GUJARAT TECHNOLOGICAL UNIVERSITY

BE-6 SEMESTER – OLD PAPER – S22 TO W25 – QUESTION BANK

Subject Name & Code:

INSTRUMENTATION AND SENSORS (3160620)

Unit 1: Fundamentals of Measurement, Sensing and Instrumentation

Repeated Questions:

1. **Define/ Differentiate between Sensor and Transducer.** (W24 - Q2a, 03 marks) (S25 - Q1a, 03 marks) (W22 - Q1a, 03 marks)
2. **Define Measurement and Instrumentation.** (W25 - Q1a, 03 marks) (W23 - Q3a, 03 marks) (S22 - Q1a, 03 marks) (S23 - Q1a, 03 marks) (S24 - Q1a, 03 marks)
3. **List various physical variables.** (W24 - Q1a, 03 marks) (S23 - Q2a, 03 marks) (S24 - Q1b, 04 marks) (W22 - Q1b, 04 marks)
4. **List the use of following given sensor, 1. Piezometer 2. Inclinometer.** (S25 - Q1b, 04 marks) (S23 - Q1b, 04 marks) (W24 - Q4b, 04 marks)
5. **What is strain gauge? & explain load cell.** (S25 - Q2a, 03 marks) (S23 - Q1c, 07 marks)
6. **Explain types of instrumentation.** (W24 - Q1b, 04 marks) (S23 - Q3b, 04 marks) (W22 - Q2b, 04 marks)

Other Important Questions:

1. **Define measurement and instrumentation. List different types of sensors used in engineering applications.** (W25 - Q1a, 03 marks)
2. **What is measurement & instrumentation? & Explain the elements of measurement systems.** (S23 - Q1a, 03 marks)
3. **Give the definition of a) Measurement b) Instrumentation.** (S24 - Q1a, 03 marks)
4. **What is sensor? List out various type of sensor with their use.** (S23 - Q2b, 04 marks)
5. **What do you mean by sensor? Explain different types of sensors in detail.** (S24 - Q1c, 07 marks)
6. **What is sensor? Explain different types of sensors in detail.** (W23 - Q1c, 07 marks)
7. **What is sensor? Explain the different criteria to choose sensor.** (S22 - Q1b, 04 marks)
8. **Differentiate between the Absolute and Secondary instruments.** (S22 - Q2a, 03 marks)
9. **Explain sensor classification based on the physical properties.** (S22 - Q2b, 04 marks)
10. **Differentiate between sensor and transducer.** (W23 - Q1a, 03 marks)
11. **Explain various specifications of sensor.** (W23 - Q1b, 04 marks)
12. **Compare with necessary examples: Permanent installation and Temporary installation.** (W24 - Q1c, 07 marks) (S22 - Q1c, 07 marks)
13. **List various Flow sensor and explain any one of them.** (S25 - Q1c, 07 marks) (S23 - Q2c, 07 marks)
14. **List various pressure sensor and explain any one of them.** (S23 - Q2c OR, 07 marks) (W22 - Q4a, 03 marks)
15. **Explain the working principle of different types of flow sensors. Differentiate between Ultra Sonic and Electromagnetic type flow sensors.** (W22 - Q2c, 07 marks)
16. **What are the main characteristics to choose Permanent installations and Temporary installations?** (W22 - Q4c OR, 07 marks)
17. **Write note on type of instruments.** (W23 - Q2c, 07 marks)
18. **Explain the Classification of Transducer in detail.** (S24 - Q5c, 07 marks)

Unit 2: Sensor Installation and Operations

Repeated Questions:

1. **Explain Measurement uncertainty.** (S25 - Q3a OR, 03 marks) (W24 - Q2b, 04 marks) (S23 - Q3a, 03 marks) (S22 - Q5a, 03 marks)
2. **List Criteria for Sensor selection.** (W24 - Q3b, 04 marks) (S23 - Q4b OR, 04 marks) (S24 - Q3b, 04 marks) (W22 - Q3b OR, 04 marks)
3. **List Criteria for Sensor siting.** (S25 - Q4b, 04 marks) (W24 - Q3b OR, 04 marks) (S23 - Q4a, 04 marks) (W22 - Q3b, 04 marks)
4. **Explain in brief sensor installations.** (S25 - Q3b, 04 marks) (S24 - Q4b, 04 marks) (W23 - Q4b, 04 marks) (W23 - Q3c, 07 marks)
5. **Define target for Approach to Planning Monitoring Programs.** (S25 - Q4a, 03 marks) (S23 - Q4a, 03 marks)
6. **Explain the flow of planning of monitoring programs.** (S24 - Q3a, 03 marks) (S22 - Q3a, 03 marks)

