Assignment 11

The due date for submitting this assignment has passed.

Due on 2021-04-07, 23:59 IST.

As per our records you have not submitted this assignment.

1) What is the key advantage of using tunable filter configuration for FBG interrogation? ***1 point***

- Immune to noise
- Highly sensitive
- large spectrum range
- High precision

No, the answer is incorrect.
Score: 0

Accepted Answers:
large spectrum range

2) For a Fabry Perot etalon in which two identical mirrors are separated by a distance of 6 mm and are located in a medium with refractive index 1.5. How many number of modes will be supported by the cavity if the mirror reflectivity spectral width is 166.4 GHz? ***1 point***

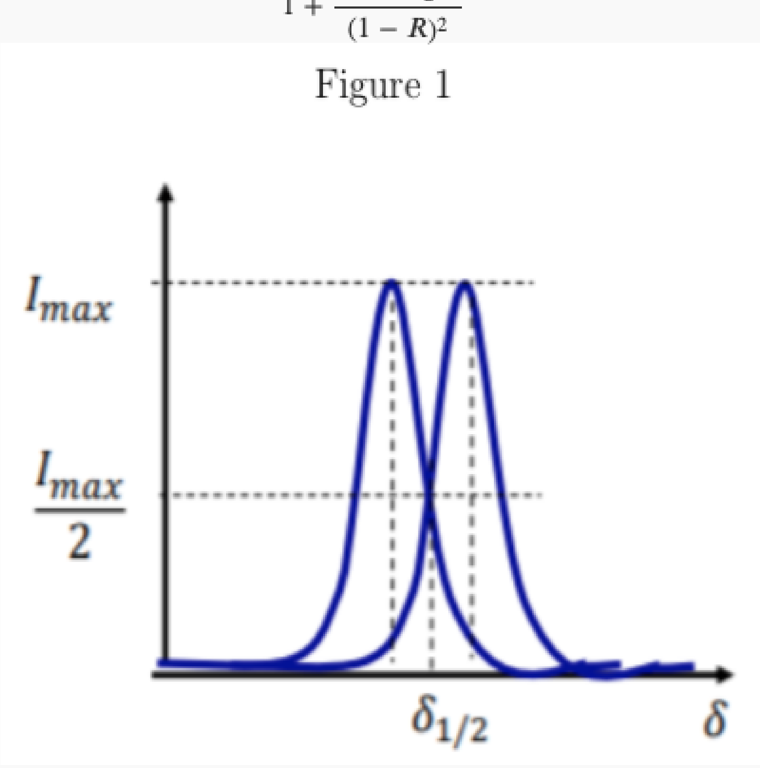
- 2
- 10
- 360
- 450

No, the answer is incorrect.
Score: 0

Accepted Answers:
10

3) The condition for two closely separated wavelengths λ_1 and λ_2 as per figure 1, to be distinguished (resolved) by a Fabry Perot etalon is: ***1 point***
Hint:Intensity distribution of a Fabry Perot etalon is

$$I_t = \frac{I_{max}}{1 + \frac{4R(sin\frac{\delta}{2})^2}{(1-R)^2}}$$



- $\delta = \frac{\sqrt{R}}{1-R}$
- $\delta = \frac{1-R}{\sqrt{R}}$
- $\delta = \frac{R-1}{\sqrt{R}}$
- $\delta = \frac{R}{\sqrt{R-1}}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\delta = \frac{1-R}{\sqrt{R}}$

4) What is the advantage of matched filter FBG over Fabry Perot etalon for interrogation? ***1 point***

- Large spectral range
- Suitable for multiple independent grating sensors
- Highly sensitive detection
- Set up will be free from environmental perturbations

No, the answer is incorrect.
Score: 0

Accepted Answers:
Suitable for multiple independent grating sensors

5) The reflection spectrum of the FBG can be approximated as a Gaussian function described below : ***1 point***

$$R(\lambda) = R_0 exp(-4\ln 2\frac{(\lambda-\lambda_B)^2}{(\Delta\lambda)^2})$$

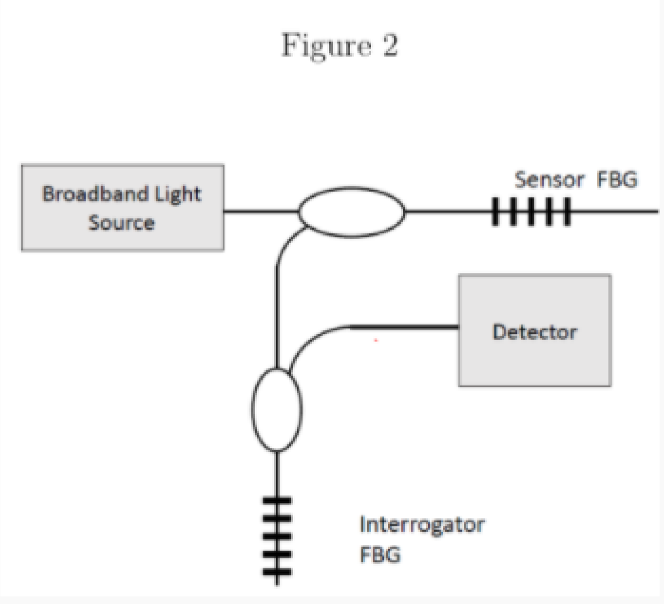
where λ_B is the Bragg wavelength, R_0 is the peak reflectivity at the Bragg wavelength and $\Delta\lambda$ is R.M.S. spectrum width. Assume that the FBGs used in the system have a reflection slope as described above, what would be the wavelength at which we can achieve maximum spectral sensitivity? Hint: Evaluate $\frac{d^2R}{d\lambda^2}$ and equate to 0.

