Rayat Shikshan Sanstha's

YASHAVANTRAO CHAVAN INSTITUTE OF SCIENCE, SATARA

(AUTONOMOUS)

CBCS

Reaccredited by NAAC with 'A+' Grade

Syllabus for

Master of Science

Part - II

APPLIED MICROBIOLOGY

Syllabus to be implemented from June, 2019 onwards

A. RULES AND REGULATIONS:

1. Any person who has taken the degree of B. Sc. of this Institute or the degree of any other statutory University and has kept four terms in the Institute as a post-graduate student be admitted to the examination for the degree of Master of Science (M. Sc.) in Applied Microbiology.
2. A student shall be held eligible for admission to the M. Sc. Applied Microbiology course provided s/he has passed the B. Sc. examination with Microbiology as a principal subject or with a subsidiary/interdisciplinary/applied/allied subjects and has passed the entrance examination conducted by the Institute.
3. The students with B. Sc. from other universities shall be eligible if they qualify through the entrance examination.
4. While preparing the merit list for M. Sc. admission, the performance at B.Sc. III (Microbiology) and the performance at the entrance examination should be given equal weightage (50:50).
5. The examination shall be split up into four semesters.
6. The commencement and conclusion of each semester shall be notified by the Institute from time to time.
7. A student who has passed in semester examination shall not be allowed to take the examination in the same semester again.
8. Each theory paper in each semester as well as each practical course shall be treated as separate head of passing.
9. The result shall be declared at the end of each semester examination as per Institute rules.

B. SYLLABUS FOR MASTER OF SCIENCE (M.Sc.):

1. Title: Subject:- APPLIED MICROBIOLOGY

2. Year of implementation: June 2019 onwards

Total number of semesters :	**04**
(Two semesters per year)	
Total No. of papers :	**16**
Total no. of practical courses :	**08**
No. of theory papers per semester :	**04 / 04 / 05 / 03**
No. of practical courses per semester :	**02**
Maximum marks per paper(practical) :	**100**
Distribution of marks –	
Internal evaluation :	**20**
External evaluation :	**80**
(Semester exam)	
Total marks for M. Sc. Degree	
Theory papers :	**1600**
Practical course :	**800**
	2400

3. General Objectives of the Course:

A prime objective to maintain updated curriculum and providing therein inputs to take care of fast paced developments in knowledge of Applied Microbiology and in relation to International context, a two year programme is formulated for M.Sc. Applied Microbiology as per UGC guidelines and to develop competent microbiologists to achieve desirable placements in the country and abroad. The programme obliges students to read original publications and envisages significant inputs in the laboratory work, communication skill, creativity, planning, execution and critical evaluation of the studies undertaken. In addition to disciplines viz. Virology, Immunology, Genetics, Molecular Biology, Enzymology, Biostatistics, Bioinformatics, Scientific writing, Computer Science etc.

The overall structure of the course to be implemented from the academic year 2018– 2019 onwards is as given below. Students are required to undertake a research project in all the semesters at the department. In the project, the student is expected to study research methodology that includes literature survey, experimental work and report writing following the IMRAD (Introduction, Aims and objectives, Materials and Methods, Results and Discussion) system. Students shall compulsorily deliver one seminar/research paper before submission of project and submit a certificate from the Head of the Department regarding satisfactory completion of the same at the time of the practical examination of semester IV. Students are also required to undertake a compulsory educational tour organized by the Department in each year (M. Sc. I and M. Sc. II) to various places of microbiological interest and submit a tour report duly signed by the Head of the Department, at the time of the practical examinations respectively.

2. Duration:

• The course shall be a full time course.

• The course shall be of two years, consisting of four semesters.

3. Fee Structure:

• **Entrance Examination fees:** as prescribed by the Institute.

• **Course Fee:** as prescribed by the Institute.

4. Eligibility ForAdmission:

• As per Rule (2) for graduates of this Institute.

• As per Rule (3) for graduates from other universities and merit of entrance exam.

5. Medium of instruction : English

6. Structure of the Course

M.Sc. Part I

Semester I

Nature of the Course	Paper Code	Name of the Paper
Theory	MAMiT 101	MICROBIAL BIODIVERSITY
	MAMiT 102	RECENT TRENDS IN VIROLOGY
	MAMiT 103	MICROBIAL BIOCHEMISTRY AND PHYSIOLOGY
	MAMiT 104	ESSENTIALS OF GENETICS
Practical	MAMiP 105	PRACTICAL COURSE I: LAB I
	MAMiP 106	PRACTICAL COURSE I: LAB II

Semester II

Nature of the Course	Paper Code	Name of the Paper
Theory	MAMiT 201	ANALYTICAL TECHNIQUES
	MAMiT 202	MICROBIAL METABOLISM
	MAMiT 203	MOLECULAR BIOLOGY AND GENETICS
	MAMiT 204	ESSENTIALS OF IMMUNOLOGY
Practical	MAMiP 205	PRACTICAL COURSE II: LAB I
	MAMiP 206	PRACTICAL COURSE II: LAB II

M.Sc. Part II

Semester III

Nature of the Course	Paper Code	Name of the Paper
Theory	MAMiT 301	MICROBIAL ECOLOGY AND EXTREMOPHILES
	MAMiT 302	RESEARCH METHODOLOGY & BIOSTATISTICS
	MAMiT 303	GENE TECHNOLOGY AND GENOMICS
	MAMiT 304	PHARMACEUTICAL MICROBIOLOGY
	MAMiT 305 E-1	FOOD AND DAIRY TECHNOLOGY - I
	MAMiT 305 E-2	ESSENTIALS OF BIOINFORMATICS
Practical	MAMiP 306	PRACTICAL COURSE III: LAB I
	MAMiP 307	PRACTICAL COURSE III: LAB II

Semester IV

Nature of the Course	Paper Code	Name of the Paper
Theory	MAMiT 401	INDUSTRIAL MICROBIOLOGY
	MAMiT 402	MICROBIOLOGICAL QUALITY CONTROL AND ASSURANCE
	MAMiT 403 E-1	FOOD AND DAIRY TECHNOLOGY - II
	MAMiT 403 E-2	ADVANCED BIOINFORMATICS
Practical	MAMiP 404	PRACTICAL COURSE IV: LAB I
	MAMiP 405	PRACTICAL COURSE IV: LAB II

M.Sc. Evaluation Structure Semester – III

	ESE	Internal Exam		Practical			Submission		Total
		ISE – I	ISE- II		Exam	Journal	Project Part I	Day to day performance	
MAMiT 301	80	10	10	Lab – V	70	10	30	10	
MAMiT 302	80	10	10						
MAMiT 303	80	10	10	Lab - VI	70	10			
MAMiT 304	80	10	10						
MAMiT 305	80	10	10						
Total	400	50	50		140	20	30	10	700

M.Sc. Evaluation Structure Semester – IV

	ESE	Internal Exam		Practical			Submission		Total
		ISE – I	ISE- II		Exam	Journal	Project Part I	Day to day performance	
MAMiT 401	80	10	10	Lab – VII	70	10	30	10	
MAMiT 402	80	10	10						
MAMiT 403	80	10	10	Lab - VIII	70	10			
Total	240	30	30		140	20	30	10	500

* Official Copy of Evaluation Structure for M.Sc. II is enlisted on the last two pages of the syllabus.