Other Important Questions:

1. **Explain the characteristics of an ideal transducer.** (W25 - Q1b, 04 marks)
2. **What is calibration of sensors? Explain its importance.** (W25 - Q2a, 03 marks)
3. **Explain the procedure for sensor installation and configuration.** (W25 - Q2b, 04 marks)
4. **Explain the need for sensor selection in instrumentation systems.** (W25 - Q3b OR, 04 marks)
5. **Explain sensor selection.** (W23 - Q2a, 03 marks)
6. **Explain sensor siting.** (W23 - Q3b, 04 marks)
7. **Define: Sensor siting.** (S22 - Q3a OR, 03 marks)
8. **Explain in brief: Sensor selection criteria.** (S22 - Q3b, 04 marks)
9. **Decide the order and methodology for sensor installation.** (W24 - Q3a, 03 marks)
10. **Describe the order and methodology for sensor installation.** (S23 - Q4a OR, 03 marks)
11. **Describe the order and methodology for sensor installation by considering example of Real Time Hydrological Information System.** (S22 - Q4c, 07 marks)
12. **Construct a conceptual instrumentation and monitoring program.** (W24 - Q2c OR, 07 marks)
13. **Write a short note on Construct a conceptual instrumentation and monitoring program.** (S22 - Q3c OR, 07 marks)
14. **Explain one case study of Approach to Planning and Monitoring Programs.** (S25 - Q4c, 07 marks) (S23 - Q4c OR, 07 marks)
15. **Explain in brief sensor monitoring (or measurement).** (W23 - Q3c OR, 07 marks)
16. **Predict the response of sensors to various inputs.** (W24 - Q2c, 07 marks)
17. **Write a short note on to predict the response of various inputs.** (S25 - Q3c OR, 07 marks) (S22 - Q3c, 07 marks)
18. **Differentiate between types of sensors and their modes of operation and measurement.** (S25 - Q5b, 04 marks) (S22 - Q4b, 04 marks) (W22 - Q4b, 04 marks)
19. **Differentiate between types of sensors and their modes of operation.** (W22 - Q4b, 04 marks)
20. **Explain types of Systematic errors in measurement.** (S24 - Q2b, 04 marks)
21. **Explain types of error in measurement.** (W23 - Q2b, 04 marks)
22. **Discuss in detail various types of errors associated in measurement and how these errors can be minimized?** (S25 - Q2c OR, 07 marks) (W22 - Q3c, 07 marks)
23. **Explain in detail the various sources of measurement errors and their minimization.** (W25 - Q2c OR, 07 marks)
24. **Define and explain the static characteristics of an instrument.** (W22 - Q3a, 03 marks)

Unit 3: Data Analysis and Interpretation

Repeated Questions:

1. **Define mean, median, and mode with examples.** (W25 - Q3a, 03 marks) (S22 - Q2c OR, 07 marks) [Covers similar statistical terms]
2. **Define: (i) Average value (mean) (ii) Standard deviation (iii) Median (iv) Mode.** (S25 - Q4b OR, 04 marks) (W23 - Q4b, 04 marks)
3. **Define following term 1. Average value (mean) 2. Standard deviation.** (S25 - Q5a, 03 marks) (S23 - Q5a OR, 03 marks)
4. **Define following term 1. Mode 2. Range.** (W24 - Q4a, 03 marks) (S23 - Q5a, 03 marks)
5. **Define following term 1. Median 2. Range.** (S24 - Q5a, 03 marks)
6. **Explain the working and applications of piezometer and inclinometer.** (W25 - Q3c, 07 marks) [Implies uses listed in other papers]
7. **Explain Piezometer with proper diagram.** (W22 - Q3a OR, 03 marks) [Diagram given - refer Question paper of W22]
8. **Write a note on Inclinometer.** (W23 - Q3b OR, 04 marks)

Other Important Questions:

