

Course outline

How does an NPTEL online course work?

Week 0

Week 1

Week 2

Week 3

Week 4

● Noise Mitigation Techniques

○ Lock in detection

● Amplitude modulated sensors-1

● Gas absorption spectroscopy by Dr Anish Bekal

● Optical Fiber Sensors : Week 4 Feedback Form

○ Quiz : Assignment 4

● Assignment 4 solutions

Week 5

Week 6

Week 7

Week 8

Week 9

Week 10

Week 11

Week 12

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Assignment 4

The due date for submitting this assignment has passed.

Due on 2021-02-17, 23:59 IST.

As per our records you have not submitted this assignment.

1) **Statement 1:** Minimum detection limit of a sensor is limited solely by the bit resolution of the optical receiver. **1 point**

Statement 2: Absorption spectroscopy can be used to find the constituents of a star

- Statement 1 is true Statement 2 is true
- Statement 1 is true Statement 2 is false
- Statement 1 is false Statement 2 is false
- Statement 1 is false Statement 2 is true

No, the answer is incorrect.
Score: 0

Accepted Answers:
Statement 1 is false Statement 2 is true

2) The SNR of a single measurement signal is 2. To get a SNR of 20, the number of averages required is _____.

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Range) 90,110

1 point

3) Suppose N is the number of consecutive samples in a run length averaging block. Choosing larger N results in _____ SNR improvement and _____ bandwidth. **1 point**

- Low, High
- High, Low
- Low; Low
- Moderate, high

No, the answer is incorrect.
Score: 0

Accepted Answers:
High, Low

4) Savitsky-Golay filter takes window size and polynomial order as input parameters. The choice of higher order and smaller window size gives _____ SNR improvement and _____ bandwidth. **1 point**

- High, low
- High, high
- Low, low
- Low, high

No, the answer is incorrect.
Score: 0

Accepted Answers:
Low, high

5) Lock-in detection uses the manipulation of _____ to maximize the signal. **1 point**

- Amplitude
- Wavelength
- Polarization
- Phase

No, the answer is incorrect.
Score: 0

Accepted Answers:
Phase

Questions 6 and 7 use the following information

A sinusoidal signal of 10 nV amplitude and 10 kHz is fed into a low-noise amplifier with a gain of 10^3 and input noise of $5nV/\sqrt{Hz}$. Suppose we need to design a filter to achieve SNR of 20.

6) The filter should require _____ Hz bandwidth. [Hint: Round upto 2 decimal values]