10. System of Examination: applicable to Institute.

1. Scheme of examination:

- Semester exam (both theory and practical examination) should be conducted by the Institute at the end of each term (semester).
- Theory paper of the external examination should be of 80 marks.
- The internal evaluation test for 20 marks should be conducted by the Department.
- There should be two tests for each course paper in the middle of the Semester.
- The two practical course examinations should be of 100 marks each.
- Question paper should be set in view of the entire syllabus and covering each unit of the syllabus.

2. Standard of passing:

As per the rules and regulations of the Institute for the M. Sc. Course.

3. Nature of question paper and scheme of marking:

a) Institute examination theory paper: Maximum marks –**80**

- Total number of questions –**06.**
- All questions are compulsory.
- The question paper will be divided into two sections, Section I and Section II, of 40 marks each.

• Each section is based on any two units from the theory course, with equal weightage.

• Each section will consist of three questions, the nature of which will be as follows:

Section	Question No.	Title of the Question	Total No. of Sub-Questions	Total No. of Sub Questions to be Attempted	Weightage
I	1	Long answer	01	01	14
	2	Attempt any two	03	02	16
	3	Attempt any four	03	02	10
II	4	Long answer	01	01	14
	5	Attempt any two	03	02	16
	6	Attempt any four	03	02	10

• Both sections are to be written in the same answer book.

b) Internal Semester Evaluation- ISE: Maximum marks –20

• Objective- multiple choice/True or false/ fill in the blanks/match thefollowing.

• The internal examination will be divided into two parts.

• The Internal Semester Evaluation – Part I or ISE I, will be a online test, conducted by the Institute.

• ISE II will be a offline test, the nature of which will be decided by the department and which will consist of objective and subjective questions.

• The ISE II for one out of five/three theory courses will be a seminar.

c) Practical Examination (External only) Maximum marks –100

• Equal weightage shall be given to the two units of the practical course.

• Total number of questions –**06**

• All questions should be compulsory

C. INTAKE CAPACITY:

1. 30 + 10% (drop out) every year on the basis of entrance examination.

2. The above includes 10 % students from other Universities.

D.CREDIT SYSTEM:

1. Definition of CREDITS:

1. Lectures
2. Practicals
3. Seminars
4. Private study work in theLibrary/Home
5. Examinations
6. Online Examination
7. Project
8. Industrial training
9. Other activities

2. Credits by lectures and practicals:

- Total instructional days as per norms of UGC =**180**
- One (**01**) credit is equivalent to **12** contact hours.
- There are four (**04)** theory papers with **04** hours teaching per week.
- Each theory paper consists of **04**units.
- There are two (**02**) practical courses of **09** hours duration per week.
- Each practical course consists of **02** units.

• Therefore the distribution of credits (per semester) is–

Course Type	**Contact Hours**	**Credits**
Theory Paper		
Unit - I	15	01
Unit – II	15	01
Unit – III	15	01
Unit - IV	15	01
	Total	04
Practical Course		
Unit – I		02
Unit - II		02
	Total	04
Total credits per semester = 24		
Theory Course	04 × 04 =	16
Practical Course	02 × 04 =	08

- As there are four (**04**) semesters to the M. Sc. course, the total credits form lectures and practicals should be - **04 × 24 = 96** credits.

3. M. Sc. Course Work (credit system) for a student:

• A student has to take **96** credits to complete the course.

1) Theory courses : **16 × 04 = 64** credits
2) Practical/Project : **08 × 04 = 32** credits
   (Project at the Department/University/Industry: **04,** Practical course: **04**)

• Time course: **02** years minimum **or** till **96** credits arecompleted.

4. Class capacity:

Theory: maximum **32** students per class

Practical courses: **12** students per batch

5. Examination:

Theory Examination:

External: 80 marks per theory paper (examination at the end of the Semester)

• This will be conducted by the Institute.

Internal: 20 marks per theory paper

• ISE I: It will be a online test conducted by the Institute – 10 marks.

• ISE II: It will be a offline test conducted by the Department – 10 marks.

Practical Examination:

• This will be conducted by the Department as per the guidelines of the Institute.

Project Evaluation:

External: 30 marks by the external examiners through observation of the oral presentation and assessment at the time of the practical examination

Internal: 30 marks by the concerned project supervisor as the internal Examiner during progress of the project work.

SEMESTER III

MAMiT 301: MICROBIAL ECOLOGY & EXTREMOPHILES

Learning Objectives:

The student should:-

1. Learn the significance of microbial ecology.
2. Get introduced to ecology as a tool for global sustainability.
3. Understand the applications of extremophiles.
4. Get acquainted with the human microflora and its effects on health.

UNIT I: Basic Concepts of Microbial Ecology **15**

A) Microbial Ecology – Concepts, niche, habitat, ecosystem and applications. Introduction to microbial diversity, types of micro organisms- bacteria, archaea, eukarya, interactions between micro organisms, ecological succession.

B) Development of Microbial Communities:

i) Introduction
ii) Microbial community dynamics –
  a) Population selection within communities
  b) Succession within microbial communities
  c) Genetic exchange in microbial communities
iii) Structure of microbial communities –
  a) Diversity and stability
  b) Species diversity indices
  c) Genetic and molecular diversity indices.
iv) Ecosystems –
  a) Experimental models
  b) Microcosms

UNIT II: Recent Concepts in Microbial Ecology **15**

A) Microbial biofilm –

i) Physiology, morphology, biochemistry of microbial biofilm formed in natural environment.
ii) Mechanism of microbial adherence.
iii) Laboratory methods used to obtain biofilm (with respect to physiology, growth, special arrangement, depth, surface physico chemistry)

iv) Beneficial and harmful role of biofilms.

B) Biomimicry – Concept and Applications.

C) Bioremediation and Biodegradation -

i) Engineering and bioremediation process its needs and limitations. Molecular technique in Bioremediation.

ii) Degradation of aromatic and alicyclic compounds- important organisms, use of mixed cultures common pathways of aromatic degradation, aerobic and anaerobic degradation of aromatic compounds.

UNIT III: Microbiome **15**

A) Introduction: Microbiome Ecosystem Ecology

B) Human Microbiome project: Scientific background; Initiation of the HMP; The goal of the HMP; Implementation of the National Institute of Health HMP; The International Human Microbiome Consortium (IHMC).

C) Healthy Human Microbiome: Typical components and diversity of the microbiome; archaea, viruses, fungi, and other eukaryotes; Geographical variation in the healthy microbiome; Microbiome establishment and early colonization; Hallmarks of health; outlook.

D) Human Microbiome at the interface of health and disease: Influences on the microbiota during host life cycles; Disease links and health implications.

UNIT IV: Extremophiles and their Applications **15**

A) Extremophiles

i) Concept

ii) Thermophiles – Nucleic acids, Membrane adaptations, Proteins.

iii) Psychrophiles – Membrane adaptation, Proteins.

iv) Acidophiles – Mechanism to tolerate acid and metal and acid toxicity.

v) Alkalophiles- Bioenergetics adaptations.

B) Extremozymes

i) Extremozyme – Characteristics, examples, structure, Biotechnological uses of archea as extremozymes and applications.

ii) Biotechnological, applications of extreme proteins from different groups- methanogens.

iii) Polyextremophiles – characteristics, examples and uses

Learning Outcomes:

After learning the theory paper, the student will be able to:-

1. Comprehend the concepts of microbial ecology.
2. Apply recent trends in ecology for global sustainability.
3. Utilize extremophiles as industrial tools.
4. Imbibe basic concepts of the human microbiome.