1. **Explain the working principle of strain gauge and its application.** (W25 - Q1c, 07 marks)
2. **Explain the principle and working of a strain gauge. Derive the expression of gauge factor.** (S25 - Q2b, 04 marks) (W22 - Q1c, 07 marks)
3. **Explain the Working Principle of Strain Gauge with its application and derive the expression of Gauge Factor.** (W24 - Q3c, 07 marks)
4. **Write a note on Strain Gauge sensor.** (W23 - Q4c OR, 07 marks)
5. **Why Piezometer is used? Give the types of Piezometers.** (S24 - Q3a OR, 03 marks)
6. **Explain Piezometer.** (W23 - Q3a OR, 03 marks)
7. **Show the use of following given sensor, 1. Piezometer 2. Inclinometer.** (W24 - Q4b, 04 marks)
8. **Justify the following terms in the context of normal frequency distribution of data (a) Mean Value, (b) Deviation, (c) Average deviation, (d) Variance, (e) standard deviation.** (W24 - Q4c, 07 marks)
9. **Define the following terms in the context of normal frequency distribution of data (a) Mean Value, (b) Deviation, (c) Average deviation, (d) Variance, (e) standard deviation.** (W22 - Q3c OR, 07 marks)
10. **Discuss the process of data reduction and interpretation using statistical tools.** (W25 - Q3a OR, 03 marks)
11. **Explain in brief about data reduction and interpretation with necessary example.** (W24 - Q3c OR, 07 marks) (S22 - Q4c OR, 07 marks)
12. **Explain the different Data Reduction Techniques in detail.** (S24 - Q3c OR, 07 marks)
13. **Explain Data Reduction and Interpretation.** (W23 - Q5b OR, 04 marks)
14. **Write a short note on the data analysis and interpretation with reference to inclinometer.** (S24 - Q5b, 04 marks) (S22 - Q5b, 04 marks)
15. **Summarize on the data analysis and interpretation with reference to inclinometer.** (W24 - Q5b OR, 04 marks)
16. **You are a civil engineer analyzing the compressive strength of concrete samples (in MPa) from three suppliers. Given the following data: Supplier A: 34, 36, 35, 33, 34, 36, 34, 37, 36, 35 Supplier B: 38, 39, 37, 40, 36, 39, 38, 37, 38, 40 Supplier C: 32, 31, 33, 31, 34, 33, 32, 35, 34, 31 Based on your analysis of statistical measures (average, standard deviation, mode, and range), provide recommendations for selecting a concrete supplier for this project** (W24 - Q4c, 07 marks)
17. **Explain measurement uncertainty with an example.** (W25 - Q3c OR, 07 marks)
18. **Explain the concept of measurement uncertainty propagation in instrumentation.** (W25 - Q4b, 04 marks)
19. **Differentiate between continuous and discrete signals.** (S25 - Q3b OR, 04 marks) (S22 - Q3b OR, 04 marks)

20. **Define: (i) Discrete Signal (ii) Noise(iii) Signal to Noise ratio** (W23 - Q5a, 03 marks)
21. **What is a noise? & explain the different types of noise.** (S24 - Q3b OR, 04 marks)
22. **Define: Signal and Noise.** (S25 - Q4a OR, 03 marks) (W24 - Q4a OR, 03 marks) (S22 - Q4a OR, 03 marks)
23. **What is noise? & explain SNR.** (S23 - Q3b OR, 04 marks) (W22 - Q4b OR, 04 marks)
24. **Explain Time domain signal processing.** (W24 - Q4b OR, 04 marks) (S23 - Q5b, 04 marks) (S24 - Q4b OR, 04 marks) (S22 - Q4b OR, 04 marks)
25. **Explain Time domain signals processing.** (W23 - Q5c OR, 07 marks)
26. **Write a short note on the time domain signal processing.** (S25 - Q5b OR, 04 marks) (S24 - Q4b OR, 04 marks)
27. **What are the different types of signal and differentiate it.** (S23 - Q3a OR, 03 marks) (S24 - Q2a, 03 marks) (W22 - Q2a, 03 marks)
28. **Explain the principle of operations of LVDT with the help of neat sketch.** (W23 - Q5c, 07 marks) [Diagram given - refer Question paper of W23]
29. **What is the Working principle of Load Cell.** (S24 - Q5a OR, 03 marks)
30. **Explain in brief Load Cell.** (W23 - Q5a OR, 03 marks)
31. **Explain the types of proximity sensors and describe their use as accelerometer and vibration sensor.** (S25 - Q3c, 07 marks) (S23 - Q3c OR, 07 marks) (W22 - Q2c OR, 07 marks)

