



**RAJARSHI SHAHU MAHAVIDYALAYA (AUTONOMOUS),
LATUR**

M. Sc. (SEMESTER PATTERN)

M. Sc. SECOND YEAR

SUBJECT: MICROBIOLOGY

SEMESTER- III and IV

CURRICULUM (CBCS)

Effective progressively from June 2020

RAJARSHI SHAHU MAHAVIDYALAYA (Autonomous), LATUR

Program: M.Sc. Microbiology

C.B.C.S

Course Structure

M. Sc. Second Year

Semester	Course code	Title of the Course	Hours/ Wk	Marks		Credits
				In Sem	End Sem	
SEM-III	P-IMU-384	Immunology	04	40	60	4
	P-AMB-385	Advanced Molecular Biology	04	40	60	4
	P-MDE-386	Microbial Diversity and Extremophyles	04	40	60	4
	P-QUB-387	Quantitative Biology (Elective)	04	40	60	4
	P-SEM-383	Seminar based on theory papers	01	25		1
	P-LAC-388	Lab. Course-IX(Based on Theory Paper P-IMU-384)	04	20	30	2
	P-LAC-389	Lab. Course-X(Based on Theory Paper P-AMB-385)	04	20	30	2
	P-LAC-390	Lab. Course-XI (Based on Theory Paper P-MDE-386)	04	20	30	2
	P-LAC-391	Lab. Course-XII (Based on Theory Paper P-QUB-387)	04	20	30	2
	TOTAL				625	
SEM-IV	P-FET-493	Fermentation Technology	04	40	60	4
	P-MPM-494	Medical and Pharmaceutical Microbiology	04	40	60	4
	P-EEM-495	Ecology and Environmental Microbiology	04	40	60	4
	P- BPG-496	Bioinformatics ,proteomics and genomics (Elective)	04	40	60	4
	P-LAC-492	Seminar based on theory papers	01	25		1
	P-LAC-497	Lab. Course-XIII (Based on Theory paper P-MIB-451 and P-MIB-452)	04	20	30	2
	P-LAC-498	Lab. Course-XIV(Based on Theory paper P-MIB-453 and P-MIB-454)	04	20	30	2
	P-DIS-499	Dissertation	04	40	60	4
	TOTAL				625	

Rajarshi Shahu Mahavidyalaya(Autonomous),Latur

Program: M.Sc. Microbiology

Curriculum: (CBCS)

M. Sc. Part-II

1. Introduction:

Draft of syllabus for M.Sc. microbiology program is designed to meet the requirements of innovative, skill based and career oriented education. The syllabus also caters for the student's need for various competitive examinations in related fields in India and abroad. The syllabus of M. Sc. microbiology course will orient and train the students in view of microbial genetics and molecular biology, occurrence of metabolic events and its relation to environment and agriculture, to understand and apply this knowledge for carrier orientation.

2. Learning Objectives of the Program:

The Board of Studies in Microbiology of this autonomous college designed the program envisioning the following objectives.

- 1) To promote a clear, complete and advanced mastery in the discipline of Microbiology.
- 2) To provide basic ideology of biological sciences with special reference to Microbiology and its related branches. To direct the students to explore the details of life forms at cellular and molecular level.
- 3) To encourage students' motivation and enthusiasm and to help them not only to appreciate the beauty of microbial life forms, their interactions with biotic and abiotic factors and their varied metabolic capabilities.
- 4) To inspire the students to explore the wonderful properties of microbial life in goodwill of sustainable development and protection of human life and environment.
- 5) To develop problem solving skills in students and encourage them to carry out innovative research projects thereby inculcating in them the spirit of knowledge creation.
- 6) To enable students to develop employable skills concurrently with an understanding of theoretical foundations and practical techniques required in R & D, quality control, regulatory function in various industries

3. Program specific Outcomes:

The Masters in Microbiology Program will address the increasing need for skilled scientific manpower with an understanding of research ethics involving microorganisms to contribute to application, advancement and impartment of knowledge in the field of microbiology and molecular biology globally. The laboratory training will empower them to prepare for careers in broad range fields.