References:-

1) R.M.Atlas, R. Bartha (2008) Microbial Ecology: Fundamentals and Applications, 4th Ed. Pearson India Education Services – **UNIT I, II, III.**
2) Charles Greday, Nicolas Glansdorff.(2007) Physiology and Biochemistry of Extremophiles, ASM Press. **UNIT IV.**
3) Rajendran P, Gunasekaran P. (2011) Microbial Bioremediation, MJP Publishers, Chennai – **UNIT II.**
4) Odum Eugene (2004) Fundamentals of Ecology, Cengage Learning – **UNIT I.**
5) The Human Microbiome : At the Interface of Health and Disease – Ilseung Cho and Martin J. Blaser, Nature Journal – **UNIT III**

MAMiT 302: RESEARCH METHODOLOGY AND BIOSTATISTICS

Learning Objectives:

The student should:-

1. Get basic knowledge on the fundamentals of research methodology.
2. Learn how to present research in scientific manner.
3. Get acquainted with different biostatistical tools in modern research.
4. Understand the relationship between statistics and biological research.

UNIT I: Introduction to Research Methodology I 15

A) Research Methods vs. Methodology

i) Introduction.
ii) Types: Library research, field research, laboratory research.

B) Defining a Research Problem

i) Concept.
ii) Selecting the research problem.
iii) Techniques involved in defining problem.
iv) Conclusion of the problem.

C) Research Design

i) Need for research design.
ii) Concept in research design.
iii) Types of research design.

D) Developing a Research Plan

i) Need.
ii) Essential characteristics of research plan.

UNIT II: Introduction to Research Methodology II 15

A) Reporting Practical and Project Work

i) Structure of report-
ii)Title, authors and their institution , abstract ,keywords, abbreviations.
iii) IMRAD technique
  a) Introduction
  b) Material and methods
  c) Result discussion and conclusion
  d) Acknowledgements.

B) Preparing a Grant Proposal for Research Project

C) Manuscript Submission to Research Journals

i) Statement of proposal.
ii) Ethical considerations.
iii) Publishing editorial issues.
iv) Preparation and submission.

UNIT III: Descriptive Statistics **15**

A) Importance of statistics in Biology

i) Samples and Population
ii) Types of data, random sampling methods and sampling errors, scales and variables, accuracy and precision.

B) Measures of Central Tendency

i) Mean (arithmetic, geometric, harmonic), median, percentile and mode.
ii) Measures of dispersion – mean deviation, standard deviation and variance.
iii) Measures of a) Skewness , b) Kurtosis.

UNIT IV: Hypothesis Testing **15**

A) Introduction to Hypothesis Testing

i) Null hypothesis

ii) Alternate hypothesis.

B) Statistical Tools

i) Significance level, type I and type II errors, p-value, one tailed and two tailed tests.
ii) Distribution of sample means, standard error and confidence interval, Degrees of freedom
iii) Equality of two population means, proportions: t-tests and ztest
iv) Chi square test - test for goodness of fit, independence and homogeneity
v) F test and ANOVA

Learning Outcomes:

After learning the theory paper, the student will be able to:-

1. Design a research plan.
2. Present research in scientific language.
3. Analyse research data employing biostatistical tools.
4. Statistically signify the importance of research data.

References:-

1. N. Gurumani (2010) Scientific thesis writing and paper presentation, MJP Publishers, Chennai – **UNIT I, II.**
2. C. R. Kothari (2004) Research Methodology; Methods and Techniques, 2nd Ed, New Age International Publishers, New Delhi - **UNIT I, II.**
3. Irfan Ali Khan and Atiya Khanum, Fundamentals of Biostatistics. 3rd Ed. Ukaaz, Publications, Hyderabad - **UNIT III, IV.**
4. Robert R. Sokal and F. James Rohlf (1969) Introduction to Biostatistics, 2nd Ed, Dover Publications, INC. Mineola, New York – **UNIT III, IV.**
5. P.N. Arora, P.K.Malhan (2006) Biostatistics, Himalaya Publishing House, Mumbai. – **UNIT III, IV.**

MAMiT. 303: GENE TECHNOLOGY

Learning Objectives:

The student should:-

1. Get basic knowledge on gene technology
2. Get acquainted with the recent research in the sphere of gene technology.
3. Understand the tools and techniques used in genetic engineering.
4. Learn about emerging trends in gene technology

UNIT –I: DNA Libraries **15**

A) Introduction and types-

Genomic and cDNA library.

B) Preparation of Genomic Library-

Isolation of genomic DNA, generation of suitable sized fragments, cloning in suitable vector systems, and transformation in suitable host.

C) Preparation of cDNA library-

Isolation of mRNA, preparation of cDNA fragments**,** cloning in suitable vector systems, and transformation in suitable host.

D) Screening of Libraries-

Criteria to identify particular gene from gene library –

1. DNA sequencing
2. Expression of particular protein with immunological epitope
3. Enzymatic activity

UNIT –II: Directed Mutagenesis and Protein Engineering **15**

A) Directed Mutagenesis:

Oligonucleotide directed mutagenesis with M-16 phage, PCR-amplified oligonucleotide directed mutagenesis, error-prone PCR, Random insertion and deletion mutagenesis, selection of mutant peptide – phage display and cell surface display

B) Protein Engineering:

Adding disulfide bonds, changing aspargine to other amino acids, reducing number of free sulfhydryl residues, increasing enzymatic activity, modifying metal cofactor requirement, decreasing protein sensitivity, modifying protein sensitivity, increasing enzyme stability and specificity, altering multiple properties.

UNIT –III: Genetic Engineering in Plants and Animals

A] Plants

i) Plant transformation with Ti and Ri plasmid.
ii) Ti plasmid derived vector systems.
iii) Physical methods for transformation.
iv) Chloroplast engineering.

B] Animals

i)Gene transfer vectors
ii)Transfection – a) Physical, b) Chemical.
iii)Production of transgenic mice ,
iv)Applications of transgenic mice

UNIT –IV :Recent Trends in Gene Technology **15**

A] Genomics-
Concept, Introduction, Comparative genomics of bacteria

B] Proteomics-
Concept, Introduction, Expression analysis and characterization of proteins

C] CRISPR / Cas9 in Genome Editing-
Concept, Introduction, Applications.

Learning Outcomes:

After learning the theory paper, the student will be able to:-

1. Access various genomic libraries.
2. Comprehend recent trends in protein engineering.
3. Utilize the applications of genetic engineering to industrial use.
4. Understand the significance of gene technology for biological research.

References:-

1) Sandhya Mitra – Genetic Engineering: Principles and Practice, McGraw Hill Education (India) Pvt. Ltd – **UNIT I.**
2) Glick, Pasternak, Patten –(2010) Molecular Biotechnology: Principles and Applications of Recombinant DNA Technology (4^{th} Edition) ASM Press – **UNIT I, II, III.**
3) S.B. Primrose, R. M. Twyman – Principles of Gene Manipulation and Genomics (7^{th} Edition) Blackwell Publishing – **UNIT I, II, III, IV.**
4) Hartl and Jones – Genetics: Analysis of Genes and Genomes (8^{th} Edition) Jones and Bartlett Learning – **UNIT I.**
5) Review Article: CRISPR/CAS 9 in genome editing by Haifeng Wang, Marie La Bussa, Lei S. Qi – **UNIT IV.**
6) Recent trends progress in CRISPR technology by Yue Mei, Yan Wang – Journal of Genetics and Genomics (2016) – **UNIT IV.**

MAMiT 304: PHARMACEUTICAL MICROBIOLOGY

Learning Objectives:

The student should:-

1. Get basic knowledge on community medicine.
2. Get acquainted with the recent research on drug discovery and development.
3. Understand the tools and techniques used in antimicrobial testing.
4. Learn about emerging trends in biopharmaceuticals.