Unit 4: Frequency Domain Signal Processing and Analysis

Repeated Questions:

1. **Explain the need for frequency domain analysis and its principles.** (S25 - Q5c, 07 marks) (W24 - Q5c, 07 marks) (S23 - Q5c OR, 07 marks) (S24 - Q5c, 07 marks) (W22 - Q5c, 07 marks) (S22 - Q5c, 07 marks)
2. **What is FFT and explain its application in civil engineering.** (S25 - Q5c OR, 07 marks) (W24 - Q5c OR, 07 marks) (S23 - Q5c, 07 marks) (W22 - Q5c OR, 07 marks)
3. **Explain Fourier Transform & its application.** (W24 - Q5b, 04 marks) (S23 - Q5b OR, 04 marks)
4. **Explain Noise reduction with filters.** (W24 - Q5a, 03 marks) (W23 - Q5b, 04 marks) (S22 - Q5a OR, 03 marks)
5. **Describe Noise reduction with filters.** (S25 - Q5a OR, 03 marks)
6. **Write a short note on the Fast Fourier Transform (FFT).** (S24 - Q5b OR, 04 marks) (S22 - Q5b OR, 04 marks)
7. **Explain the basic concepts in frequency domain signal processing and analysis.** (S24 - Q2c OR, 07 marks) (W23 - Q2c OR, 07 marks) (S22 - Q5c OR, 07 marks)
8. **Explain types of filters used in frequency domain analysis.** (S25 - Q4c OR, 07 marks) (S24 - Q4c OR, 07 marks) (W23 - Q4c, 07 marks)
9. **Discuss the below terms, 1. Leakage 2. Frequency Resolution.** (W24 - Q5a OR, 03 marks)
10. **Write a short note on leakage and frequency resolution.** (W25 - Q4b OR, 04 marks)

Other Important Questions:

1. **Draw and explain the block diagram of a data acquisition system (DAQ).** (W25 - Q2c, 07 marks)
2. **Explain the concept of frequency domain signal analysis.** (W25 - Q3b, 04 marks)
3. **Explain the role of FFT in noise reduction with a suitable example.** (W25 - Q4a, 03 marks)
4. **Describe the importance of data filtering techniques in signal conditioning.** (W25 - Q4c, 07 marks)
5. **Explain the need for frequency domain analysis.** (W25 - Q4a OR, 03 marks)
6. **Differentiate between analog and digital signal processing.** (W25 - Q5a, 03 marks)
7. **Write short note on case study: use of sensors in structural health monitoring.** (W25 - Q5b, 04 marks)
8. **Design a conceptual instrumentation system for monitoring vibrations in a tall building.** (W25 - Q5c, 07 marks)
9. **Define signal conditioning. Why is it needed?** (W25 - Q5a OR, 03 marks)
10. **Write a note on measurement system design considerations.** (W25 - Q5b OR, 04 marks)
11. **Explain time-domain and frequency-domain signal processing comparison.** (W25 - Q5c OR, 07 marks)
12. **Draw and explain the block diagram of the instrumentation system.** (S25 - Q2c, 07 marks)
13. **Draw and Explain the block diagram of instrumentation system.** (S24 - Q2c, 07 marks) (S22 - Q2c, 07 marks)
14. **Draw the functional block diagram of measurement system. Mentions the purpose of measurement. What are the methods of measurement?** (S24 - Q4c, 07 marks) (W22 - Q4c, 07 marks)
15. **Explain Frequency resolution.** (S24 - Q4a, 03 marks)
16. **Define: Frequency resolution.** (S22 - Q4a, 03 marks)
17. **What is the importance of frequency domain analysis?** (W22 - Q5a, 03 marks)
18. **Explain Fourier Transform?** (W22 - Q5a OR, 03 marks)
19. **What is aliasing? How can it remove?** (S25 - Q4a, 03 marks) (W23 - Q4a, 03 marks)
20. **List any two light sensors.** (S24 - Q4a OR, 03 marks) (W22 - Q4a OR, 03 marks)
21. **Explain the concept of measurement uncertainty propagation in instrumentation.** (W25 - Q4b, 04 marks)

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