

Enrollment No./Seat No.:

GUJARAT TECHNOLOGICAL UNIVERSITY
Bachelor of Engineering - SEMESTER - III EXAMINATION - WINTER 2025

Subject Code: BE03013041

Date: 22-12-2025

Subject Name: Statistical Techniques for Environmental Engineering

Time: 10:30 AM TO 01:00 PM

Total Marks: 70

Instructions

- 1. Attempt all questions.**
- 2. Make suitable assumptions wherever necessary.**
- 3. Figures to the right indicate full marks.**
- 4. Simple and non-programmable scientific calculators are allowed.**

- | | Marks | | | | | | | | | | | | |
|---|-------------------------------|---|-------------------------------|-------|---|-------|----|-------|---|-------|---|-------|---|
| Q.1 (a) For what type of data is a Pie diagram most suitable? Mention one important caution to be observed while using it. | 03 | | | | | | | | | | | | |
| (b) Discuss the significance of statistics for Environmental Engineering. | 04 | | | | | | | | | | | | |
| (c) Differentiate between the following pairs of statistical data types, providing an Environmental Engineering example for each: (a). Qualitative vs. Quantitative data (b). Primary vs. secondary data (c). Discrete vs. Continuous data | 07 | | | | | | | | | | | | |
| Q.2 (a) Define and explain the following statistical terms with respect to Environmental Engineering data analysis (any three): (1) Mean (2) Median (3) Mode (4) Range | 03 | | | | | | | | | | | | |
| (b) An air pollution monitoring station recorded the daily average PM ₁₀ concentrations (in $\mu\text{g}/\text{m}^3$) for 30 days and grouped the data as follows: | 04 | | | | | | | | | | | | |
| <table border="1" style="width: 100%; border-collapse: collapse;"><thead><tr><th>PM₁₀ Concentration ($\mu\text{g}/\text{m}^3$)</th><th>Number of days (Frequency, f)</th></tr></thead><tbody><tr><td>20-30</td><td>5</td></tr><tr><td>30-40</td><td>10</td></tr><tr><td>40-50</td><td>8</td></tr><tr><td>50-60</td><td>4</td></tr><tr><td>60-70</td><td>3</td></tr></tbody></table> | | PM ₁₀ Concentration ($\mu\text{g}/\text{m}^3$) | Number of days (Frequency, f) | 20-30 | 5 | 30-40 | 10 | 40-50 | 8 | 50-60 | 4 | 60-70 | 3 |
| PM ₁₀ Concentration ($\mu\text{g}/\text{m}^3$) | Number of days (Frequency, f) | | | | | | | | | | | | |
| 20-30 | 5 | | | | | | | | | | | | |
| 30-40 | 10 | | | | | | | | | | | | |
| 40-50 | 8 | | | | | | | | | | | | |
| 50-60 | 4 | | | | | | | | | | | | |
| 60-70 | 3 | | | | | | | | | | | | |
| Estimate the mean PM ₁₀ concentration. | | | | | | | | | | | | | |
| (c) Consider the pesticide concentration data: 0.10, 0.12, 0.14, 0.15, 0.16, 0.17, 0.18, 0.20, 0.22, 0.25, 0.28, 0.30 (n=12). Calculate Q ₃ (Third Quartile), 3 rd Decile (D ₃) and the 80 th Percentile (P ₈₀). | 07 | | | | | | | | | | | | |

OR

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|---|-----------|
| (c) A set of groundwater samples were tested for nitrate concentration (in mg/L). The ordered results from 12 samples are: 1.7, 2.0, 2.1, 2.5, 2.8, 3.0, 3.3, 3.5, 3.8, 4.2, 4.8, 5.0. Calculate (1) Q ₁ (2) 2 nd Decile (D ₂) and (3) the 75 th Percentile (P ₇₅). | 07 |
| Q.3 (a) Mention one advantage of collecting data from field surveys in environmental studies. | 03 |
| (b) Explain Experimental Variability. | 04 |