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Range) 0.009,0.011

0.5 points

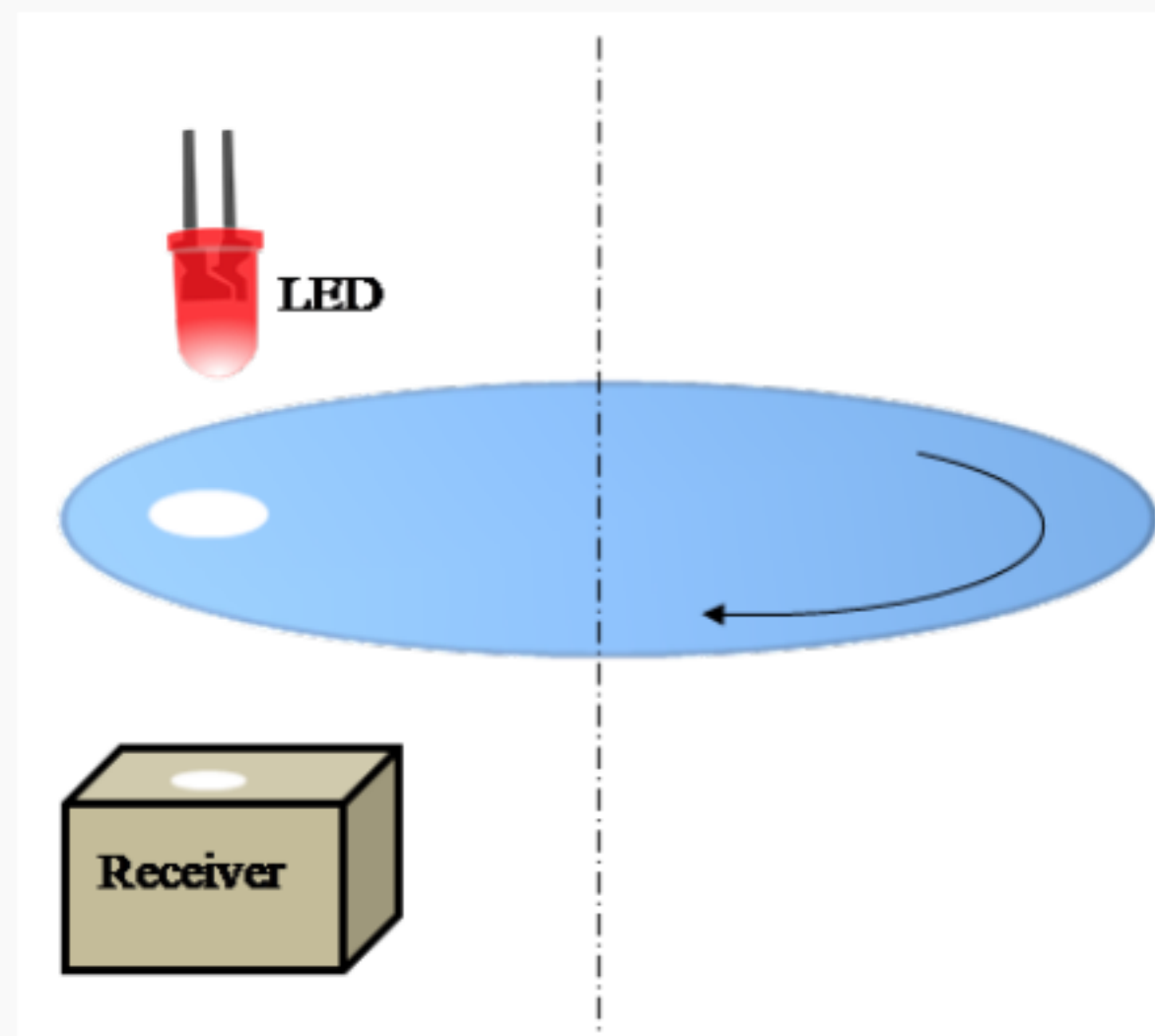
7) Quality factor of the filter should be _____ [Hint: Use scientific notation. For ex: 1e3 is the scientific notation 10^3]

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Range) 0.9e7,1.1e7

0 points

8) You are given the task of finding the speed of a rotating disc using the following setup. The disc contains a hole near the edge which allows light from LED to pass through it towards the receiver unit. Suppose the maximum speed at which the disk rotates is 7200 rpm, what is the expected frequency of the received signal ? **1 point**



- 60 Hz
- 120 Hz
- 240 Hz
- 300 Hz

No, the answer is incorrect.
Score: 0

Accepted Answers:
120 Hz

Questions 9 and 10 use the following information

Design a gesture recognition system for a personal computer to recognize movements with 1 cm resolution over a 1 square meter region at a distance of 1 m. Assume source power of 100 mW at 1550 nm wavelength, scattering coefficient of 0.1 by the human body, and receiver aperture of 10 cm diameter.

9) The number of detector elements required to realize the above specs is _____

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Range) 9000,11000

1 point

10) The spacing between two consecutive elements is _____ cm [Hint: Round upto 2 decimal values]

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Range) 0.09,0.11

1 point

11) Suppose you are given Ethane gas ($\sigma(\lambda_R) = 1 \times 10^{-17} \text{ cm}^2$) in a 2m long gas cell. If we measure $\frac{I(\lambda_R)}{I(\lambda_{NR})}$ using differential absorption spectroscopy, the number density of the gas in the cell is _____

Hint: Use scientific notation. For ex: 10e2 is the scientific notation for 10^2

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Range) 3e14,4e14

0 points