M.Sc. Microbiology student will acquire:

- 1) Knowledge about various methodological and analytic approaches that are used within the specialization.
- 2) Knowledge of the leading edge in a chosen specialized area of Microbiology, based on own research experience from a master's project and literature survey.
- 3) Aptitude to compete in national level competitive exams such as NET-JRF or GATE or International exams and can pursue career in higher studies.
- 4) A better theoretical and practical insight into methods used to obtain the knowledge of microbiology with respect to microbial physiology and metabolism, molecular genetics, biosynthesis of proteins, enzymology, microbial pathogenicity, environmental and agricultural microbiology, genetic engineering and microbial technology.
- 5) The practical skills to demonstrate the use of equipments, technologies and standard operating procedures common to microbiology.
- 6) Ability to apply the scientific method and hypothesis testing in the design and execution of experiments, hypothesis generation, collection and analysis of data, and interpretation and presentation of results.
- 7) Talent to critically evaluate and predict the technological, ethical, social and environmental impacts associated with the microbiological activities and their by acknowledges health, safety and environment (HSE) issues in handling chemicals and microbiological materials.
- 8) Skill to communicate scientific outcomes to the general public and experts by writing well structured reports; through scientific publications and posters, and by Oral presentations.

4. Employability

- i. Skilled manpower suitable for academic and research institutions as technicians.
- ii. Suitable for different government and non-governmental and private companies
- iii. Skilled students who can do PhD and contribute to field of Microbiology

5. Duration of the Course:

Two years.

6. Eligibility for the Course:

B.Sc. Microbiology or one of the optional subject should be Microbiology at B.Sc. Level.

7. Intake Capacity:

30

8. Fees for Course:

As per University/College rules.

9. Admission / Selection procedure:

Admission by merit through Registration

10. Standard of Passing:

As per BOE Norms.

11. Nature of question paper with scheme of marking:

As per BOE Norms.

13. List of book recommended:

Included in syllabus.

15. Rules and regulations and ordinance if any:

As per UGC/University/College rules

16. Medium of the language:

English

RAJARSHI SHAHU MAHAVIDYALAYA(AUTONOMOUS) , LATUR

M. Sc. Second Year Semester III

MICROBIOLOGY

COURSE –IMMUNOLOGY

COURSE CODE: P-IMU-384

Total Teaching Hours:60

Marks: 100, Credits: 4

Periods/Week: 4

CIA- 40, ESE- 60

Course objectives:

- To understand and be able to explain the defense system of human body.
- Study of various applications of Immunological techniques.
- To study Immunological system and immune responses-Hypersensitivity and autoimmune diseases.

Course outcome:

After successful completion of course students are able to

- Gain information about different types of lymphoid organs as primary and secondary lymphoid organs.
 - Understand Immunogen and immunoglobulin, Organization and Expression of Immunoglobulin genes, and Major, Minor Histocompatibility Complexes and Clinical immunology.
-

Unit I: Organs and Cells of Immune System

15

- 1.1 Primary lymphoid organs, thymus, bone marrow- structure and function. Lymphatic system, transporter of antigen introduction.
- 1.2 Secondary lymphoid organs, spleen and lymph nodes structure and functions. Mucosal associated lymphoid tissue, (MALT) - tonsils. Cutaneous associated lymphoid tissue, keratinocytes and Langerhans cells - Location and immunological functions.
- 1.3. Lymphoid cells - B- lymphocytes and T lymphocytes - maturation, activation and differentiation. Receptor on B and T cells. Null cells, $\gamma \delta$ T cells - Intraepithelial lymphocyte (IEL) - function, Mesangial cells, Microglial cells - Structures and secretions - interleukin I, hydrolytic enzymes, complement proteins, α – Interferon, Tumor necrosis factor α (TNF - α) (IL- 6, GM- CSF, G- CSF, M- CSF).
- 1.4. Growth factors associated in haematopoiesis, Granulocytes -Neutrophile, Basophile, Eosinophile -immune response generated against parasite by granulocytes.
- 1.5. Mast cell - Structure, function in innate immunity and acquired immunity. Dendritic cell - structure and function.

Unit II: Immunogens and Immunoglobulin

15H

- 2.1 Types of antigens - Exogenous, Endogenous, Autologous, Xenogenic and Allogetic. General properties of antigens -Molecular size, chemical composition, foreignness, specificity, haptens, super antigens and adjuvants: Freund, complete and incomplete adjuvants, Depot effect, Macrophage activation, Effect of lymphocyte, antitumor action.
- 2.2 Epitopes: A.A.sequence /structure. Immunoglobulins: Classes, Structure, distribution and function. Isotypic, Allotypic, Idiotypic determinants. Idiotypic network. Antibody production theories.

Unit III: Organization and Expression of Immunoglobulin genes.

