	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)	

5.	Application of other software (graphpad / systat) for statistical analysis	
Pedagogy:	Experiments in the laboratory, data collection and processing.	
References/ Readings	As given under respective Theory Course MITC-404	
Learning outcomes	Able to collect, handle, process and present the microbiology-related data. Apply the principles of statistics to biological experiments.	

Programme: M.Sc. (Microbiology)
Course Code: MITC-405
Title of the Course: MICROBIAL TAXONOMY AND SYSTEMATICS [T]
Number of Credits: 3, Theory
Contact hours: 45
Effective from Academic Year: 2022-23

Prerequisites	It is assumed that students should have a basic understanding of binomial nomenclature, the basis of classification systems and be familiar with the distinguishing features of different groups of microorganisms.	
Objective:	To introduce the concepts, tools and techniques of taxonomy and systematics of the microbial world. To introduce the salient features of various microbial groups and their underlying diversity.	
Content:		
1.		**(30)**
1.1	**Microbial taxonomy and systematics** Concepts of taxonomy (characterization, classification and nomenclature) and systematics; binomial classification and taxonomic hierarchy of microorganisms, three domain, six-kingdom, 8-kingdom systems, Endosymbiotic theory.	
1.2	**Phenotypic characters** - Morphology, Biochemical tests (e.g. API, BIOLOG), Bacteriophage typing, Serotyping.	
1.3	**Chemotaxonomic markers** - Cell wall components, lipid composition, cellular fatty acid (FAME analysis), isoprenoid quinones, protein profiles (e.g. MALDI-TOF), cytochrome composition, polyamines.	
1.4	**Nucleic acid based techniques** – T-RFLP, G+C content (T_m and HPLC); 16S rRNA / 18S rRNA / ITS gene sequencing; phylogenetic analysis; DNA-DNA hybridization; DNA barcoding.	
1.5	Concepts of species, numerical taxonomy and polyphasic taxonomy.	
2.	Salient features of phylum, class and orders with representative examples of the following – Archaea, Eubacteria (bacteria, cyanobacteria, actinomycetes), Mycota, Protista (algae, protozoa, diatoms); and viruses.	**(15)**