

## Course outline

How does an NPTEL online course work?

Week 0

Week 1

Week 2

Week 3

Week 4

Week 5

● Amplitude modulated sensors-2

● Amplitude modulated sensors-3

● Amplitude modulated sensors-4

● Problem Discussion

● Pulse-oximeter by Prof V Jagadeesh Kumar

○ Quiz : Assignment 5

● Optical Fiber Sensors : Week 5 Feedback Form

● Assignment 5 solutions

Week 6

Week 7

Week 8

Week 9

Week 10

Week 11

Week 12

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Live Session

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# Assignment 5

The due date for submitting this assignment has passed.

**Due on 2021-02-24, 23:59 IST.**

As per our records you have not submitted this assignment.

1) What is the pink/flicker noise?

**1 point**

- Electronic noise in receiver  
 Slow fluctuation of properties of the condensed matter materials of devices  
 Both  
 None of these

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

2) What are the typical two wavelengths used in pulse oximeter?

**1 point**

- 650nm,980nm  
 680nm,940nm  
 710nm,910nm  
 740nm,880nm

**No, the answer is incorrect.**  
**Score: 0**
**Accepted Answers:**  
*680nm,940nm*

 3) In free space optical time domain reflectometry, what is the spatial resolution that can be achieved using  $0.1\mu S$  and  $1nS$  pulses.

**1 point**

- 100m,10cm  
 200m,5cm  
 15m,15cm  
 45m,25cm

**No, the answer is incorrect.**  
**Score: 0**
**Accepted Answers:**  
*15m,15cm*

Use the following information is common for Questions 4 &amp; 5:

 Calculate the Rayleigh back scattering coefficient for a  $10\mu s$  pulse is launched into an optical fiber whose characteristics are as follows:  $NA = 0.25$ ,  $n_{eff}$  is 1.45, and  $\alpha_S = 0.45dB/Km$ .

4) What is the Rayleigh back-scattering coefficient if the wavelength of the launched light is 1550 nm?

**1 point**

- $-11dB/10\mu S$   
  $-21dB/10\mu S$   
  $-31dB/10\mu S$   
  $-41dB/10\mu S$

**No, the answer is incorrect.**  
**Score: 0**
**Accepted Answers:**  
 *$-31dB/10\mu S$* 

5) What is the Rayleigh back-scattering coefficient if the wavelength of the launched light is 1310 nm?

**1 point**

- $-17dB/10\mu S$   
  $-27dB/10\mu S$   
  $-37dB/10\mu S$   
  $-47dB/10\mu S$

**No, the answer is incorrect.**  
**Score: 0**
**Accepted Answers:**  
 *$-27dB/10\mu S$* 

6) What type of optical source is typically used in OTDR

**1 point**

- LED  
 Gas laser  
 Fiber laser  
 Fabry-Perot semiconductor laser

**No, the answer is incorrect.**  
**Score: 0**
**Accepted Answers:**  
*Fabry-Perot semiconductor laser*

7) What limits the launched power in OTDR

**1 point**

- High power will damage the fiber  
 High power will induce non-linear effect in the fiber  
 Most of the power will be lost in transmission side  
 None of these

**No, the answer is incorrect.**  
**Score: 0**
**Accepted Answers:**  
*High power will induce non-linear effect in the fiber*

The following information is common for Questions 8 &amp; 9:

Consider an optical fiber-based OTDR in which the launched power is 100 mW and the dynamic range is 30 dB.

 8) What should be the receiver sensitivity if coupling loss is 2 dB and pulse width used is  $1\mu S$ . Assume numerical aperture of the fiber is 0.14,  $n_{eff}$  is 1.46 and the fiber attenuation is  $0.2dB/Km$ .

**1 point**

- 1.22 pW  
 0.87 nW  
 0.57 nW  
 0.69 pW

**No, the answer is incorrect.**  
**Score: 0**
**Accepted Answers:**  
*0.69 pW*

 9) In the above problem, how many averages are required to fulfill the requirement if the detector sensitivity is  $-106.64$  dBm?

**1 point**

- 512  
 1024  
 2048  
 4096

**No, the answer is incorrect.**  
**Score: 0**
**Accepted Answers:**  
*1024*

The following information is common for Questions 10 &amp; 11:

 In an optical fiber-based OTDR system, the launched power is 80mW, the coupling loss is negligible, and the dynamic range is 15 dB. Suppose a  $1\mu s$  pulse is launched into a fiber whose Rayleigh back scattering coefficient is  $-52dB/\mu s$ .

 10) Assuming that the ADC voltage range is 0 - 0.1 V and the responsivity of the photo detector is 20 A/W, the trans-impedance gain required is \_\_\_\_\_ M $\Omega$  (integer value).

**No, the answer is incorrect.**  
**Score: 0**
**Accepted Answers:**  
*(Type: Range) 9,11*
**1 point**

11) \_\_\_\_\_ number of bits are required in the ADC to represent the whole sensing range.

**No, the answer is incorrect.**  
**Score: 0**
**Accepted Answers:**  
*(Type: Range) 9,11*
**1 point**

The following information is common for Questions 12 &amp; 13:

For an OTDR using optical fiber, 1 m spatial resolution is required.

 12) Bandwidth required for the receiver in the above OTDR is \_\_\_\_\_ MHz. Assume  $v_g = 2 \times 10^8 m/s$ 

**No, the answer is incorrect.**  
**Score: 0**
**Accepted Answers:**  
*(Type: Range) 31,38*
**1 point**

 13) If the receiver design is based on Trans Impedance Amplifier (TIA) configuration, feedback resistance needed is \_\_\_\_\_ M $\Omega$ . Where gain bandwidth product of the op- amp is 400MHz and diode capacitance and feedback capacitance is 2nF each. Take 3dB bandwidth from the previous solution.

**No, the answer is incorrect.**  
**Score: 0**
**Accepted Answers:**  
*(Type: Range) 11,15*
**1 point**

14) Gas spectroscopy can be done in optical fiber by providing holes in the fiber for the infusion of the gas species while allowing for the light confinement. The technique is implemented in:

**1 point**

- Panda fiber  
 Double core fiber  
 Multi mode fiber  
 Photonic bandgap fiber

**No, the answer is incorrect.**  
**Score: 0**
**Accepted Answers:**  
*Photonic bandgap fiber*

15) Poor accuracy while maintaining high precision in an instrument may be addressed by

**1 point**

- Averaging  
 Calibration  
 Both  
 None of these

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