SANDIP UNIVERSITY

School of Science

Third year B.Sc. Microbiology

Year: Third Year **Semester: VI**

Course: Biostatistics **Course Code: XMI601**

Teaching Scheme (Hrs/Week)				Continuous Internal Assessment (CIA)					End Semester Examination		Total
L	T	P	C	CIA-1	CIA-2	CIA-3	CIA-4	Lab	Theory	Lab	
4	0	-	4	10	20	10	10	-	50	-	100
Max. Time, End Semester Exam (Theory) - 3Hrs.											

Prerequisite	Students should have the basic knowledge of statistics.

Objectives	
1	To understand the role and importance of statistics in Biology
2	To understand different terminologies of biostatistics
3	To understand different methods of data collection and representation
4	To understand how correlation and regression works in biological experiments
5	To understand the bioinformatics world

Unit Number	Details	Hours
1	Introduction: types of biological data (data on ratio scale, interval scale, ordinal scale, nominal scale, continuous and discrete data), frequency distribution and graphical representations (bar graph, histogram and frequency polygon), cumulative frequency distribution, populations, samples, random sampling, parameters and statistics	12 L
2	Measures of central tendency and dispersion: Arithmetic mean, geometric mean, harmonic mean, median, quantiles, mode, range, variance, standard deviation, moments, coefficient of variation, Shannon-Weaver index	12 L
3	Probability: Permutations and Combinations, Probability of an event, addition and multiplication of probabilities Distributions: Normal distribution, skewness and kurtosis, binomial distribution, Poisson distribution	12 L
4	Statistical hypothesis testing: Statistical testing, errors, one-tailed and two-tailed testing, t-test, Fisher exact test, chi square test, two sample hypothesis (testing difference between two means), Non parametric tests (Mann-Whitney test) Paired sample hypothesis (testing mean difference), Wilcoxon paired sample test, single factor ANOVA, Kruskal-Wallis test, Tukey test, Newman-Keuls test, two factor ANOVA	12 L
5	Correlation and Regression: Linear regression, correlation and Pearson coefficient of correlation, rank correlation and Spearman rank correlation coefficient	12 L
	Total	**60 L**

Course Outcome	
Students should able to	
CO1	Students will understand the role and importance of statistics in Biology
CO2	Students will understand different terminologies of biostatistics
CO3	Students will understand the different methods of data collection and representation
CO4	Students will understand how correlation and regression works in biological experiments
CO5	Students will understand the bioinformatics world

	Resources
Recommended Books	1. Zar, JH, Biostatistical Analysis, Pearson-Prentice Hall (2007). 2. Rao K Visweswara, Biostatistics: A Manual of Statistical Methods for Use in Health, Nutrition & Anthropology, Jaypee Brothers Publishers (2007) 3. Pagano, M. and Gauvreau, K., Principles of Biostatistics, Thomson Learning (2005) 4. Mahajan BK, Methods in Biostatistics, Jaypee Brothers Publishers (2002). 5. Introduction to biostatistics, Pranab Kumar Banerjee. 6. ABC of Research Methodology and Applied Biostatistics, M N Parikh and Nithya Gogtay. 7. Biostatistics in brief, K Viswesara Rao 8. Introduction to Biometry, S G Purohit, V D Ranade and A V Dusane 9. Basic statistics, B L Agarwal 10. Introduction to biostatistics and research methods, PSS Sundar Rao and J Richards
Reference Books	1. Fundamentals of biostatistics, Khan and Khanum 2. Methods in Biostatistics for medical students and research workers, B K Mahajan 3. Biostatistics – Principle and Practice, B Antonisamy, Soloman Chrostopher and P Prasanna Samuel 4. Drought stress in peanut, Lambert Publication , Laware And Shinde. 5. An Introduction to Biostatistics, N. Gurumani

SANDIP UNIVERSITY

School of Science
Third Year B.Sc Microbiology

Year: Third Year **Semester: VI**

Course: Food and Dairy Microbiology **Course Code: XMI602**

Teaching Scheme (Hrs/Week)				Continuous Internal Assessment (CIA)					End Semester Examination		Total
L	**T**	**P**	**C**	**CIA-1**	**CIA-2**	**CIA-3**	**CIA-4**	**Lab**	**Theory**	**Lab**	
4	0	-	4	10	20	10	10	-	50	-	100
Max. Time, End Semester Exam (Theory) - 3Hrs.											