15H

- 3.1 Genetic model for Ig structure, Germ line and somatic variation models, Dryer and Bennett two gene models, K chain genes, λ chain genes, Heavy chain genes, VH gene segments.
- 3.2 Gene rearrangement in VH region -In light chain, In heavy chain, Mechanism of variable region DNA rearrangement.
- 3.3 Generation of antibody diversity, Regulation of Ig gene transcription

Unit IV: Major and Minor Histocompatibility Complexes.

15 H

- 4.1 MHC class-I, MHC class-II - Structure of molecules, gene organization. Genetic polymorphism of molecule, Peptide interaction with molecule, MHC and immune responsiveness, MHC and susceptibility to infectious diseases.
- 4.2 Minor MHA - structure, role and genetics, HLA system, Antigen processing and presentation.
- 4.3 Hypersensitivity, Immunology of Tumors, Immunodeficiency diseases, autoimmune diseases, Immunomodulation / Immunological tolerance.

REFERENCES:

- 1) A handbook of practical immunology by G. P. Talwar, Vikas Publishing House, New Delhi.
- 2) Genes VII by Benjamin Lewin, Oxford University Press.
- 3) Immunology (2nd edition) by C. Vaman Rao, Narosa publication.
- 4) Immunology (2nd edition) by Janis Kubly, W. H. Freeman and company.
- 5) Immunology (8th Edition) by D. M. Weir, Churchill Livingstone.
- 6) Roitt's Essential Immunology (9th edition) by Ivan Roitt, Blackwell Sciences.

M. Sc. Second Year Semester III
MICROBIOLOGY
LAB. COURSE-IX
Based on Theory Paper
IMMUNOLOGY
(Course Code: P-LAC-388)

Teaching Hours 30

Marks 50 (Credit: 02)

Specific Program Outcome:

- Understanding of diverse Microbiological processes. Basic skills such as culturing microbes, maintaining microbes, safety issues related to handling of microbes, Good Microbiological practices etc.
- Moderately advanced skills in working with microbes such as Pathogens.
- The student will be equipped to take up a suitable position in academia or industry, and to pursue a career in research if so desired.

Specific Course Outcome:

After successful completion of this course student will acquire skills to perform different immunological reactions .

Student will be able to apply skills to perform serological diagnosis of diseases

1. Antigen – Antibody reactions
 - a. Agglutination –
 - b. SlideTest – Widal test
 - c. Tube test - Dreyer's technique
 - d. Bordet Durham's technique
 - e. Precipitation - Slide - VDRL, RPR, RA
 - f. Complement fixation test - Coomb's test (demonstration)
2. Radial Immunodiffusion
3. Immunohaematology.
 - a. DLC, TLC, RBC count
 - b. Blood grouping .
4. Separation of serum proteins by electrophoresis.
5. Preparation of 'H' antigen of *S. typhi* by Craigies tube method.
6. Preparation of 'O' antigen of *S. typhi* by phenol agar method.

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M. Sc. Second Year Semester III

MICROBIOLOGY

COURSE TITLE –ADVANCED MOLECULAR BIOLOGY

COURSE CODE: P-AMB-385

Total Periods: 60 ,Periods/Week: 4

Credits: 4 ,Max. Marks: 100,

CIA- 40, ESE- 60

Course objectives: Syllabus of the Course Advanced molecular biology is designed to:

- Understand Modern techniques in molecular biology.
- Understand cloning methods of cloning.
- Understand role of Recombinant DNA in industrial and forensic science field.
- Understand manipulation of microbial genome for beneficial purpose.

Course outcomes:

After successful completion of course students are able to

- Describe and demonstrate techniques of gene cloning and categorize essential tools in genetic engineering and hybridization techniques.
- Compose polymerase chain reaction and apply PCR for molecular diagnosis of viral bacterial pathogens.
- Describe methods of DNA insertion into host cell and construction of cDNA. Apply plant transformation technology.

