GUJARAT TECHNOLOGICAL UNIVERSITY
Integrated Master of Science (Biotechnology)
Semester: 7
Subject Name: Statistics
Subject Code: 1370405

Prerequisite: Candidates enrolling in the integrated MSc in Industrial Biotechnology with an elective in Statistics are expected to possess a solid foundation in mathematics, including calculus, linear algebra, and probability theory. Prior exposure to basic statistical concepts and data analysis methods is recommended, enabling students to apply quantitative techniques to interpret experimental data and support decision-making in bioprocess optimization and research.

Rationale: Integrating an elective in Statistics into the MSc Industrial Biotechnology curriculum is essential for fostering robust quantitative analytical skills that are critical for the modern biotechnological landscape. By equipping students with the statistical tools necessary to design experiments, analyze complex datasets, and validate research outcomes, this course enables data-driven decision making in process optimization, quality control, and risk assessment. This quantitative foundation not only enhances the reproducibility and reliability of experimental research but also empowers graduates to innovate and optimize bioprocesses in industrial applications.

Course Scheme:

Teaching Scheme			Total Credits	Assessment Pattern and Marks				Total Marks
				Theory		Practical		
L	T	PR	C	ESE (E)	PA(M)	ESE (V)	PA (I)	
0	0	4	2	0	0	0	50	50

Course Content:

Sr. No.	Course Content	No. of Hours	% of Weightage
1	**Introduction** Types of biological data (ordinal scale, nominal scale, continuous and discrete data), frequency distribution and graphical representations (bar graph, histogram, box plot and frequency polygon), cumulative frequency distribution, populations, samples, simple random, stratified and systematic sampling.	5	10
2	**Descriptive statistics** Measures of Location, Properties of Arithmetic Mean, median, mode, range, Properties of Variance and Standard Deviation, Coefficient of Variation, Grouped Data, Graphic Methods, Obtaining Descriptive Statistics on Computer, Case study.	10	16
3	**Probability and Distribution** Introduction to probability and laws of probability, Random Events, Events-exhaustive, Mutually exclusive and equally likely (with simple	10	16

	exercises), Definition and properties of binomial distribution, poisson distribution and normal distribution.		
4	**Correlation and regression analysis** Correlation, Covariance, calculation of covariance and correlation, Correlation coefficient from ungrouped data Spearson's Rank Correlation Coefficient, scatter and dot diagram, General Concepts of regression, Fitting Regression Lines, regression coefficient, properties of Regression Coefficients, Standard error of estimate.	**10**	**16**
5	**Statistical hypothesis testing** Making assumption, Null and alternate hypothesis, error in hypothesis testing, confidence interval, one-tailed and two-tailed testing, decision making.	**5**	**10**
6	**Tests of significance** Steps in testing statistical significance, selection and computation of test of significance and interpretation of results; Sampling distribution of mean and standard error, Large sample tests (test for an assumed mean and equality of two population means with known S.D.), z-test; Small sample tests (t-test for an assumed mean and equality of means of two populations when sample observations are independent); Parametric and Non parametric tests (Mann-Whitney test); Paired and unpaired t-test, chi square test.	**10**	**16**
7	**Experimental Designs** Introduction to study designs: Longitudinal, cross-sectional, retrospective and prospective study, Principles of experimental designs, Randomized block, and Simple factorial designs, Analysis of variance (ANOVA) and its use in analysis of RBD, introduction to meta-analysis and systematic reviews, ethics in statistics.	**10**	**16**

Reference Books:

No	Author	Name of the Book	Publisher	Year of Publication / Edition
1	Norman T.J. Bailey	Statistical Methods in Biology	Cambridge University Press	3rd Edition
2	P. N. Arora and P. K. Malhan	Biostatistics	Himalaya Publishing House	2nd Edition
3	Jerold Zar	Biostatistical Analysis	Pearson Education	4th Edition
4	ML Samuels, JA Witmer	Statistics for the Life Sciences	Prentice Hall	3rd edition

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
1	Understand how to summarize statistical data;	UN
2	Apply appropriate statistical tests based on an understanding of the study question, type of study and type of data;	AN
3	Interpret results of statistical tests.	EL

*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create

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