UNIT- I Community Medicine and Epidemiology 15

A] Fundamentals of Community Medicine

i) Definition of health, dimensions of health.
ii) Determinants and indicators of health.
iii) Concept of well- being.

B) Basics of Epidemiology

i) Concept of causation: Germ theory, epidemiological triad, multifactorial causation, web of causation.
ii) Natural history of disease- prepathogenesis and pathogenesis phase.
iii) Changing pattern of disease.

UNIT II: Drug Discovery and Development: 15

A] Introduction

i) Contributions and postulates of Paul Ehrlich
ii) Significance of terms - lead optimization, candidate selection

B] Drug Discovery and Design

i) Conventional Process of bioprospecting (medicinal chemistry)
ii) Extraction and purification principles,
iii) Purification and characterization of bioactive molecules from natural sources
iv)Rational Drug Design – Principle (Structure Activity Relationship- SAR) and Tools (applications of High Throughput Screening, Combinatorial Synthesis, Pharmacogenomics)

C] Drug Development

i) Preclinical Development – Toxicity Testing: Acute, Sub-acute and Chronic.
ii) Clinical Development – Clinical Trials: Aims, Objectives, Conduct, Phases of Clinical Trials – I,II,III, IV.

UNIT III: Antimicrobial Testing Systems **15**

A] Introduction:

Antimicrobial agents, broad types, therapeutic ratio, MIC and MBC.

B] Antimicrobial Susceptibility Testing

i) Use of liquid and solid media.

ii) Factors affecting susceptibility testing, guidelines issued by CLSI.

iii) Diffusion methods –

a) Agar Dilution Technique
b) Gradient Plate Technique
c) E-test
d) Kirby Bauer Method
e) Stokes Method

iv) Susceptibility Testing for –

a) Anti-mycobacterial agents.
b) Anti-fungal agents.
c) Anti-protozoan agents.
d) Anti-viral agents.

UNIT IV: Biopharmaceuticals **15**

A] Introduction:

Concept and significance of biopharmaceuticals.

B] Regulations and Recommendation

i) Regulatory authorities and their role – the FDA.

ii) The concept of Pharmacopoeia – USP, EP, BP and IP.

C] Drug Formulation Studies

i) Drug formulations – carriers and delivery systems.

ii) Targeted drug delivery and sustained release.

iii) Pharmacokinetics – ADME / Bioavailability studies.

Learning Outcomes:

After learning the theory paper, the student will be able to:-

1. Understand the importance of community medicine.
2. Imbibe the basic concepts of drug development.
3. Practically perform antimicrobial testing.
4. Comprehend the concept of biopharmaceuticals.

References:-

1. K. Park (2009), Park's Textbook of Preventive and Social Medicine (20th Edition) – **UNIT I.**
2. Konrad J. Karczewski, Roxana Daneshjou, Russ B. Altman (2012) Chapter 7. Pharmacogenomics PLOS – **UNIT II.**
3. Franklin T.J. and Snow G.A., (1975), Biochemistry of Antimicrobial Action, Chapman and Hall, London – **UNIT III.**
4. Gale E.F., Cundliffe E., Reynolds P.E., Richmond M.H. and Waring M.J., (1972), The molecular basis of antibiotic action, John Wiley and Sons, London - **UNIT III.**
5. Goldstein A., Aronow L. and Kalman S.M. (1969) Principles of Drug Action, The Basis of Pharmacology, Harper International Edition, New York – **UNIT III.**
6. Mannfred A. Holliger, (2008) Introduction to Pharmacology, 3rd Edition, CRC Press – **UNIT IV.**
7. Kokate C. K., Purohit A.P., Gokhale A.B.(2000) Pharmacology, 4th Edition, Nirali Prakashan – **UNIT IV.**

MAMiT 305 E-1 DAIRY AND FOOD MICROBIOLOGY – I

Learning Objectives:

The student should:-

1. Learn the significance of microbiology in food and dairy technology.
2. Study the usage of different microorganisms.
3. Understand the tools and techniques used in genetic engineering.
4. Learn about emerging trends in gene technology.

UNIT I: Microrganisms in Dairy **15**

A) Naturally Present Microorganisms

Sources and beneficial role of microorganisms.

B) Spoilage Causing Microorganisms

i) Mechanism of spoilage.
ii) Causative agents and control measures of: natural curdling, gas production, ropiness, proteolysis, lipolysis.

C) Milk Borne Diseases

i) Milk borne infections: Salmonellosis, Botulism, Aflatoxicosis.
ii) Milk borne diseases: Listeriosis, TB.

D) Starter Culture

i) Introduction and Background
ii) Role, Nature and Types: single strains, mixed strains, multiple strains.
iii) Factors affecting starter culture.
iv) Starter culture defects.
v) Evaluation of starter culture.
vi) Genetics and metabolism of starter culture.

UNIT II: Milk Processing and Milk Products **15**

A) Processing of Milk

i) Introduction, type and standards of market milk
ii) Microbiological quality of market milk
iii) Processing steps-
   a) Pre-processing : Pumping, Filtration, Cooling, Centrifugal clarification, standardization, Homogenization
   b) Processing: Pasteurization LTH, HTST and Sterilization: Complete in

bottle,2 stage, UHT.

c) Post processing: Cooling, packaging, distribution.

B) Processed milk products

Cheese and allied products.

UNIT III: Microbiology in Foods **15**

A) Microorganisms in foods

Role, Significance

B) Microorganism in food spoilage:

i)Types of foods and their spoilage

ii) Microbial, biochemical aspect of food spoilage

iii) Physiology of food spoilage organisms : Importance, Response of microbes, future prospectus.

C) Food Borne Diseases

i) Bacterial diseases: *E. coli* EHEC o157:H7 and other strains, *L. monocytogenes, H. pylori.*

ii) Fungal, algal, viral, prions and other non-bacterial forms.

D) Food Preservation

i) Control of spoilage: By physical removal, heat, low temperature, reduced a_w, low pH, oranic acids, modified atmosphere, anti-microbial preservatives, irradiation, canning.

ii) Control by combination of methods (Hurdle concept)

iii) Novel emerging techniques of preservation: Bacteriocin – Introduction, types, mode of action, applications.

UNIT IV: Microorganisms in Food Processing **15**

A) Fermented & Processed Foods

i) Indian fermented foods: Idli, Jilebi, Dhokla, Tofu.

ii) Oriental mold modified foods: Soya sauce, Miso, Hamanatto, Sufu.

iii) Fermented meats and fish: sausage, fish sauce.

iv) Fermentation: wine, vinegar.

B) Genetically Engineered Microorganisms in the Food Industry

i) Concept, advancements, principles

ii) Role of genetically engineered microbes in the food industry.

Learning Outcomes:

After learning the theory paper, the student will be able to:-

1. Understand the role of microorganisms in food and dairy industries.
2. Practically apply the techniques of food & dairy technology.
3. Comprehend the processing and preservation of milk and dairy products.
4. Prepare different fermented foods using various microorganisms.

