

Unit 10 - Week 7 Lectures

Course outline

How to access the portal

Week- 0

Week 1 Lectures

Week 2 Lectures

Week 3 Lectures

Week 4 Lectures

Week 5 Lectures

Week 6 Lectures

Week 7 Lectures

Light sources, detectors and amplifiers

Basics of lasers-I (Structure of lasers, Process of photon emission)

Basics of lasers-II (Einstein's theory of radiation)

Basics of lasers-III (Population inversion and rate equation for lasers)

Basic properties of semiconductor lasers-I (Energy gap, Intrinsic and Extrinsic semiconductors)

Quiz : Assignment-7

Week-7 Feedback

Assignment-7 Solutions

Week 8 Lectures

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Assignment-7

The due date for submitting this assignment has passed.

Due on 2019-09-18, 23:59 IST.

As per our records you have not submitted this assignment.

1) The phenomenon when an excited electron jumps from an energy state E_2 to an energy state E_1 ($E_2 > E_1$) without any external energy being supplied is called as **1 point**

- Absorption
 Stimulated emission
 Spontaneous emission

No, the answer is incorrect.
 Score: 0

Accepted Answers:
Spontaneous emission

2) If an electron jumps from energy state E_2 to E_1 and spontaneously emits a photon of wavelength 1550 nm, the value of $E_2 - E_1$ is **1 point**

- 0.8 eV
 0.4 eV
 1.2 eV
 Cannot be determined

No, the answer is incorrect.
 Score: 0

Accepted Answers:
0.8 eV

3) Energy density of a blackbody radiation over the frequency range of f to $f + df$ is given by **1 point**

- $\frac{8\pi hf^3 df}{c^3 e^{hf/kT} - 1}$
 $\frac{8\pi hc^3 df}{f^3 e^{hf/kT} - 1}$
 $\frac{8\pi hc^3 df}{f^3 e^{hf/kT} - 1}$
 $\frac{8\pi hf^3 df}{c^3 e^{hf/kT} - 1}$

No, the answer is incorrect.
 Score: 0

Accepted Answers:
 $\frac{8\pi hf^3 df}{c^3 e^{hf/kT} - 1}$

4) In a two-level system, suppose N_1 is the population of electrons occupying energy state E_1 and N_2 is the population of electrons occupying energy state E_2 ($E_2 > E_1$), if the rate of change of N_1 when a photon flux $\phi_p df$ is incident on the system is given by $\frac{dN_1}{dt} = a\phi_p df N_1 + B_{21}\phi_p df b + AN_2$, a and b are (B_{12} , B_{21} and A are Einstein's coefficients of absorption, stimulated emission and spontaneous emission respectively.) **1 point**

- $-B_{12}, N_2$ respectively.
 B_{12}, N_1 respectively.
 $B_{12}, -N_2$ respectively
 $B_{12}, -N_1$ respectively

No, the answer is incorrect.
 Score: 0

Accepted Answers:
 $-B_{12}, N_2$ respectively.

5) In a two-level system, Einstein's coefficients for absorption and stimulated emission are not exactly equal. **1 point**

- True
 False

No, the answer is incorrect.
 Score: 0

Accepted Answers:
False

6) In a two-level system, in steady state, the ratio of coefficient of spontaneous emission (A_{21}) at 80 GHz to A_{21} at 10 GHz is **1 point**

- 8
 64
 1/8
 1/4

No, the answer is incorrect.
 Score: 0

Accepted Answers:
64

7) In a three-level system, if $\tau_{21} = 4 \mu s$, $\tau_{32} = 2 ns$, $\tau_{31} = 2 \mu s$, the critical value of pump rate (A_p) at which population inversion takes place is approximately **1 point**

- $0.5 \mu s^{-1}$
 $1.5 \mu s^{-1}$
 $0.4 \mu s^{-1}$
 $0.25 \mu s^{-1}$

No, the answer is incorrect.
 Score: 0

Accepted Answers:
 $0.25 \mu s^{-1}$

8) For a three-level system given in Question 7, the effective lifetime of photon is **1 point**

- $1.998 \mu s$
 $1.998 ns$
 $0.25 \mu s$
 $0.25 ns$

No, the answer is incorrect.
 Score: 0

Accepted Answers:
1.998 ns

9) In Question 7, if τ_{31} and τ_{32} are interchanged, population inversion cannot be sustained. **1 point**

- True
 False

No, the answer is incorrect.
 Score: 0

Accepted Answers:
True

10) In an n-type semiconductor, the majority charge carriers are **1 point**

- Electrons
 Holes

No, the answer is incorrect.
 Score: 0

Accepted Answers:
Electrons