

INSTRUCTIONS TO PAPER SETTERS:**MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from question no. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only one question from each unit.

UNIT I

Introduction to Quality Planning and Control: Environmental monitoring and measurements, Grab and composite monitoring. Assessment of measurement variation, Sampling design. Description of data, statistical evaluation of data, Central tendency, Variance and standard deviation, Coefficient of variation, Box and whisker plots, Dot plots and histograms, Laws of errors. Methodology of analytical quality control of Laboratory testing Environmental Quality. Environmental process control, Statistical control charts for variables, Control charts for attributes, Multicharacteristic control charts.

[No. of Hours: 10]**UNIT II**

Statistical Tools for Environmental Quality: Sampling distribution description for environmental measurements, Normal distribution, t-distribution, Log-Normal distribution, Poisson distribution, Binomial distribution, Kolmogorov-Smirnov(K-S) test for Goodness of Fit, Normal Probability Plots, Testing Goodness of Fit for discrete distribution, Chi-Squared Statistic, Confidence intervals from the Normal Distribution, Mean and variance relationship for log-normal data, Confidence interval based on Chebyshev's inequality.

[No. of Hours: 10]**UNIT III**

Hypothesis Testing: Null hypothesis, Type I and type II errors, Test involving single sample, Test operating characteristic, Sample size and its significance, Nonparametric tests. Test involving two samples, Rank based alternative to two Sample t- Test, More than two populations: Analysis of Variance (ANOVA).

Correlation and Regression: Association between pairs of variables, Spearman's coefficient of Rank Correlation, Bimodal and Multimodal data, Linear Regression, Regression residue plot, Regression diagnostics, Regression analysis of grouped data, Non linear regression, Correlation and regression computing using MS-Excel, Estimating a mean and Standard Deviation using linear regression, Expected normal Scores, Inverse normal Cumulative Distribution function, Maximum likelihood, Zero modified data.

[No. of Hours: 11]**UNIT IV**

Tools for Analysis of Temporal and Spatial Data: Box-Jenkins Time series models viz. AR, MA, ARMA models, Non stationary models, Model Identification, Parameter Estimation, Models testing and validation. Geostatistical Modeling, Semi Variograms and Cross Variograms, Kriging, Implication of Variography, Estimated Distribution, Volume Estimation.

[No. of Hours: 10]**Text and Reference Books:**

1. Michael E. Ginevan & Douglas E. Splitstone, "Statistical Tools For Environmental Quality Measurement", Chapman & Hall/CRC Press.
2. Johnson/ Gupta Miller and Freund's, "Probability and Statistics for Engineers", Pearson Publication.
3. Levin, "Statistics for Management", Pearson Publication.
4. Eugene L. Grant & Richard S. Leavenworth, "Statistical Quality Control", TMH Publication.
5. Brian P. Macfie & Philip M. Nufrio, "Applied Statistics for Public Policy", PHI Publication.
6. B.L. Agarwal, "Basic Statistics", New Age International Publication.
7. Lipschutz, "Introduction to Probability and Statistics (Schaum's OutlineSeries)", TMH Publication.