References:-

1. K. Vijaya Ramesh (2007) Food Microbiology, MJP Publishers, Chennai – **UNIT I, II.**
2. Swaminathan M (1974) Essentials of Food and Nutrition (2nd Edition) Ganesh and Co. – **UNIT I, II.**
3. Modi H.A. (2009) Dairy Microbiology, Pointer Publishers, India – **UNIT III, IV.**
4. J.S. Yadav, Grover S., Batish V.K. (1993) Comprehensive Dairy Microbiology, Metropolitan Book Cooperative Pvt. Ltd. – **UNIT III, IV.**
5. Frazier W, Westoff D. (2013) Food Microbiology (5th Edition) Tata McGraw Hill Education – **UNIT I, II.**

MAMiT 305.E-2 – ESSENTIALS OF BIOINFORMATICS

Learning Objectives:

The student should:-

1. Learn basics of the networking and the internet.
2. Get introduced to the fundamentals of bioinformatics.
3. Learn about the tools and techniques employed in the field of bioinformatics.
4. Get acquainted to various concepts constituting bioinformatics.

Unit I: Networking and the Internet (15)

A] Computer Networking:-

Fundamentals of Networking: DSI Referencing Model, TCP/IP, Network topologies and protocols. Networking gadgets (router, switch,etc), Communication links(Wire pairs, coaxial cables, fiber optics, microwave, satellite,etc). Local Area Network (LAN), Wide Area Network (WAN), Metropolitan Area Network (MAN).

B] Network Security:-

Fundamentals, Types of attacks, Firewall, Packet filtering, Classification of data security threats, Protection Mechanism (Authentication, Access Control and Access Rules). Encryption/ Decryption techniques.

C] The Internet:-

Introduction, Concept of the Internet, World Wide Web, Browsers – Chrome, Mozilla, Firefox, Opera, Safari, IE/Edge. Search Engines- Google, Bing, Significance of the Net.

Unit II: Introduction to Bioinformatics (15)

A] Essentials of Bioinformatics:-

Introduction, Definition and History of Bioinformatics, Nature, Scope and Branches of Bioinformatics. Applications.

B] Biological Database Systems:-

Introduction to Database, Database system, Biological Databases, Criteria for Classification of biological databases and their types.

i)Nucleic acid databases(GenBank, DDBJ, EMBL).

ii) Protein Databases(Primary, Secondary and Composite).

iii) Specialized Genome Databases.

iv) Structural Classification Databases(CATH, SCOP).

v) Structural Databases(PDB).

Unit III: Tools and Techniques in Bioinformatics (15)

A] Tools and Formats:-

i) Tools: BLAST, Types of BLAST, Applications.

ii) Formats: Types of Formats, FASTA, SAM, GVF. Importance.

B] Techniques:-

i) Sequence Alignment: Introduction, Types – Global and Local Alignment, Pairwise Sequence Alignment, Multiple Sequence Alignment(MSA) : Progressive and Iterative Methods e.g. Clustal W, Clustal X.

ii) Sequence and Structure Visualization Tools:

Introduction, General Properties of Map Viewer, ORF Finder, Locus Link, Swiss PDB Viewer, Webmol, Rasmol, Chime, MOLMOL, Phymol, SQL.

Unit IV: Concepts in Bioinformatics (15)

Introduction to omics. Concept, salient features and applications of – Genomics, Proteomics, Metabolomics, Lipidomics, Glycomics, Foodomics, Transcriptomics, Pharmacogenomics and Pharmacogenetics. Significance in biological research.

Learning Outcomes:

After learning the theory paper, the student will be able to:-

1. Understand the working of the internet and networking systems.
2. Comprehend the fundamental concepts of bioinformatics.
3. Interpret and analyse computational data using different tools and formats.
4. Master the different concepts constituting the field of bioinformatics.

References:-

1. P. Narayan, Bioinformatics – A Primer – **UNIT I, II,III.**
2. Jin Xiong, Essential Bioinformatics: Genomics and Proteomics(With Practical Exercises) – **UNIT I, II, III.**
3. C. Stan Tsai, Computational Biochemistry, John Wiley and Sons – **UNIT II.**
4. N. Gautam, Bioinformatics – Databases and Algorithms – **UNIT II,III,IV.**
5. V. Rajaraman, Fundamentals of Computers, Phi Learning, ISBN:8120321758, 2001 –**UNIT I.**
6. Tanenbaum Andrew S, Computer Networks, 4th Edition, Prentice Hall PTR, ISBN:8120321758, 2003 –**UNIT I.**
7. Rohit Khurana, Computer Fundamentals and Internet Basics –**UNIT I.**

PRACTICAL COURSES

Learning Objectives:

The student should:-

1. Learn the different aspects of microbial ecology like biofilm, biodegradation, etc.
2. Get acquainted with the mechanisms employed by extremophiles for survival.
3. Learn about the nuances of the human microbiome.
4. Practically learn the constituents of research presentation like abstract, review and poster.
5. Study and practically analyze biological data using biostatistical tools.
6. Employ various methods involved in the branch of gene technology.
7. Explore the different facets of pharmaceutical microbiology by practical analysis and testing.

MAMiP 306 PRACTICAL COURSE – III: LAB - V

UNIT - I

A] Microbial Ecology

1) Adhesion of microorganisms to surface by dip slide method.
2) Study of siderophore producing microorganisms.
3) Isolation of petroleum degrading bacteria and determination of degradation rate.
4) Determination of rate of degradation of dye using microbial isolate.

B] Extremophiles

5) Isolation of thermophiles from compost heap.
6) Screening of alkaliphilic bacteria from soil/water.
7) Isolation and enrichment of psychrophiles.
8) Screening of halophilic and halotolerant microorganisms.

C] Human Microbiome

9) Qualitative analysis of the hand microbiome by suitable method.
10) Isolation of etiological agent of dental caries.

UNIT - II

A] Research Methodology

1) Abstract writing.
2) Review Writing.
3) E-poster Presentation.

B] Biostatistics

4) Determination of measures of central tendency :
   a) Mean, b) Median, c) Mode
5) Determination of measures of dispersion –
   a) Mean deviation, b) Standard deviation, c) Coefficient of verification.
6) Estimation of confidence interval for a normal distribution.
7) T-test and chi-square with test on sample data.

MAMiP 307 PRACTICAL COURSE – III: LAB - VI

UNIT - I

A] Gene Technology

1) DNA amplification by PCR.
2) In-vitro seedling growth and multiplication of carrot.
3) Isolation of plasmid by chemical method.
4) Plasmid curing.
5) Isolation of lysozyme from egg white.
6) Preparation of protoplast using lysozyme and protoplast fusion.
7) Study of bacterial transformation.
8) Demonstration of Southern Blotting.

UNIT - II

A] Pharmaceutical Microbiology

1) Determination of Epidemiological Ratios:
   a) Human Development Index, b) Mortality Ratio, c) Morbidity Ratio.
2) Extraction of bioactive ingredients from plant and its activity fraction.
3) Determination of Minimum Inhibitory Concentration (MIC) of drug.
4) Estimation of antimicrobial activity using CLSI.
5) Determination of phenol coefficient.
6) Study of antimicrobial activity of spices.
7) Determination of microbial load of non-sterile products – ointments, capsules.
8) Determination of drug sensitivity of *Streptococcus mutans*.

Learning Outcomes:

After learning the theory paper, the student will be able to:-

1. Practically comprehend the different concepts of microbial ecology and human microbiome.
2. Analyze and present research data employing the media of abstract, review and e-poster.
3. Process and comprehend biological data using biostatistical tools and techniques.
4. Practically perform experiments related to gene technology and pharmaceutical microbiology.