- (c) A pilot-scale wastewater treatment unit's efficiency in removing a specific pollutant (in%) was measured over 10 trials: 85, 92, 75, 80, 95, 83, 89, 78, 91, 87. Calculate the (a) Range of the removal efficiencies, (b) Mean Deviation, (c) Standard Deviation, and (d) Coefficient of Variation. 07

OR

- (a) How can a scatter diagram help in studying the relationship between rainfall and river discharge? 03
- (b) Explain Real Variability. 04
- (c) The BOD values (mg/L) of wastewater samples collected on 8 different days are: 190, 205, 200, 220, 215, 195, 210, 225. (a) Calculate the Range and Standard Deviation. (b) Find the Coefficient of Variation (C.V.) and comment on the consistency of the BOD values. 07

- Q.4** (a) Differentiate between mean deviation and standard deviation 03
- (b) Calculating the average discharge quality of combined wastewater from different industrial sources 04

Industrial Source	Flow Rate (MLD)	BOD Concentration (mg/L)
Textile Factory	20	150
Food Processing	30	80
Chemical Plant	10	250

The average BOD concentration of the combined wastewater.

- (c) The daily suspended particulate matter (SPM) concentration (in $\mu\text{g}/\text{m}^3$) was measured at a site over 20 days. The data is as follows: 110, 115, 120, 118, 122, 116, 125, 110, 119, 121, 124, 117, 123, 116, 119, 121, 120, 115, 124, 118. (a) Prepare a Frequency Distribution Table with histogram using a class interval width of $3 \mu\text{g}/\text{m}^3$ (starting the first class at 109.5). (b) State whether this data should be presented using a histogram or a bar diagram and why. 07

OR

- (a) Distinguish between Range and Standard Deviation. 03
- (b) An environmental consulting firm is assessing air quality in a region that includes urban, suburban, and rural areas. They want to find the overall average concentration of nitrogen oxides (NO_x). 04

Area	Population (Thousands)	Avg. NO _x (ppb)
Urban	500	45
Sub urban	300	20
Rural	100	10

Calculate the population-weighted average NO_x concentration for the region.

- (c) An environmental auditing firm collected data from a city's water infrastructure projects regarding two aspects: the primary Source of Funding for 100 projects (Qualitative Data) and the Daily Water Loss over 10 days at a single treatment plant (Quantitative Data).

07

Funding Source	Number of Projects
Municipal Budget (MB)	45
State Grants (SG)	30
Federal Loans (FL)	15
Private Investment (PI)	10

Daily Water Loss Data (MJ):

Day	Water Loss (MJ)	Day	Water Loss (MJ)
1.	2.5	6.	2.6
2.	2.8	7.	3.1
3.	2.9	8.	3
4.	2.7	9.	2.8
5.	2.4	10.	2.5

- (a) Present the Funding Source data in a Pie Diagram showing percentage share. (b) Prepare a frequency distribution table for the daily water loss. (c) Identify the type of data for Funding Source and Water Loss and suggest which type of chart is appropriate for each.

- Q.5 (a)** A sample of 150 river water samples shows a mean turbidity of 12 NTU. The population standard deviation is 3 NTU. Test at 5% significance level if the mean turbidity differs from the standard limit of 11 NTU.

03

- (b) Describe the steps involved in performing one-way ANOVA.

04

- (c) What is skewness? Describe Karl Pearson's coefficient of skewness and its interpretation.

07

OR

- (a) A wastewater treatment plant claims that the average BOD of treated water is 20 mg/L. A sample of 100 water samples shows a mean BOD of 21 mg/L. Assume population standard deviation $\sigma=5$ mg/L. Test at 5% significance level whether the plant's claim is valid.

03

- (b) Define Analysis of Variance (ANOVA). What is its importance in statistics?

04

- (c) Define regression. Explain the concept of regression lines and regression coefficients.

07