Unit I: Basic tools of r DNA Technology

15H

- 1.1 Enzymes used with their types, mode of activity and examples: Nucleases Exonucleases (BAL 31 nuclease, Exonuclease I, III), Endonucleases.
- 1.2 Restriction endonucleases type I, II, III, restriction modification system: nomenclature and classification of type II endonucleases (S1 nuclease).
- 1.3 DNA polymerase (E. coli DNA pol. I, T7 DNA Pol., Klenow fragments, Thermostable DNA Pol., Terminal Transferase and Reverse Transcriptase).
- 1.4 DNA ligation (Linkers and Adaptors). DNA Manipulating enzymes (Polynucleotide kinase, Phosphatase, Methylase, Topoisomerase and Ribonucleases).
- 1.5 Cloning Vectors (their structure, genealogy and derivatives): Plasmids (pBR 322 and pUC18). Bacteriophage lambda (λ), Cosmids , Phasmids and Phagemids as vectors.
- 1.6 Artificial chromosome vectors (YACs, BACs, PACs, and MACs). Animal virus derived vectors, SV40vaccina/bacculo and retroviral vectors. Expression vectors, Shuttle vectors, Integrative vectors.
- 1.6 Gene probes: development and labeling of DNA and RNA probes.

Unit II: Nucleic acid amplification, Sequencing and Hybridization Techniques 15H

- 2.1 Polymerase Chain Reaction (PCR) -Primer design, fidelity of thermal enzymes, DNA polymerase, variations in PCR and its applications.
- 2.2 PCR in gene recombination, deletion, addition, overlap extension and SOEing, site specific mutagenesis, PCR in molecular diagnostics, viral and bacterial detection.
- 2.3 Methods of nucleic acid detection, sequencing methods (enzymatic DNA sequencing, chemical DNA sequencing, principles of automated DNA sequencing, RNA sequencing, thermal cycle dideoxy DNA sequencing, and pyrosequencing).
- 3.3 Methods of nucleic acid hybridization (Southern blotting, Northern blotting, in situ hybridization). DNA fingerprinting, chromosome walking and jumping.

Unit III: Cloning and Screening methodologies 15 H

- 3.1. Insertion of foreign DNA into the host cells: transformation, transfection: chemical and physical method, liposomes, microinjection, electroporation, biolistic, somatic cell fusion, gene transfer by pronuclear microinjection.
- 3.2 Cloning and expression in yeast (*Saccharomyces*, and *pichia*), animal and plant cells. Plant transformation technology: Basic of tumor formation, hairy root, features of Ti and Ri plasmids, mechanism of DNA transfer, role of virulence gene, use of Ti and Ri as plasmids vectors. Factors affecting expression in plants and animal cells, strategies to create knockout (KO) cells and transgenic animals.
- 3.3 cDNA and genomic cloning, expression cloning, jumping and hopping libraries, phage display. Construction of cDNA and genomic DNA libraries. Screening libraries with gene probes, colony hybridization, plaque hybridization, screening by gain of function, immunological screening.

Unit IV: Applications of rDNA technology and Legal issues 15H

- 4.1 Molecular Markers- types and applications. Construction of molecular maps (genetic and physical maps). DNA chip Technology and Microarrays (a brief account).
- 4.2 Applications of recombinant DNA technology in medicine, agriculture, Forensic and veterinary sciences.
- 4.3 Engineering microbes for the production of antibiotics, enzymes, Insulin, growth hormones, monoclonal antibodies etc. Human genetic engineering and Gene therapy - methods of gene therapy, gene therapy in treatment of diseases, Stem cell therapy, Future of stem cell therapy, gene targeting. Gene silencing in bacteria. CRISPR- Cas systems for editing and targeting genome.
- 4.4 Science and the constitution - ethical, legal and environmental issues associated with rDNA Technology.

REFERENCES

- 1) DNA cloning: A practical approach by D.M. Glover and D.D. Harnes, RL press, Oxford 1995.
- 2) Essentials of molecular biology vol. I (A Practical Approach) by Brown T.A., IRL press Oxford. 1995.
- 3) From Gene to Clone by E. L. Winnacker.
- 4) Genetic engineering, principles and practice, by Sandhya Mitra. Macmillan India Ltd.
- 5) Genome mapping and sequencing by Ian Dunham. Horizon Scientific press.
- 6) Manipulation and expression of Recombinant DNA. Robertson.
- 7) Methods in enzymology gene expression technology by D.A Godgel. Academic press Inc, San Diego.
- 8) Methods in enzymology guide to molecular cloning techniques, vol. 152 S. L. Berger. Academic press .Inc, san Diegn, 1996.
- 9) Molecular biotechnology (2nd edition), by S.B. Primrose, Blackwell Scientific publishers, Oxford.
- 10) Molecular biotechnology: principles and application of Recombinant DNA II by Bernard R. Glick and J. Pastemak, ASM publication.
- 11) An introduction to genetic engineering (2nd edition) by Nicholl D.S.T., Cambridge University press, Cambridge, U.K.
- 12) PCR application. Protocol for functional genomics by Michael A. Innis. David H., Gelfand John J. Sninsky, Academic Press.
- 13) PCR technology- principles and application for DNA amplification by Henry A Erilch (Ed) Stockton Press. 1989.
- 14) Route maps in gene technology by M.R. Walker and R. Rapley, Blackwell science, Oxford.
- 15) Molecular cloning by Sambrook J, Fritsch E.F and Maniatis, cold spring harbor laboratory press, New York.
- 16) Principles of Gene Manipulation and Genomics, Third Edition. S.B. Primrose, S.B. and R.M. Twyman, Blackwell Publishing Company, Oxford, UK. 2006
- 17) Gene Cloning and DNA Analysis: An Introduction. Fifth Edition. T.A. Brown, WileyBlackwell, UK. 2006.
- 18) Ethics of Emerging Technologies: Scientific Facts and Moral Challenges. John Wiley and Sons Inc. Thomas F. Budinger and Miriam D. Budinger. 2006.