References:-

1. R.M.Atlas, R. Bartha (2008) Microbial Ecology: Fundamentals and Applications, 4th Ed. Pearson India Education Services – **UNIT I, II, III.**
2. C.R.Kothari (2004) Research Methodology; Methods and Techniques, 2ndEd, New Age International Publishers, New Delhi.
3. Irfan Ali Khan and Atiya Khanum, Fundamentals of Biostatistics. 3rd Edn. Ukaaz, Publications, Hyderabad.
4. Sandhya Mitra – Genetic Engineering: Principles and Practice, McGraw Hill Education (India) Pvt. Ltd.
5. Kokate C. K., Purohit A.P., Gokhale A.B. (2000) Pharmacology, 4th Edition, Nirali Prakashan.

SEMESTER IV

MAMiT 401 – INDUSTRIAL MICROBIOLOGY

Learning Objectives:

The student should:-

1. Learn basic concepts of fermentation technology.
2. Know the significance of microbial sensors.
3. Study the significance and economical aspects of solid state fermentation.
4. Get acquainted with various concepts related to intellectual property.

Unit I: Fermentation Technology **(15)**

A) Bioreactor

i) Design and operation.

ii) Batch culture fermenter : Main parts, peripherals parts and accessories, alternative vessel design, types of instrumentation, common measurement and control system, sensors.

iii) Simple continuous culture : Accessories and peripherals.

iv) Fermenter preparation and use.

v) Inoculation techniques in bioreactor, sampling from fermenter vessel.

vi) Maintenance of fermenter components.

vii) Type of organism used in fermentation.

viii) Sub fermenter system – a new approach.

ix) Solution to common problems in fermentation.

Unit II: Microbial Biosensors **(15)**

A] Concept of Biosensors

a) Cell Immobilization - Introduction, Immobilized cell system **–**

i)Surface attachment of cells.

ii)Entrapment within porous matrices.

iii) Containment behind a barrier.

iv) Self aggregation of cells

b) Design of immobilized cell reactors –

i) Mass transport phenomena in immobilized cell system.

ii) Reaction and diffusion in immobilized cell system

iii) Bioreactor design

iv) Physiology of immobilized microbial cells.

B] Types of electrochemical microbial sensors –

i) Optical biosensors.

ii) Other types.

Unit III: Solid State Fermentation and Fermentation Economics (15)

A) Solid state fermentation (SSF) :-

Introduction, comparison of SSF and submerged fermentation, Advantages, disadvantages, problems, types, Factors affecting, fermenter design for SSF, Koji manufacturing process, industrial application of SSF, amylase production – case study.

B] Fermentation economics:-

Introduction, economic objectives. Various aspects influencing fermentationeconomics – Strain improvement, High yielding strain, Market potential, fermentation media and raw material, fermentation equipments, recovery cost, water uses and recycling, effluent treatment.

Unit IV: IPR and Patenting (15)

A] Intellectual Property Rights

Introduction and concept of IPR, the World Intellectual Property Organization(WIPO), Fields of intellectual property protection, General introduction to patents, copyrights and trademarks.

B] Patents:

i) Introduction, conditions of patentability, drafting and filing a patent, examination of a patent application, infringement, exploitation of the patented invention, compulsory licenses. Utility models

ii) Indian Patent Act

C] Intellectual Property and Bioethics:

Introduction, general principles and key aspects.

Learning Outcomes:

After learning the theory paper, the student will be able to:-

1. Use and manipulate different types of fermenter and fermentation systems.
2. Comprehend the use of microbial biosensors.
3. Employ the technique of solid state fermentation for laboratory production of metabolites.
4. Utilize bioethical concepts and fundamentals for social welfare.

References:-

1. Mansi E. L. (2011) Fermentation Microbiology and Biotechnology (2nd Edition), CRC Press – **UNIT I, II.**

2. Patil S.C. (2010) Industrial Microbiology, S. Chand and Company – **UNIT II.**

3. Casida J.R. (2016) Industrial Microbiology, New Age International Pvt. Ltd. – **UNIT III.**

4. Peppler H.J., Pearlman D. (1979) Microbial Technology (2nd Edition), Academic Press – **UNIT III.**

5. Stanbury P.P., Whitekar A., Hall S.J. (2008) Principles of Fermentation Technology, Elsevier – **UNIT III.**

6. Intellectual Property Rights in India, Shodhganga, Chapter 2 – **UNIT IV.**

7. WIPO Intellectual Property Handbook (2004) 2nd Edition, Chapters 1 and 2 – **UNIT IV.**

8. Intellectual Property and Bioethics: An Overview – WIPO Booklet – **UNIT IV.**

MAMiT 402– MICROBIOLOGICAL QUALITY CONTROL AND ASSURANCE

Learning Objectives:

The student should:-

1. Learn specific requirements for production of different products in the pharmaceutical industry.
2. Know the techniques and tools for facility and instrument qualification.
3. Study the concept of clean room technology and culture maintenance and disposal.
4. Learn the essentials of analytical techniques employed in the pharmaceutical industry.

Unit I: Pharmaceutical Industry (15)

A] Schedule M:-

i) Part I-A: Specific Requirements for Manufacture of Sterile Products, Parenteral Preparations and Sterile Ophthalmic Preparations.

ii) Part I-B: Specific Requirements for Manufacture of Oral Solid Dosage Forms (Tablets and Capsules).

iii) Part I-C: Specific Requirements for Manufacture of Oral Liquids(Syrups, Elixirs, Emulsions and Suspensions).

iv) Part I-D: Specific Requirements for Manufacture of Topical Products i.e. External Preparations (Creams, Ointments, Pastes, Mulsions, Lotions, Solutions, Dusting Powders and Identical Products).

v) Part I-E: Specific Requirements for Manufacture of Metered-Dose-Inhalers(MDI).

vi) Part I-F: Specific Requirements of Premises, Plant and Materials for Manufacture of Active Pharmaceutical Ingredients (Bulk Drugs).

Unit II: Facility and Instrument Qualification (15)

A] Introduction:-

URS, IQ, OQ, PQ.

B] HVAC Qualification:-

Heating Ventilation Air Conditioning System, Constituents of the System – Temperature, Relative Humidity, Air Velocity, Differential Pressure and Room to Room Air Balancing, HEPA Filtration, LAF, Viable Count.

C] Utility Qualification:-

Purified Water System and Pharmaceutical Air Monitoring.

D] Instrument Qualification:-

1) Autoclave, 2) Dry heat sterilizer, 3)Incubator and 4) Laminar Air Flow Cabinet.

Unit III: Maintenance of Clean Room & Microbiological Laboratory (15)

A] Facility Requirements:-

Introduction and guidelines.

B] Gowning Requirements:-

Introduction and guidelines.

C] Disinfectant Qualification:-

Introduction, Types of Disinfectants, Disinfectant Efficacy Testing.

D] Clean-in Place(CIP) and Sterilize-in Place(SIP):-

Introduction, Principle, Protocol and Applications of CIP and SIP.

E] Culture Maintenance:-

Reference cultures used in the pharmaceutical industry, maintenance.

F] Disposal Systems:-

Disposal protocols and systems for cultures and media.

Unit IV: Essentials of Analytical Techniques in Pharma Industry (15)

A] Media Preparation, Sterilization and Growth Promotion.

Guidelines for a) Media Preparation, b) Sterilization and c) Growth Promotion.

B] Environment Monitoring.

