GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Science (Industrial Biotechnology)

Level: PG

Course / Subject Code: IB01001051

Course / Subject Name : Statistics

1. Learning Outcomes

Learning Outcome Component	Learning Outcome (Learner will be able to)
Theoretical understanding of Statistics	● Summarise statistical data. ● Interpret results of statistical tests.
Critical thinking and Problem Solving	● Apply appropriate statistical tests based on an understanding of the study question, type of study and type of data.
Effective Communication	● Understand the different concepts and theories pertaining to statistics.
Professional & Ethical Behaviour	● Perform data analysis and statistical calculations without bias.

LO – PO Mapping: Correlation Levels:
1 = Slight (Low); 2 = Moderate (Medium); 3 = Substantial (High), "-"= no correlation

Sub Code: 1310105	PO1	PO2	PO3	PO4	PO5	PO6	PO7
LO1: Theoretical understanding of Statistics	2	2	3	2	2	2	2
LO2: Critical thinking and Problem Solving	3	3	2	3	2	3	3
LO3: Effective Communication	3	2	2	3	3	2	2
LO4: Professional & Ethical Behaviour	2	2	2	3	2	2	3

2. Course Duration: The course duration is 45 sessions of 60 minutes each.

3. Course Contents:

Module No:	Module Content	No. of Sessions	70 Marks (External Evaluation)
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,	6	10

	Coefficient of Variation, Grouped Data, Graphic Methods, Obtaining Descriptive Statistics on Computer, Case study.		
3	**Probability and Distribution** Introduction to probability and laws of probability, Random Events, Events-exhaustive, Mutually exclusive and equally likely (with simple exercises), Definition and properties of binomial distribution, poisson distribution and normal distribution.	6	10
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.	7	10
5	**Statistical hypothesis testing** Making assumption, Null and alternate hypothesis, error in hypothesis testing, confidence interval, one-tailed and two-tailed testing, decision making.	4	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.	9	10
7	**Experimental Designs** Introduction to study designs: Longitudinal, cross-sectional, retrospective and prospective study, Principles of experimental designs, Randomized block, and Simple factorial designs,	8	10

	Analysis of variance (ANOVA) and its use in analysis of RBD, introduction to meta-analysis and systematic reviews, ethics in statistics.		

4. Pedagogy:

- ICT enabled Classroom teaching
- Practical / live assignment
- Interactive classroom discussions

5. Evaluation:
Students shall be evaluated on the following components:

A	**Mid-Semester Examination**	**(Internal assessment-30 Marks)**
B	**End-Semester Examination**	**(External assessment-70 Marks)**

6. 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

Note: Wherever the standard books are not available for the topic appropriate print and online resources, journals and books published by different authors may be prescribed.

7. List of Journals/Periodicals/Magazines/Newspapers / Web resources, etc

- https://www.slideshare.net/BrijeshKumar230/laws-of-probability-75500744
- https://www.mathsisfun.com/data/standard-deviation.html
- https://www.scribbr.com/statistics/statistical-tests/

Course Outcomes:

On completion of this course, students should be able to:

- Understand how to summarise statistical data;
- Apply appropriate statistical tests based on an understanding of the study question, type of study and type of data;
- Interpret results of statistical tests.