Programme: M.Sc. (Microbiology)
Course Code: MITC-404
Title of the Course: BIOSTATISTICS [T]
Number of Credits: 3, Theory
Contact hours: 45
Effective from Academic Year: 2022-23

Prerequisites	Basic ability to handle numbers and calculation.	
Objective:	The paper develops concepts about types of data observed in biological experiments, its handling and processing. It develops concepts of hypothesis and formulation of experiments. It gives understanding of various statistical operations needed to carryout and process the biological data.	
Content:		
1.		**(15)**
1.1	**Characteristics of biological data:** Variables and constants, discrete and continuous variables, relationship and prediction, variables in biology (measurement, ranked, attributes), derived variables (ratio, index, rates), types of measurements of biological data (interval scale, ratio scale, ordinal scale, nominal scale, discrete and continuous data).	
1.2	**Elementary theory of errors:** exact and approximate numbers, source and classification of errors, decimal notation and rounding off numbers, absolute and relative errors, valid significant digits, relationship between number of valid digit and error, the error of sum, difference, product, quotient, power and root, rules of calculating digits.	
1.3	**Data handling:** Population and samples, random samples, parameter and statistics, accuracy and precision, accuracy in observations Tabulation and frequency distribution, relative frequency distribution, cumulative frequency distribution. **Graphical representation:** types of graphs, preparation and their applications.	
2.		**(15)**
2.1	**Measures of central tendency:** characteristics of ideal measure, Arithmetic mean – simple, weighted, combined, and corrected mean, limitations of arithmetic mean; Median – calculation for raw data, for grouped data, for continuous series, limitations of median; Mode – computation of mode for individual series, by grouping method, in a continuous frequency distribution, limitations of modes; Relationship between mean, median and mode; mid-range, geometric mean,harmonic mean, partition value, quartiles, deciles, percentiles.	
2.2	**Measure of dispersion:** variability, Range, mean deviation, coefficient of mean deviation, standard deviation (individual observations, grouped data, continuous series), variance, coefficient of variance, limitation. Skewness – definition, positive, negative, purpose, measure, relative	

	measure, Karl Pearson's Coefficient, Bowley's Coefficient, Kelly's Measure, Moments.	
2.3	**Correlation analysis** – Correlation, covariance, correlation coefficient for ungrouped data, Pearson's Rank Correlation coefficient, scatter and dot diagram (graphical method). **Regression analysis -** Linear and exponential function - DNSA conversion by reducing sugar, survival/growth of bacteria, regression coefficients, properties, standard error of estimates, prediction, regression analysis for linearequation.	
3.		**(15)**
3.1	Probability: Probability, Combinatorial Techniques, Elementary Genetics, Conditional Probability, Bayes' Rule, Statistical Independence, Binomial, Poisson, Normal Distributions.	
3.2	Hypothesis Testing – parameter and statistics, sampling theory, sampling and non-sampling error, estimation theory, confidence limits testing of hypothesis, test of significance; Students' T-test, t-distribution, computation,paired t-test.	
3.3	Chi-square test, F-test and ANOVA.	
Pedagogy:	Lectures/tutorials/assignments/MOODLE/Videos	
References/ Readings	Arora, P. N. and Malhan, P. K., Biostatistics, Himalaya Publishing House.	
(Latest editions)	Cochran, WG and Snedecor, GW Statistical Methods. Iowa State University Press.	
	Danilina, N.I., Computational Mathematics, Mir Publishers.	
	Kothari, C. R., Quantitative Techniques, Vikas Publishing House.	
	Surya, R. K., Biostatistics, Himalaya Publishing House.	
Learning outcomes	Able to collect, handle, process, present and analyse the biological data. Apply the principles of statistics to biological experiments.	

Programme: M.Sc. (Microbiology)
Course Code: MIPC-404
Title of the Course: BIOSTATISTICS [P]
Number of Credits: 1, Practical
Contact hours: 30
Effective from Academic Year: 2022-23

Prerequisites	Basic ability to handle numbers and calculation.	
Objective:	The paper develops concepts about types of data observed in biological experiments, its handling and processing. It develops concepts of hypothesis and formulation of experiments. It gives understanding of various statistical operations needed to process the biological data.	
Content:		**(30)**
1.	Excel spreadsheet and data analysis	
2.	Linear equation analysis (regression analysis).	
3.	Normal distribution.	
4.	Hypothesis testing (T Test, Z test)	