M. Sc. Second Year, Semester III

MICROBIOLOGY

LAB. COURSE-X

Based on Theory Paper ADVANCED MOLECULAR BIOLOGY

(COURSE CODE: P-LAC -389)

Hours 30

Marks 50(Credit: 02)

Course Objectives

Learning objectives of the Lab course are

- Understand Basic molecular techniques.
- Understand Determination of molecular size of DNA, and Plasmid.
- Understand and design experiments to study gene expression in bacteria.
- Understand gene cloning and its uses.

Course outcomes

After successful completion of course student will be able to perform

- Isolation of DNA and Plasmid
 - PCR techniques.
 - Restriction mapping.
 - Selection of Transformed cells.
-

1. Isolation of pBR 322/ pbluescript by alkaline detergent method - A mini prep procedure
2. DNA fingerprinting.
3. DNA ligation by T4 DNA ligase.
4. DNA molecular size determination.
5. Isolation of genomic DNA and its confirmation by Southern blotting
6. Isolation of plasmid DNA and its Restriction digestion.
7. PCR amplification from genomic DNA and analysis by agarose gel electrophoresis.
8. RAPD application.
9. Restriction mapping.
10. Demonstration of gene cloning.
11. Selection of transformed cells by blue white selection techniques

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M. Sc. Second Year

Semester III

MICROBIOLOGY

COURSE TITLE: MICROBIAL DIVERSITY AND EXTREMOPHYLES

COURSE CODE: P-MDE-386

Total Periods: 60

Periods/Week: 4, Credits: 4,
Max. Marks: 100, CIA- 40, ESE- 60

Course objectives: Syllabus of the course Microbial diversity and extremophiles is designed to-

- Understand microbial habitat.
- Understand physiology of Archaea family of bacteria.
- Understand how microbes live in extreme condition.
- Understand process of isolation and use of Extremophiles microbes.
- Understand complex diversity of microbes.

Course outcomes:

After successful completion of course students are able to

- Understand and explain distribution, abundance and ecological niches of microbes, Construct, Demonstrate Phylogenetic relationship between Bacterial, Archaeal, Eucaryal.
- Describe primitive life form and adaptation of microbes to it.
- Describe and explain the microbial diversity present in different extreme environment. Describe distribution, abundance, classification of Extremophiles.
- Describes structure and applications of products synthesized by Extremophiles.

Unit I: Biodiversity and Thermophiles

(15)

- 1.1 Introduction to microbial diversity, the fundamental similarity of all living things, facets of microbial diversity, Types-Bacterial, Archaeal, Eucaryal, Characteristics and Classification of Archae (Methanogens).
- 1.2 Classification, Hyper-thermophilic habitat and ecological aspects. Molecular basis of thermo-stability, Heat stable enzymes and metabolism, Genetics of thermophiles, Minimal complexity model systems.
- 1.3 Commercial aspects of thermophiles and application of thermoenzymes.

Unit II: Acidophiles and Alkalophiles

(15)

- 2.1 Acidophiles- Classification, life at low pH, acido-tolerance, applications.
- 2.2 Alkalophiles-Isolation, Distribution and Taxonomy. Cell structures - Flagella, Cell wall, Cell membrane. Physiology - Growth conditions, Mutants, Antiporters and alkaliphily. Intracellular enzymes. Molecular biology- Alkalophiles as DNA sources, secretion vectors, promoters.

