

# Unit 11 - Week 8 Lectures

## Course outline

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### Week 2 Lectures

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Basic properties of semiconductor lasers-II (Fermi level)

Optical properties of semiconductors-I (Direct bandgap and indirect bandgap, Density of states)

Optical properties of semiconductors-II (Gain, absorption, recombination rate), Homojunction lasers

Double heterostructure lasers, Introduction to Quantum well lasers

Semiconductor optical amplifier

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## Assignment-8

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

**Due on 2019-09-25, 23:59 IST.**

1) In a semiconductor material at  $T = 100\text{ K}$ , assume that the Fermi energy level is  $0.1\text{ eV}$  below the conduction band energy ( $E_c$ ). The probability of a state being occupied by an electron at  $E_c + kT$  is **0 points**

- 0.38 %  
 2.06 %  
 0.77 %  
 1.00 %

**No, the answer is incorrect.**  
Score: 0

**Accepted Answers:**  
*0.77 %*

2) In Question 1, if the band gap of the material is  $0.5\text{ eV}$ , the material is **1 point**

- p-type material  
 n-type material  
 Intrinsic material  
 Cannot be determined.

**No, the answer is incorrect.**  
Score: 0

**Accepted Answers:**  
*n-type material*

3) In a semiconductor material, as the temperature increases **1 point**

- Probability of energy states above Fermi energy level being occupied increases.  
 Probability of energy states above Fermi energy level being occupied decreases.  
 Probability of energy states below Fermi energy level being occupied increases.  
 Probability of energy states above Fermi energy level being occupied remains the same.

**No, the answer is incorrect.**  
Score: 0

**Accepted Answers:**  
*Probability of energy states above Fermi energy level being occupied increases.*

4) It is important to control temperature of semiconductor laser diodes because **1 point**

- As temperature increases, linewidth of the laser decreases.  
 As temperature increases, linewidth of the laser increases.

**No, the answer is incorrect.**  
Score: 0

**Accepted Answers:**  
*As temperature increases, linewidth of the laser increases.*

5) Current supply of  $0.4\text{ A}$  is supplied to a semiconductor slab of dimensions  $100\mu\text{m} \times 50\mu\text{m} \times 4\mu\text{m}$  and a photon lifetime of  $5\text{ ns}$  is observed. The electron density in the semiconductor slab is **1 point**

- $0.625 \times 10^{17}\text{ cm}^{-3}$   
  
 $1.6 \times 10^{18}\text{ cm}^{-3}$   
  
 $0.625 \times 10^{18}\text{ cm}^{-3}$   
  
 $1.6 \times 10^{17}\text{ cm}^{-3}$

**No, the answer is incorrect.**  
Score: 0

**Accepted Answers:**  
 *$0.625 \times 10^{18}\text{ cm}^{-3}$*

6) For a semiconductor slab having dimensions  $100\mu\text{m} \times 10\mu\text{m} \times 1\mu\text{m}$ , if constant of proportionality is  $\beta = 2 \times 10^{-10}\text{ cm}^3/\text{s}$  and population density of electrons and holes is  $5 \times 10^{18}\text{ cm}^{-3}$  each, the current required at steady state to maintain population density is **1 point**

- 0.4 A  
 0.12 A  
 0.6 A  
 0.8 A

**No, the answer is incorrect.**  
Score: 0

**Accepted Answers:**  
*0.8 A*

7) For a certain semiconductor optical amplifier (SOA), the single pass gain is  $5.23$  and  $R = 0.1$ , the maximum gain is **1 point**

- 12.7 dB  
 18.61 dB  
 25.4 dB  
 30 dB

**No, the answer is incorrect.**  
Score: 0

**Accepted Answers:**  
*12.7 dB*

8) For the SOA given is Question 7, the minimum gain is **1 point**

- 1.82 dB  
 5.23 dB  
 2.61 dB  
 1.30 dB

**No, the answer is incorrect.**  
Score: 0

**Accepted Answers:**  
*2.61 dB*

9) For the SOA given in Question 7, the gain ripple is **1 point**

- 16.79 dB  
 10.08 dB  
 20.17 dB  
 28.70 dB

**No, the answer is incorrect.**  
Score: 0

**Accepted Answers:**  
*10.08 dB*

10) The condition on the value of  $R$  for the SOA given in Question 7 is **1 point**

- $R > 0.19$   
  
 $R < 0.19$   
  
 $R$  can have any real value.

**No, the answer is incorrect.**  
Score: 0

**Accepted Answers:**  
 *$R < 0.19$*