- $\lambda = \lambda_B - \frac{\sqrt{8ln2}}{\Delta\lambda}$
- $\lambda = \lambda_B + \frac{\Delta\lambda}{\sqrt{8ln2}}$
- $\lambda = \lambda_B + \frac{\sqrt{8ln2}}{\Delta\lambda}$
- $\lambda = \lambda_B - \frac{\sqrt{\Delta\lambda}}{8ln2}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\lambda = \lambda_B + \frac{\Delta\lambda}{\sqrt{8ln2}}$

6) As shown in figure 2, a matched filter interrogation scheme consists of a sensor FBG and interrogator FBG with two 3 dB couplers. If the reflectivity is R for both FBGs, what is the output power of the system? Assume that the input power is P_0 ***1 point***



- $\frac{RP_0^2}{16}$
- $\frac{R^2P_0^2}{8}$
- $\frac{RP_0}{16}$
- $\frac{R^2P_0}{16}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{R^2P_0}{16}$

7) The input power from the source is 1 mW. Assume that the FBGs which have Bragg wavelength of 1550.425 nm and reflectivity of 90%.If the strain coefficient of FBG is $1pm/\mu\epsilon$, what are the maximum and minimum power at the detector for the strain of $100\mu\epsilon$ in the system describe in figure 2? ***1 point***

Hint: The reflection spectrum of the FBG $R(\lambda) = R_0 exp\left(-4\,ln2\frac{(\lambda-\lambda_B)^2}{(\Delta\lambda)^2}\right)$

- 30.61mW , 13.32mW
- 30.61μW , 13.32μW
- 90.36mW , 2.67mW
- 90.36μW , 2.67μW

No, the answer is incorrect.
Score: 0

Accepted Answers:
30.61μW , 13.32μW

8) Momentum matching condition for Stimulated Brillowin Scattering(SBS) is written as:Where,$\vec{k}_p$ is the wave vector of pump,$\vec{k}_s$ is the wave vector of signal and $\vec{k}_A$ is the wave vector of acoustic wave. ***1 point***

- $\vec{k}_p = \vec{k}_s - \vec{k}_A$
- $\vec{k}_p - \vec{k}_s = \vec{k}_A$
- $\vec{k}_s - \vec{k}_A = \vec{k}_p$
- $\vec{k}_s = \vec{k}_A - \vec{k}_p$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\vec{k}_p - \vec{k}_s = \vec{k}_A$

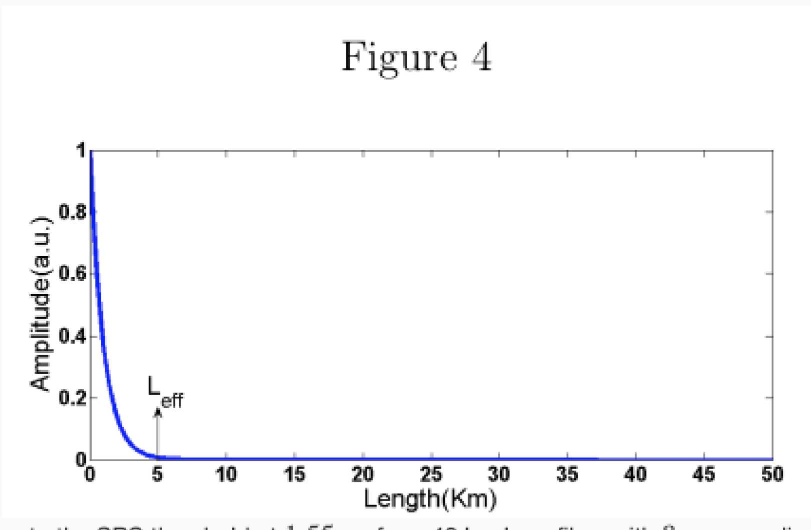
9) Consider a silica glass fiber with GeO_2 concentration of 20 wt% which supports a sound velocity of 5300 m/s and a refractive index of 1.48. Estimate the frequency shift of the scattered wave at a pump wavelength of 1.55 μm for Stimulated Brillowin Scattering(SBS). ***1 point***

- 16.35 MHz
- 2.68 GHz
- 25.63 GHz
- 10.12 GHz

No, the answer is incorrect.
Score: 0

Accepted Answers:
10.12 GHz

10) Brillowin threshold power is expressed as $P_{Th} = 21 \times \frac{A_{eff}}{g_B \times L_{eff}}$ where A_{eff} is the effective area of the fiber, g_B is the Brillouin gain, and L_{eff} is the effective length of the fiber, which may be approximated as $\frac{1}{\alpha}$ as per figure 4 for sufficiently long distance. ***1 point***



Estimate the SBS threshold at $1.55\mu m$ for a 40 km long fiber with $8\mu m$ core diameter. How much does it change at $1.55\mu m$? Use $g_B = 5 \times 10^{-11} m/W$ and loss value 0.2 dB/km at $1.55\mu m$ respectively.

- $125.25\mu W$
- $165.26mW$
- $65.25\mu W$
- $485.51\mu W$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$485.51\mu W$