 0

Accepted Answers: $(\nu_3 - \nu_2)$

1 point

7) In the above question, if the lineshape function is only due to lifetime broadening, then the linewidth ($\Delta\nu$) in terms of M is:

- M/π
- $2M/\pi$
- $2/\pi M$
- $1/\pi M$

No, the answer is incorrect. Score: 0

Accepted Answers: $2/\pi M$

1 point

8) Consider two different 2-level non-degenerate atomic systems P and Q. It is given that the ratios of the radiative and the non-radiative transition rates (A and S) for the two atomic systems P and Q are 2:1 and 1:2, respectively. If the radiative transition rates for the two systems are the same, then the ratio of the total spontaneous transitions T_P and T_Q for the atomic systems P and Q is

- 1:2
- 2:1
- 1:3
- 3:1

No, the answer is incorrect. Score: 0

Accepted Answers: 1:2

1 point

9) State whether the following statement is TRUE or FALSE:

- TRUE
- FALSE

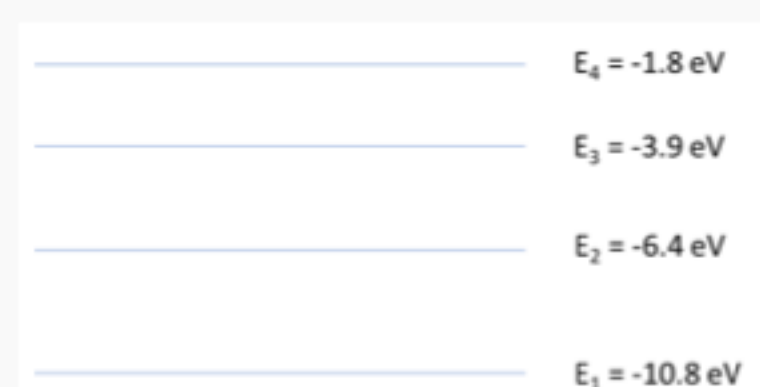
No, the answer is incorrect. Score: 0

Accepted Answers: TRUE

0 points

Doppler broadening is inhomogeneous broadening because different atoms "see" different velocity components of the incoming light, resulting in interaction of light with different frequencies.

10) Radiation from a tungsten-halogen lamp passes through a particular gas at room temperature. The atomic energy levels of the gas is shown below. If the absorption spectrum of the gas is measured, then a maximum of how many dips can be observed in the visible region (400 nm – 700 nm) of the spectrum?



- 1
- 2
- 3
- 4

No, the answer is incorrect. Score: 0

Accepted Answers: 2

1 point