Prerequisite	**Basic concepts of microbiology and microbial techniques**

Objectives	
1	To understand the beneficial role of microorganisms in fermented foods
2	To understand food processing and the microbiology of different types of fermented food products including dairy
3	To know the spoilage mechanisms in foods and thus identify methods to control deterioration and spoilage
4	To recognize and describe the characteristics of important pathogens and spoilage microorganisms in foods
5	To understand of the basis of food safety regulations and Discuss the rationale for the use of standard methods and procedures for the microbiological analysis of food and dairy products

Unit Number	Details	Hours
1	**1. Classification of Foods based on stability:** Perishable, Semi-perishable & stable **2. Food spoilage:** a. Chemical and physical properties of food affecting microbial growth b. Sources of food spoilage micro-organisms c. Spoilage of i. Meat and Poultry products ii. Bread iii. Fruits and Vegetables iv. Eggs v. Sea foods vi. Canned foods **3. Food preservation:** a. Principles of food preservation	**12 L**

	b. Thermal destruction of bacteria - use of low temperature and high temperature. c. Determination of TDP, TDT, D, F, and Z values d. Use of chemicals and antibiotics in food preservation e. Canning f. Dehydration g. Use of radiations h. Principles of Hazard Analysis and Critical Control Points (HACCP)- i. Introduction to Tetrapack technology	
2	**1. Microbial food intoxication and infections:** a. Food poisoning by: i. *Staphylococcus aureus* ii. *Campylobacter* iii. *Clostridium botulinum* iv. *Aspergillus flavus* b. Food infection by : i. *Salmonella typhimurium* ii. *Vibrio parahemolyticus* **2. Fermented foods:** a. Definition and Types b. Significance of fermented foods (probiotic characteristics of lactic acid bacteria) c. Fermentation of *Idli* **3. Applications of genetically modified microorganisms:** a. Starter cultures b. Genetically modified foods i. Food grade Bio-preservatives ii. Recombinant Dairy enzymes / Proteins	**12 L**
3	**Dairy Development in India:** Role of National Dairy Development Board (NDDB), National Dairy Research Institute (NDRI), Military dairy farm, Indian Dairy Corporation (IDC), Dairy Co-operatives, Milk Grid, Operation Flood. **Milk Chemistry and Constituents:** a. Definition and Composition of milk b. Types of Milk (skimmed, toned and homogenized). c. Concept of clean milk d. Factors affecting quality and quantity of milk. e. Nutritive value of milk f. Physico-Chemical properties of milk.	**12 L**
4	**Microbiology of milk:** a. Common micro-organisms found in milk b. Fermentation and spoilage of milk c. Milk borne diseases **Preservation of Milk by Pasteurization & its storage:** a. Methods of Pasteurization – LTH, HTST, UHT b. Storage specifications after pasteurization c. Phosphatase test and its significance	**12 L**
5	**Microbial analysis of milk:** a. Dye reduction test (using methylene blue and resazurin)	**12 L**

	b. Total bacterial count. c. Brucella ring test and tests for mastitis. d. Somatic cell count **Food Sanitation and regulation, Role of FDA**	
	Total	**60**

Course Outcome	
CO1	Students will be able to understand the beneficial role of microorganisms in fermented foods
CO2	Students will be able to describe the processing of food products
CO3	Students will be able to develop general understanding of role of microorganisms in food spoilage
CO4	Students will be able to gain knowledge of food borne infections, detection and prevention
CO5	Students will be able to understand the importance & methods of food preservation as well as food safety

