Week 11: Assignment 11

The due date for submitting this assignment has passed.

Due on 2021-10-13, 23:59 IST.

As per our records you have not submitted this assignment.

1) Which of the following mechanism gives higher modulation speed in silicon photonics modulators? *1 point*

- Carrier injection
- Carrier depletion

No, the answer is incorrect.
Score: 0
Accepted Answers:
Carrier depletion

2) The bandwidth of a P-I-N juction based carrier depleted silicon photonics modulator is independent of the applied volatge across the P-I-N junction. *1 point*

- True
- False

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

3) The required drive voltage for complete on-off modulation is more in Microring modulator than Mach-Zehnder Interferometer based modulator. *1 point*

- True
- False

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

4) The required drive voltage to achieve π phase shift is more in case of P-N (carrier depletion) based modulator than P-I-N (carrier injection) based modulator. *1 point*

- True
- False

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

Common data for questions $5-6$**:** For a standard phase modulator shown in Fig.1, when the modulated phase $\phi(t)$ can be given as $\delta \sin(2\pi f_{rf} t)$.

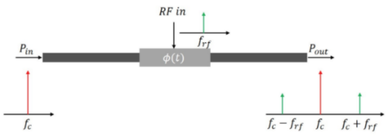

Figure 1: Phase Modulator

5) The phase difference between the modulated sidebands at frequencies $f_c + f_{rf}$ and $f_c - f_{rf}$ with respect to carrier signal f_c is *1 point*

- 0
- $\pi/2$
- arbitrary
- π

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

6) The modulation index δ for which the strength of the modulated signal at carrier frequency f_c and the first sideband $f_c + f_{rf}$ are same is .

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 1.42,1.45

1 point

Common data for questions $7-8$**:** Consider a ring modulator doped with p+ and n+ regions as shown in Fig. 2. Consider λ_r is the resonant wavelength under no bias condition,

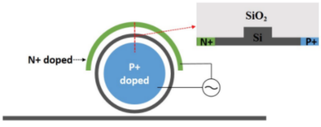

Figure 2: Ring Modulator

7) The resonant wavelength of the ring _____ as the PN diode is operated in forward bias condition. *1 point*

- red-shifted
- blue-shifted
- remains the same
- cannot be determined with given information

No, the answer is incorrect.
Score: 0
Accepted Answers:
blue-shifted

8) The Q-factor of the ring _____ as the PN diode is operated in reverse bias condition. *1 point*

- increases
- decreases
- remains the same
- cannot be determined with given

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

Common data for questions $9-10$**:** Consider a SOI rib waveguides integrated with lateral PIN diode is used for variable optical attenuator (VOA) operating at 1550 nm, as shown in Fig. 3. If the change in carrier concentration of electrons (ΔN_e) and holes (ΔN_h) concentration with the diode current I is given by $\Delta N_e = \Delta N_h = p_1 I$, where $p_1 = 6.313 \times 10^{16}$ [cm^{-3}/mA]. Assume PIN diode is of length 1 mm.

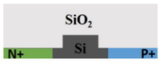

Figure 3: Variable Optical Attenuator

NOTE: Consider Soref-Bennett emprical model to solve the questions ($\Delta N_e, \Delta N_h$) are expressed in cm^{-3} and α in cm^{-1}

Soref-Bennett Emperical Model $(@\ \lambda = 1550\ nm)$

$$\Delta n = \Delta n_e + \Delta n_h = -8.8 \times 10^{-22} \Delta N_e - 8.5 \times 10^{-18} (\Delta N_h)^{0.8}$$

$$\Delta \alpha = \Delta \alpha_e + \Delta \alpha_h = 8.5 \times 10^{-18} \Delta N_e + 6.0 \times 10^{-18} \Delta N_h$$

9) The optical attenuation loss in dB for a diode current of 5 mA is _____

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 1.8,2.2

1 point

10) The current required to have π phase shift is mA _____ .

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 3.2,3.3

1 point