Introduction, Need for EM, Procedure and Significance.

C] Endotoxin Testing

Introduction, Gel Clot Method, Kinetic Assays, Medical Devices.

D] Antibiotic / Vitamin Assay.

General Information, Equipment, Test Organism, Inoculum Preparation and Standardization, Antibiotic/Vitamin Standard and Sample Solution Preparation, Growth Media and Additional Test Solutions, Potency Testing – Plate Method and Tube Method. Calculations.

E] Bioburden Estimation of Medical Devices.

Definition of Bioburden, FDA Guidelines, Significance.

F] Microbiological Examination of Non-Sterile Products.

Product Storage and Handling, Gowning Requirements, Growth Promotion and Inhibitory Properties of the Media, Suitability of the Test Method, Test Procedure, Interpretation of the Results.

G] Preservating Efficacy Testing(PET).

Media, Growth Promotion of the Media, Suitability of the Counting Method in the Presence of Product, Test Organisms, Preparation of the Inoculum, Procedure and Interpretation.

Learning Outcomes:

After learning the theory paper, the student will be able to:-

1. Understand specific requirements for production of different products in the pharmaceutical industry.
2. Comprehend the techniques and tools for facility and instrument qualification.
3. Imbibe the concept of clean room technology and culture maintenance and disposal.
4. Master the various analytical techniques employed in the pharmaceutical industry.

References:-

1. Pharmaceutical Microbiology Manual (PMM), United States Food and Drug Administration (USFDA), ORA.007, Version 1.2, 2014.
2. Indian Pharmacopoeia (IP), Volume II (P-Z, Reference Spectra and Appendices), Ministry of Health and Family Welfare, Government of India, 1996.
3. Manohar A. Potdar, Pharmaceutical Quality Assurance, 2nd Edition, Nirali Prakashan, 2007.

MAMiT 403 E-1 DAIRY AND FOOD MICROBIOLOGY – II

Learning Objectives:

The student should:-

1. Learn concepts regarding neutraceuticals and probiotics.
2. Know the rules and regulations regarding food safety and hygiene.
3. Know the techniques for physicochemical and microbiological analysis of milk.
4. Learn the essentials of quality and waste management in the dairy industry.

Unit I: Neutraceuticals and Probiotics (15)

A) Nutraceuticals and Functional Foods

i) Concept, biological significance of nutraceuticals and nutrigenomics.
ii) Nutraceuticals and dietary supplements.
iii) Functional food in disease prevention : Angiogenesis and cardiovascular diseases, cancer, diabetes, cholesterol management and obesity.
iv) Health benefits of nutraceuticals. Pigments – chlorophyll, carotenoid, anthocyanin, isoflavonoids, omega 3 and omega 6 fatty acids.

B) Probiotics:

i) Introduction, Concept, Microrganisms
ii) Crieteria for selecting microbes as probiotics
iii) Beneficial health effects and daily intake of probiotic cultures
iv) Safety issues
v) Examples of probiotic foods

Unit II: Food Safety (15)

A) Food Safety

i) Principles of food safety as per WHO.

B) Microbiological Standards for Food Safety and Hygiene.

i) FSSAI
ii) ISO

C) Food Safety Management System Plans.

i) FSMS – Meat and Meat Products (Poultry)
ii) FSMS – Bakery and Bakery Products

Unit III: Physicochemical and Microbiological Testing of Milk and Dairy Products (15)

A) Physicochemical Testing of Milk and Dairy Products

i) Introduction
ii) Analysis of milk: Fat, total solids in milk, titrable acidity, specific gravity, ash figure, chloride value, estimation of lactose, heat stability test, heat adequacy test, protein.
iii) Test for added water.
iv) Preservatives.
v) Adulterants and tests for detection.
vi) Analysis of butter: Moisture ,fat, added salt, total titrable acidity, added boric acid.
vii) Analysis of ice-cream: fat, acidity, total solids, reducing sugars.
viii) Analysis of cheese: Moisture, fat, added salt, acidity.

B) Microbiological Testing of Milk and Dairy Products

i) Introduction.
ii) Standard Plate Count.
iii) Breed Counting method / DMC.
iv) Tests for determining bacteriological quality of different dairy products.

Unit IV: Quality and Waste Management in the Dairy Industry (15)

A) Quality Management in the Dairy Industry

i) Introduction
ii) Need of microbiological quality control
iii) Role of microbiological standards
iv) National and international agencies
v) Microbiological standards for dairy products : Sources of contamination, control methods and assessment of –air, water, packaging material, equipment hygiene, personnel hygiene.
vi) Hazard Analysis Critical Control Point – HACCP.

B) Waste Management in the Dairy Industry

i) Introduction.
ii) Sources of waste.
iii)Effects of wastes on receiving streams/ sewers.
iv) Treatment of dairy waste.
v) Outline design for 2,00,000 lit/day capacity effluent treating plant.

Learning Outcomes:

After learning the theory paper, the student will be able to:-

1. Understand the concepts of neutraceuticals and probiotics.
2. Comprehend the standards and regulations related to food safety.
3. Analyse the quality of milk with regards to physicochemical and microbiological aspects.
4. Master the different concepts related to quality management and control in the dairy industry.

References:-

1. Robert E.C. Wildman, Handbook of Neutraceuticals and Functional Goods (2nd Edition) Routledge Publishers – **UNIT I.**
2. Review Article : Neutraceuticals : A review, Skylar A. Souyoul, Katharine P. Saussy, Mary P. Lupu – **UNIT I.**
3. Manual of Methods of Analysis of Foods – Microbiological Testing – Food, Safety and Standards Authority of India, Ministry of Health and Family Welfare, Government of India, New Delhi (2012) – **UNIT II.**
4. Modi H.A. (2009) Dairy Microbiology, Pointer Publishers, India – **UNIT III, IV.**
5. J.S. Yadav, Grover S., Batish V.K. (1993) Comprehensive Dairy Microbiology, Metropolitan Book Cooperative Pvt. Ltd. – **UNIT III, IV.**

MAMiT 403.E-2 – ADVANCED BIOINFORMATICS

Learning Objectives:

The student should:-

1. Learn the fundamental concept of phylogenetics and its significance.
2. Know the basics of cheminformatics.
3. Study the techniques for molecular modeling and simulations.
4. Learn the essentials of structural biology.

Unit I: Phylogenetics (15)

Phylogeny: Phylogenetic analysis, Definition and description of phylogenetic trees and various types of trees, Method of construction of Phylogenetic trees [distance based method (UPGMA, NJ), Maximum Parsimony and Maximum Likelihood method].

Unit II: Basics of Chemoinformatics (15)

Introduction to cheminformatics, evolution of cheminformatics, History of chemical information science, uses of cheminformatics, prospects of cheminformatics. History of medicinal chemistry. Prodrugs and soft drugs, Drug targets, Drug solubility, Natural resources of lead compounds, Pharmacokinetics & drug metabolism. Biological testing and bioassays, Preclinical testing and clinical trial, Synthesis.