Resources	
Recommended Books	1. Stanbury, P. F. and Whittaker, A. (1984) Principles of Fermentation technology, Pergamon press. 2. Peppler, H. L (1979), Microbial Technology, Vol I and II, Academic Press, New York. 3. Prescott, S.C. and Dunn, C. G., (1983) Industrial Microbiology, Reed G. AVI tech books. 4. Peter F. Stanbury. Principles Of Fermentation Technology, 2E, Elsevier (A Division of Reed Elsevier India Pvt. Limited), 2009 5. Casida, L. E., (1984), Industrial Microbiology, Wiley Easterbs, New Delhi Ajay Singh, Owen P. Ward, 2004 edition, Applied Bioremediation and Phytoremediation
Reference Books	1. (Soil Biology). Springer; 2. Banwart G. J. (1989). Basic Food microbiology, 2nd Edn. Chapman and Hall. International Thompson Publishing. 3. Charles R. Lane, Paul Beales, Kelvin J. D. Hughes (2012). Fungal Plant Pathogens.1st Edn. CABI Publishing. 4. Clarence Henry Eckles, Willes Barnes Combs, Harold Macy (1943). Milk and milk products, 4th Ed. McGraw-Hill book Company, Incorporated. 5. David S. Ingram, N.F. Robertson (1999). Plant Disease.1st Edn.: Collins 6. George Nicholas Agrios (2005).Plant Pathology.5th Edn. Academic Press Inc. 7. James M. Jay, Martin J. Loessner, David A. Golden (2005). Modern food microbiology, 7th Edn. Springer Science & Business. 8. John Postgate, (1998). Nitrogen Fixation. Cambridge University Press 9. K. S. Bilgrami, H. C. Dube (1984).A textbook of modern plant pathology. 7th Edn.

SANDIP UNIVERSITY

School of Science
Third Year B.Sc Microbiology

Year: Third Year **Semester: VI**

Course: Agricultural and Applied Microbiology **Course Code: XMI603**

Teaching Scheme (Hrs/Week)				Continuous Internal Assessment (CIA)					End Semester Examination		Total
L	T	P	C	CIA-1	CIA-2	CIA-3	CIA-4	Lab	Theory	Lab	
4	0	-	4	10	20	10	10	-	50	-	100
Max. Time, End Semester Exam (Theory) - 3Hrs.											

Prerequisite	Basic concepts of microbiology, microbial techniques and its importance.

Objectives	
1	To inculcate the knowledge of microorganisms and its uses in agriculture sector
2	To create the understanding of microorganisms role in agricultural productivity
3	To import the knowledge of plant diseases and microbes responsible for it
4	To develop the interest among students by explaining other applications of microorganisms in environmental cleaning
5	To learn about significance of microorganisms in advanced technologies like nanotechnology

Unit Number	Details	Hours
1	**Agriculture Technology:** **1. Plant growth improvement with respect to:** a. Disease resistance b. Environmental tolerance **2. Methods of plant disease control** a. Chemical control b. Eradication c. Biological control (employing bacterial and fungal cultures) d. Integrated pest management e. Development of insect resistant plants (BT crops) f. Application of viral proteins in controlling plant viral diseases g. Antisense RNA technology in plant disease control h. RNA interference (RNAi) in controlling plant pathogens i. Mycoviruses acting against fungal plant pathogens	**12 L**
2	**Biochemistry and production of bio-fertilizers with respect to:** a. Nitrogen Fixation i. Nonsymbiotic Nitrogen fixation : Diazotrophy, role of nitrogenase and	**12 L**

	hydrogenase, mechanism of nitrogen fixation ii. Symbiotic Nitrogen fixation : Establishment of symbiosis, Nodule development, mechanism of nitrogen fixation in root nodules iii. *Nod* genes, *Nif* genes, Nif gene cloning, b. Phosphate solubilization c. Potassium mobilization d. Iron chelation	
3	**Soil microorganisms, composition and types of soil:** a. Soil microorganisms, composition and types of soil. b. Rhizosphere microflora and its role in the rhizosphere c. Role of microorganisms in composting and humus formation d. Biofertilizers: Bacterial, Cyanobacterial ,fungal and their large scale production e. Biocontrol agents: Bacterial, Viral, Fungal and their large scale production f. Role of microorganisms in following elemental cycles in nature Carbon, Nitrogen, Sulphur, Phosphorous. g. Degradation of cellulose, hemicelluloses, lignin and pectin	**12 L**
4	**Bioremediation and Waste Water Treatment:** 1. Bioremediation: Definition, Role of plants & Microbes in Bioremediation of: a. Hydrocarbons b. Industrial Wastes: (Dyes, Paper & Pulp, Heavy metals, Dairy, Distillery , Tannery c. Xenobiotics 2. Bioaugmentation: a. Definition b. Use of microbial cultures and enzymes for bioaugmentation c. Applications 3. Genetically Modified Microorganisms in Bioremediation 4. Biosorption	**12 L**
5	**1.Brief account of microbial interactions:** Symbiosis, Neutralism, Commensalism, Competition, Ammensalism, Synergism, Parasitism, and Predation **2. Microorganisms used in Bioleaching process** a. Bioleaching of - Copper, Iron, Manganese, Gold, Silver b. Advantages of Bioleaching **3.Introduction to Nanobiotechnology:** Synthesis of Nanoparticles using microorganisms and its' applications **4.Microbial Biosensors and Biochips in Environmental Monitoring:** a. Definition, components, types, advantages & limitations b. Application of Biosensors and Biochips **5.Biofuel cells and Biodegradable plastic** **6.Bioterrorism**	**12 L**
	Total	**60**

