

INSTRUMENTATION & SENSOR TECHNOLOGIES FOR CIVIL ENGINEERING APPLICATIONS

Subject Code: BCIES1401

Paper ID: 18110719

Time: 03 Hours

Maximum Marks: 60

Instruction for candidates:

1. Section A is compulsory. It consists of 10 parts of two marks each.
2. Section B consist of 5 questions of 5 marks each. The student has to attempt any 4 questions out of it.
3. Section C consist of 3 questions of 10 marks each. The student has to attempt any 2 questions.

Section – A**(2 marks each)**

Q1. Attempt the following:

- a. Define measurement and instrumentation in the context of sensor applications.
- b. Explain the term 'physical variables' with respect to measurement systems.
- c. What are the considerations for selecting a sensor for a monitoring program?
- d. Describe the methodology for the proper installation of an inclinometer.
- e. Explain the importance of standard deviation in data analysis.
- f. Describe the significance of noise in discrete signal processing.
- g. How can the range of a data set provide insights into the variability of the measurements?
- h. Why is frequency domain analysis important in signal processing?
- i. Explain the principle of the Fourier Transform in the context of frequency domain analysis.
- j. Describe an example problem where Fast Fourier Transform (FFT) is applied.

Section – B**(5 marks each)**

- Q2. Discuss the role of different types of sensors in modern instrumentation. Provide examples of applications where each type of sensor might be used.
- Q3. Develop a comprehensive plan for the installation and configuration of a sensor network to monitor structural health in a bridge.
- Q4. Describe the process of data reduction and interpretation in sensor data analysis. Illustrate your explanation with an example involving data from an inclinometer and a strain gauge.
- Q5. Explain the process of frequency domain signal processing using the Fourier Transform. Provide a detailed example showing how the Fast Fourier Transform (FFT) can be used to identify the frequency components of a noisy signal
- Q6. Consider a monitoring program for an environmental study using various sensors (e.g., temperature, humidity, pressure). Describe how you would integrate and analyze data from these different sensors to draw meaningful conclusions about environmental changes.

Section – C**(10 marks each)**

- Q7. Discuss the various types of sensors used in instrumentation and measurement systems. Explain their principles of operation, typical applications, and the criteria for selecting an appropriate sensor for a specific application.
- Q8. Describe the process of planning and executing a sensor installation for a large-scale monitoring program. Include detailed steps on predicting sensor response to various inputs, sensor selection, siting, installation, and configuration.
- Q9. Explain the need for frequency domain analysis in signal processing and the fundamental principles involved. Describe how the Fast Fourier Transform (FFT) is used to analyze signals, including practical applications such as noise reduction and frequency resolution.