Unit III: Molecular Modelling & Simulations (15)

Overview of molecular modeling, molecular modelling methods. Semi-empirical methods, empirical methods, molecular mechanics. Conformations: global vs. local force fields: expressions for stretch, bond, torsion, etc. Description of various force fields: MM3, Dreiding, AMBER, CHARMM. Mechanics of Bio-macromolecules. Molecular Dynamics - Newton's equations for many particles, Verlet and related algorithms, types of dynamics, simulations: adiabatic, constant T, simulated annealing, etc. Conformational searching using MD and other methods. Free energy calculations.Dynamics of Bio-macromolecule. Electrostatics of biomolecules

Unit IV: Structural Biology (15)

Macromolecular Structure , Protein - Primary, Secondary, Supersecondary, Tertiary and Quaternary structure, Potential energy maps, Ramachandran map, Nucleic acid – DNA and RNA, Carbohydrates, Co-ordinate systems, Overview of experimental techniques to study macromolecular structures. Methods to study 3D structure: X-ray, NMR, Cryo-Electron microscopy. Validation using Procheck, Prosan II , Principles of protein folding and methods to study protein folding , Macromolecular interactions, Protein – Protein, Protein – Nucleic acids, Protein – Carbohydrates. Structure of Ribosome, Prediction of protein structure secondary structure prediction methods - First, second and third generation methods. Tertiary structure prediction. Homology modeling, fold recognition and ab initio methods.

Learning Outcomes:

After learning the theory paper, the student will be able to:-

1. Understand the fundamentals of phylogenetics.
2. Comprehend the concepts of cheminformatics.
3. Interpret and analyse computational data using molecular modeling and simulations.
4. Master the different concepts related to structural biology.

References:-

1. Friesner Richard A. Computational Methods for Protein Folding:advances in Chemical Physics Volume 120 Kindle Edition. Publisher: New York, John Wiley & Sons. 2002. ISBN: 0471209554 - **UNIT III, IV.**
2. Jin Xiong, Essential Bioinformatics: Genomics and Proteomics(With Practical Exercises) – **UNIT I.**
3. Heilmeyer L., Friedrich P. Protein Modules in Cellular Signalling. Publisher: Amsterdam, IOS Press. 2001. ISBN: 1586031805 – **UNIT II, III.**
4. Branden ,Tooze John. Introduction to Protein Structure. Publisher: New York, Garland Publishing Inc. 1999. ISBN: 0815323050 – **UNIT II, III, IV.**

PRACTICAL COURSES

Learning Objectives:

The student should:-

1. Learn the different components of fermentation technology and microbial bionsensors.
2. Understand the nuances of solid state fermentation and its applications.
3. Study the various facets of intellectual property.
4. Practically learn analytical techniques employed in the microbiological quality control.
5. Study and practically analyze biological data using tools and techniques of bioinformatics.
6. Explore the different facets of food and dairy microbiology by practical analysis.

MAMiP 404 PRACTICAL COURSE – IV: LAB - VII

UNIT - I

A] Fermentation Technology and Biosensors

1) Determination of blood glucose by glucometer.
2) Laboratory production of alkaline protease by solid state fermentation using bacteria.
3) Protein Assay by tyrosine curve.
4) Laboratory production of citric acid by solid state fermentation using fungi and its estimation.
5) Financial survey of fermentation economics of small-scale company.

B] Intellectual Property

6) Group Discussion on: a) Patent and Copyright, b) Bioethics.

UNIT - II

A] Microbiological Quality Control and Management

1) Determination of bioburden on textile material by AATCC 101-2004 method.
2) Determination of Thermal Death Point (TDP) and Thermal Death Time (TDT) of microorganisms.

3) Evaluation of sanitary status of eatery by swab technique.
4) In-house determination of aerobic count of microbial load by settle plate technique.
5) Sterility testing of autoclave using *Bacillus stearothermophilus*.
6) Determination of efficacy of isopropyl alcohol.
7) Preservative Efficacy Testing.
8) Instrument Qualification of: a) Incubator, b) Hot air oven.
9) Detection of leaky substances from bacterial cells.

MAMiP 405 PRACTICAL COURSE – IV: LAB - VIII

UNIT - I

A] Bioinformatics

1) Study of network IP.
2) Connecting computers in a Local Area Network (LAN).
3) Searching sequence databases by BLAST –
   a)BLASTn, b) BLASTp.
4) Determination and visualization of protein structure by Rasmol
5) Construction of phylogenetic tree by MEGA.
6) Sequence analysis by Multiple Sequence Alignment.

UNIT - II

A] Food and Dairy Microbiology

1) Estimation of antioxidants by spectrophotometric method.
2) Estimation of antinutritional factors (tannic/phytic acid).
3) Detection of food adulteration.
4) Estimation of sodium benzoate from food.

5) Detection of afla toxins from food.
6) Detection of lactic acid from curd.
7) Estimation of beta amylase from sweet potatoes.
8) Estimation of pectin from plant material.

Learning Outcomes:

After learning the theory paper, the student will be able to:-

1. Comprehend the different components of fermentation technology and microbial bionsensors.
2. Practically produce industrially important products in laboratory using SSF.
3. Understand the components of intellectual property like patent, copyright and bioethics.
4. Perform analytical techniques employed in the microbiological quality control.
5. Practically analyze biological data using tools and techniques of bioinformatics.
6. Perform experiments related to food and dairy microbiology.

References:-

1. Peppler H.J., Pearlman D. (1979) Microbial Technology (2nd Edition), Academic Press
2. Pharmaceutical Microbiology Manual (PMM), United States Food and Drug Administration (USFDA), ORA.007, Version 1.2, 2014.
3. Manual of Methods of Analysis of Foods – Microbiological Testing – Food, Safety and Standards Authority of India, Ministry of Health and Family Welfare, Government of India, New Delhi (2012)
4. Friesner Richard A. Computational Methods for Protein Folding:advances in Chemical Physics Volume 120 Kindle Edition. Publisher: New York, John Wiley & Sons. 2002. ISBN: 0471209554.

Evaluation Structure
Class –M. Sc II
(Physics, Zoology, Botany, Microbiology)

Semester III

	ESE	Internal Exam		Practical			Submission		Total
		ISE-I	ISE-II		Exam	Journal	Project Part-III	Student Performance	
Paper IX	80	10	10	Lab- V	70	10	15	05	
Paper X	80	10	10						
Paper XI	80	10	10	Lab- VI	70	10	15	05	
Paper XII	80	10	10						
Paper XIII	80	10	10						
Total	400	50	50		140	20	30	10	700

Semester IV

	ESE	Internal Exam		Practical			Submission		Total
		ISE-I	ISE-II		Exam	Journal	Project Part-IV	Student Performance	
Paper XIV	80	10	10	Lab- VII	70	10	15	05	
Paper XV	80	10	10	Lab- VIII	70	10	15	05	
Paper XVI	80	10	10						
Total	240	30	30		140	20	30	10	500

4/4/19

Controller of Examination
Y.C.Institute of Science,Satara
(Autonomous)

Course Structure
Class –M. Sc II
(Physics, Zoology, Botany, Microbiology)

M. Sc –II SEMESTER –III			
Sr. No.	SUBJECT TITLE	THEORY (TH)	
		No. of lectures	Credits
1	M*T 301	4	4
2	M*T 302	4	4
3	M*T 303	4	4
4	M*T 304	4	4
5	M*T 305	4	4
6	M*P 306	4	4
7	M*P 307	4	4
	TOTAL OF	28	28

M. Sc –II SEMESTER –IV			
Sr. No.	SUBJECT TITLE	THEORY (TH)	
		No. of lectures	Credits
1	M*T 401	4	4
2	M*T 402	4	4
3	M*T 403	4	4
4	M*P 404	4	4
5	M*P 405	4	4
	TOTAL OF	20	20

Note: Above Course structure and Evaluation Structure will be implemented from June 2019

(Dr Torane A.P.)
Academic Registrar