Course Outcome

Students should able to	
CO1	Students will be able to develop understanding towards microbial importance in other fields such as agriculture and environment
CO2	Students will be able to describe the role of microbes in agriculture productivity, diseases reduction
CO3	Students will be able to understand technical know-how involved in agro based products
CO4	Students will be able generate a sense of the environmental issues
CO5	Students will be able to develop problem solving approach towards environmental and social issues by using microbial techniques

Resources	
Recommended Books	1. Stanbury, P. F. and Whittaker, A. (1984) Principles of Fermentation technology, Pergamon press. 2. Peppler, H. L (1979), Microbial Technology, Vol I and II, Academic Press, New York. 3. Prescott, S.C. and Dunn, C. G., (1983) Industrial Microbiology, Reed G. AVI tech books. 4. Peter F. Stanbury. Principles Of Fermentation Technology, 2E, Elsevier (A Division of Reed Elsevier India Pvt. Limited), 2009
Reference Books	1. Casida, L. E., (1984), Industrial Microbiology, Wiley Easterbs, New Delhi Ajay Singh, Owen P. Ward, 2004 edition, Applied Bioremediation and Phytoremediation (Soil Biology). Springer; 2. Banwart G. J. (1989). Basic Food microbiology, 2nd Edn. Chapman and Hall. International Thompson Publishing. 3. Charles R. Lane, Paul Beales, Kelvin J. D. Hughes (2012). Fungal Plant Pathogens.1st Edn. CABI Publishing. 4. Clarence Henry Eckles, Willes Barnes Combs, Harold Macy (1943). Milk and milk products, 4th Ed. McGraw-Hill book Company, Incorporated. 5. David S. Ingram, N.F. Robertson (1999). Plant Disease.1st Edn.: Collins 6. George Nicholas Agrios (2005).Plant Pathology.5th Edn. Academic Press Inc. 7. James M. Jay, Martin J. Loessner, David A. Golden (2005). Modern food microbiology, 7th Edn. Springer Science & Business. 8. John Postgate, (1998). Nitrogen Fixation. Cambridge University Press 9. K. S. Bilgrami, H. C. Dube (1984).A textbook of modern plant pathology. 7th Edn.

Year: Third Year **Semester: VI**
Course: Computational biology; food and dairy microbiology Laboratory **Course Code: XMI611**

Teaching Scheme (Hrs/Week)				Continuous Internal Assessment (CIA)					End Semester Examination		Total
L	**T**	**P**	**C**	**CIA-1**	**CIA-2**	**CIA-3**	**CIA-4**	**Lab**	**Theory**	**Lab**	
0	0	4	2	-	-	-	-	50	-	50	100
Max. Time, End Semester Exam (Theory) - 2Hrs.											

Objectives	
1	To train the students in food and dairy microbiological techniques
2	To demonstrate the significance of biostatistics

Sr. No.	Description
1	Tests for Milk and Dairy products Phosphatase test
2	MBRT test
3	Test for mastitis
4	Milk fat estimation
5	Standard Plate Count (for milk / milk product e.g. milk powder)
6	Direct Microscopic count
7	Somatic cell count
8	Visit to food industry/ dairy industry
9	Data representation- graphs
10	Central measure of tendency determination (mean,mode, median)
11	Chi square test
12	Correlation and regression analysis

Term Work:

Term Work assessment shall be conducted for the Project, Tutorials and Seminar. Term work is continuous assessment based on Attendance, Good Laboratory Practice (GLP), Timely Completion, Journal/Record book and Oral. It should be assessed by subject teacher of the institute. At the end of the semester, the final grade for a Term Work shall be assigned based on the performance of the student and is to be submitted to the University.

