ASSIGNMENT-8

The due date for submitting this assignment has passed. Due on 2016-09-13, 23:59 IST.

Submitted assignment

1) A silicon $p-i-n$ photodiode has an intrinsic region with a width of 20 $\mu$m and a diameter of 500 $\mu$m in which the drift velocity of electrons is $10^5$ m/s. When the permittivity of the device material is $10.5 \times 10^{-13}$ F/cm. Then the drift time of the carriers across the depletion region is (in ps)

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: String) 200

2) In the above question, the junction capacitance of the photodiode is

- 1 pF
- 2 pF
- 3 pF
- 4 pF

No, the answer is incorrect.
Score: 0
Accepted Answers:
4 pF

3) A germanium $p-i-n$ photodiode with active dimensions of 100 $\times$ 50 $\mu$m has a quantum efficiency of 55% when operating at a wavelength of 1.3 $\mu$m. The measured dark current at this wavelength is 8 nA, then the noise equivalent power is (It may be assumed that dark current is the dominant noise source)

- $8.78 \times 10^{-14}$ W
- $9.18 \times 10^{-14}$ W
- $13.78 \times 10^{-14}$ W
- $18.78 \times 10^{-14}$ W

No, the answer is incorrect.
Score: 0
4) In the above question, the specific detectivity for the device is \( 3 \) points
   - \( 8.1 \times 10^8 \text{ m (Hz)}^{1/2} \text{W}^{-1} \)
   - \( 9.1 \times 10^8 \text{ m (Hz)}^{1/2} \text{W}^{-1} \)
   - \( 10.1 \times 10^8 \text{ m (Hz)}^{1/2} \text{W}^{-1} \)
   - None of these

   Accepted Answers:
   - \( 8.1 \times 10^8 \text{ m (Hz)}^{1/2} \text{W}^{-1} \)

5) The quantum efficiency of a particular silicon RAPD is 80% for the detection of radiation at a wavelength of 0.9 \( \mu \text{m} \). When the incident optical power is 0.5 \( \mu \text{W} \), the output current from the device (after avalanche gain) is 11 \( \mu \text{A} \). Then the multiplication factor of the photodiode under these conditions (must be in integer form)

   Accepted Answers:
   - 38

6) An analog optical fiber system operating at a wavelength of 1 \( \mu \text{m} \) has a post-detection bandwidth of 5 MHz. Assuming an ideal detector and considering only quantum noise on the signal, then the incident optical power necessary to achieve an SNR of 50 dB at the receiver is (in dBm)

   Accepted Answers:
   - -37

7) A silicon \( p-i-n \) photodiode incorporated into an optical receiver has a quantum efficiency of 60% when operating at a wavelength of 0.9 \( \mu \text{m} \). The dark current in the device at this operating point is 3 nA and the load resistance is 4 k\( \Omega \). The incident optical power at this wavelength is 200 nW and the post-detection bandwidth of the receiver is 5 MHz. Then the root mean square (rms) shot noise current in the photodiode with a temperature of 20 \( ^\circ \text{C} \) is

   Accepted Answers:
   - \( 0.78 \times 10^{-10} \text{ A} \)
   - \( 1.18 \times 10^{-10} \text{ A} \)
   - \( 3.79 \times 10^{-10} \text{ A} \)
   - \( 8.78 \times 10^{-10} \text{ A} \)
8) In the above question, the rms thermal noise current is

- $7.78 \times 10^{-10}$ A
- $4.18 \times 10^{-10}$ A
- $4.49 \times 10^{-9}$ A
- None of these

No, the answer is incorrect.
Score: 0

Accepted Answers:
$4.49 \times 10^{-9}$ A

1 point

9) In an atomic system, the spontaneous lifetime associated with $2 \rightarrow 1$ transition is 2 ns and the energy difference between the levels is $2.4 \times 10^{-19}$ J. Then the Einstein $A$ and $B$ coefficients are respectively (Assume that the velocity of light in the medium is $1.25 \times 10^8$ m/s)

- $4 \times 10^7$ s$^{-1}$ and $6.71 \times 10^{20}$ m$^3$/J. s$^2$
- $5 \times 10^8$ s$^{-1}$ and $7.71 \times 10^{21}$ m$^3$/J. s$^2$
- $5 \times 10^7$ s$^{-1}$ and $7.71 \times 10^{20}$ m$^3$/J. s$^2$
- None of these

No, the answer is incorrect.
Score: 0

Accepted Answers:
$5 \times 10^8$ s$^{-1}$ and $7.71 \times 10^{21}$ m$^3$/J. s$^2$

3 points

10) A Fabry–Perot laser has the following parameters: internal loss coefficient $50$ dB/cm, $R_1 = R_2 = 0.3$, and distance between mirrors $= 500$ μm. Longitudinal mode spacing and the minimum gain required for oscillation are respectively (Assume that the refractive index $n = 3.5$)

- $74.21$ GHz and $81.12$ cm$^{-1}$
- $94.21$ GHz and $41.12$ cm$^{-1}$
- $85.71$ GHz and $33.58$ cm$^{-1}$
- None of these

No, the answer is incorrect.
Score: 0

Accepted Answers:
$85.71$ GHz and $33.58$ cm$^{-1}$