Notes	
1	The regular attendance of the students during semester for practical course will be monitored and marks will be given accordingly (10 Marks).
2	Good Laboratory Practices (10 Marks)
3	Timely Completion (10 Marks)

4	Journal / Record Book (10 Marks)
5	Oral / Viva (10 Marks)
Practical/Oral/Presentation:	
Practical/Oral/Presentation shall be conducted and assessed jointly by at least a pair of examiners appointed as internal and external examiners by the University. The examiners will prepare the mark/grade sheet in the format as specified by the University, authenticate and seal it. Sealed envelope shall be submitted to the head of the department or authorized person.	

Notes	
1	One experiment from the regular practical syllabus will be conducted (40 Marks).
2	Oral/Viva-voce (10 Marks).

School of Science
Third Year B.Sc Microbiology

Year: Third Year **Semester: VI**
Course: Agriculture and Applied Microbiology Laboratory **Course Code: XMI612**

Teaching Scheme (Hrs/Week)				Continuous Internal Assessment (CIA)					End Semester Examination		Total
L	**T**	**P**	**C**	**CIA-1**	**CIA-2**	**CIA-3**	**CIA-4**	**Lab**	**Theory**	**Lab**	
0	0	4	2	-	-	-	-	50	-	50	100
Max. Time, End Semester Exam (Theory) - 2Hrs.											

Objectives	
1	To train the students in soil and agriculture microbiological techniques
2	To equip the students with techniques used in other applications such as environmental, nanotechnology etc.

Sr. No.	Description
1	Screening and isolation of pesticide degrading microorganisms from soil.
2	Enrichment, Isolation, Preparation and Application of Bioinoculants (e.g. Azo-Rhizo / Blue Green Algae (cyanobacteria), phosphate solubilizer - anyone)
3	Isolation and identification of Xanthomonas spp. from infected sample
4	Isolation and identification of Aspergillus spp. from onions infected with Black Mould
5	Antifungal activity of Lactic acid bacteria.
6	Microscopic examination of Fungi causing Rust and Smut infections in Plants (Demonstration)
7	Dye removal from wastes by dead microbial Biomass
8	Biosynthesis of nanoparticles
9	Visit to Food, Dairy and Agro based Industries and preparation of visit report

Term Work:

Term Work assessment shall be conducted for the Project, Tutorials and Seminar. Term work is continuous assessment based on Attendance, Good Laboratory Practice (GLP), Timely Completion, Journal/Record book and Oral. It should be assessed by subject teacher of the institute. At the end of the semester, the final grade for a Term Work shall be assigned based on the performance of the student and is to be submitted to the University.

Notes	
1	The regular attendance of the students during semester for practical course will be monitored and marks will be given accordingly (10 Marks).

2	Good Laboratory Practices (10 Marks)
3	Timely Completion (10 Marks)
4	Journal / Record Book (10 Marks)
5	Oral / Viva (10 Marks)
Practical/Oral/Presentation:	
Practical/Oral/Presentation shall be conducted and assessed jointly by at least a pair of examiners appointed as internal and external examiners by the University. The examiners will prepare the mark/grade sheet in the format as specified by the University, authenticate and seal it. Sealed envelope shall be submitted to the head of the department or authorized person.	

Notes	
1	One experiment from the regular practical syllabus will be conducted (40 Marks).
2	Oral/Viva-voce (10 Marks).

SANDIP UNIVERSITY

Second Year B.Sc Microbiology

Year: Second Year **Semester: IV**

Course: MOOC (Genetic Engineering & Applications) **Course Code: XMI402**

Teaching Scheme (Hrs/Week)				Continuous Internal Assessment (CIA)					End Semester Examination		Total
L	**T**	**P**	**C**	**CIA-1**	**CIA-2**	**CIA-3**	**CIA-4**	**Lab**	**Theory**	**Lab**	
4	0	-	4	10	20	10	10	-	50	-	100
Max. Time, End Semester Exam (Theory) - 3Hrs.											

Prerequisite	**Basics of genes and related concepts**

Objectives	
1	
2	
3	
4	
5	

Unit Number	Details	Hours
1	**Lecture 1:** Role of genes within cells, genetic code, genetic elements that control gene expression **Lecture 2:** Method of creating recombinant DNA molecules **Lecture 3:** Types, biology and salient features of vectors in recombinant DNA technology–I: Plasmids **Lecture 4:** Phages, Cosmids, Fosmids, Phagemids, and Artificial chromosomes **Lecture 5:** Safety guidelines for recombinant DNA research **Lecture 6:** Control of spills and mechanism of implementation of biosafety guidelines	6 **L**
2	**Lecture 1**: Enzymes in genetic engineering: Restriction nucleases: exo & endo nucleases **Lecture 2:** Enzymes in modification- Polynucleotide phosphorylase, DNase and their mechanism of action. **Lecture 3:** Enzymes in modification- Methylases and phosphatases and their mechanism of action. **Lecture 4:** Enzymes in modification- Polynucleotide kinase, Ligases, RNase and their mechanism of action.	**4 L**
3	**Lecture 1:** Methods of nucleic acid detection. **Lecture 2**: Polymerase chain reaction (PCR) and its applications	**6 L**

	Lecture 3: Variations in PCR and their applications **Lecture 4:** Methods of nucleic acid hybridization **Lecture 5:** Probe and target sequences	
4	**Lecture 1:** Isolation and purification of nucleic acid (genomic/plasmid DNA and RNA) **Lecture 2:** Quantification and storage of nucleic acids. **Lecture 3:** Construction of cDNA library **Lecture 4:** Construction of Genomic library **Lecture 5:** Screening and preservation of DNA libraries **Lecture 6:** DNA Sequencing and Cloning Stategies	**6 L**
5	**Lecture 1:** Gene transfer techniques: biological methods **Lecture 2:** Gene transfer techniques: chemical methods **Lecture 3:** Gene transfer techniques: physical or mechanical methods **Lecture 4:** Agro- bacterium mediated gene transfer in plants **Lecture 5:** Chloroplast transformation	**5 L**
6	**Lecture 1:** Transgenic science in plant improvement **Lecture 2:** Biopharming - plants as bioreactors **Lecture 3:** Transgenic science for animal improvement **Lecture 4:** Biopharming- Animals as bioreactor for recombinant protein **Lecture 5:** Gene mapping in plants and animals **Lecture 6:** Marker-assisted selection for plant breeding and livestock improvement	**6L**
7	**Lecture 1:** Microbial biotechnology: Genetic manipulation **Lecture 2:** Engineering microbes for the production of antibiotics and enzymes **Lecture 3:** Engineering microbes for the production of insulin, growth hormones, monoclonal antibodies **Lecture 4:** Engineering microbes for clearing oil spills	**4L**
8	**Lecture 1:** Gene therapy: Introduction and Methods **Lecture 2:** Gene targeting & silencing **Lecture 3:** Gene therapy in the treatment of diseases **Lecture 4:** Challenges & future of gene therapy	**4L**
	Total	**41**

Course Outcome
Students should able to
CO1
CO2
CO3
CO4
CO5

Resources	
Recommended Books	1. **Introduction to Genetic Engineering -** Nicholl. Cambridge Low Price Edition, 2006. 2. **Principles of gene manipulation and Genomics -** Primrose S.B. and Twyman R.M., Blackwell Scientific Publications, 2008. 3. **Genes IX -** Benjamin Lewis. Oxford University & Cell Press, 2008.
Reference Books	1. Molecular modeling of proteins by Andreas Kukol, Humana press 2. Introduction to computational biochemistry, by C.Stan Tsai, A John WILEY & SONS, Inc., Publication. 3. Bioinformatics, Sequence and Genome analysis by David Mount. 4. Introduction to Bioinformatics, Teresa K Attwood and David J Parry-smith. 5. Essential Bioinformatics, Jin Xiong, Cambridge University press. 6. Molecular modeling of proteins by Andreas Kukol, Humana press.