2.3. Enzymes of Alkalophiles and their applications.

Unit III: Psychrophiles (15)

3.1. Conditions for microbial life at low temperature Climate of snow and ice, limits for life at subzero temperature.

3.2. Microbial diversity at cold ecosystem – snow and glaciers ice, sub glacial environments, psychro piezophiles, permafrost, anaerobic and cyanobacteria in cold ecosystem, microalgae in Polar Regions.

3.3. Molecular adaptations to cold habitats –Membrane components and cold sensing, cold adapted enzymes, cryoprotectants and ice binding proteins, role of exopolymers in microbial adaptations to sea ice.

Unit IV: Halophiles and Barophiles (15)

4.1. Halophiles- Classification, Halophilicity and Osmotic protection, Hypersaline Environments, Eukaryotic and prokaryotic halophiles Halobacteria – cell wall. Membranes, compatible solutes, osmoadaptations or halotolerance, Applications of halophiles and the ir extremozymes.

4.2. Barophiles- Classification, high pressure habitat, life under pressure, barophily, death under pressure.

REFERENCES:

- 1) Advances in applied microbiology. Vol.X, by Wayne W. Umbreit and D. Pearlman
Academic Press.
- 2) Brock biology of Microorganisms. XI by Michael T. Madigan, John M. Martinko.
Pearson Education International.
- 3) Extreme environment. Metabolism of microbial Adaptation by Milton R., Heinrich
Academic Press.
- 4) Microbial ecology. Fundamental and applications by Ronald M. Atlas and Richard
Bartha. II and IV edition.
- 5) Microbial Ecology. IInd edition by R. Campbell. Blackwell scientific
publication.
- 6) Microbial life in extreme Environment by D.J. Kushner. Academic Press.
- 7) Microbiology of extreme Environment and its potentials for Biotechnology by N.
S. Da Coasta, J. C. Duarata,, R.A.D. Williams. Elsisver applied science, London
- 8) Thermophiles. General, Molecular and applied Microbiology by Thomas
D.Brock.
Wiley Interscience publication.
- 9) Microbial ecology, Larry L. Barton and Diana E. Northup, Wiley-Blackwell.
- 10) Principles of microbial diversity, James W. Brown, American Society for
Microbiology press

M. Sc. Second Year, Semester III
MICROBIOLOGY
LAB. COURSE-XI

Based on Microbial Diversity and Extremophiles

(Course Code: P-LAC-390)

Teaching Hours 30

Marks 50(Credit: 02)

Course Objectives

Learning objectives of the Lab course are

- Understand diverse Microbiological processes.
- Understand Basic skills such as culturing microbes, maintaining microbes, safety issues related to handling of microbes, Good Microbiological practices etc.
- Moderately advanced skills in working with microbes such as Pathogens.

Course Outcomes

After successful completion of course student will be able to

- Students are enabled to isolate thermophiles, halophiles by studying different parameters.
 - Isolation of thermophiles from hot water spring (Study at least one thermostable enzyme).
-

1. Studies on halophiles isolated from high salt habitat. (Study its pigmentation and salt tolerance phenomenon).
2. Studies on alkalophiles and its enzymes (any one) isolated from extreme alkaline environment.
3. Biogenic methane production using different wastes.
4. Isolation of *Thiobacillus ferrooxidans* and *Thiobacillus thiooxidans* culture from metal sulfides, rock coal and acid mine water.

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M. Sc. Second Year Semester III

MICROBIOLOGY

PAPER XII(Elective) – QUANTITATIVE BIOLOGY

COURSE CODE: P-QUB-387

Total Teaching Hours: 60 Periods/Week: 4, Credits: 4, Max. Marks: 100, CIA- 40, ESE- 60

Course Objectives:

- To understand role of statistics in biological field.
- To understand application of different statistical parameters.
- To use of computer for biological data assessment through statistics.
- To understand role of different statistical test for validation of experimental data.

Course Outcomes:

The students able to

- Explain basic of biostatistics, like mean, mode, standard deviation etc.
 - Describe and apply the biostatistics for analysis of data.
 - Explain and understand the different methods that has been used in research like framing of hypothesis, research paper formulation, types of research papers etc.
 - Describe working of computer application and it's uses.
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Unit I: Introductory biostatistics and Measures of Central Tendency (15)

- 1.1 Introductory biostatistics: Sampling. Data collection and presentation: Types of data, Methods of data collection. Graphical (Histogram, frequency polygon and o give curves, Box plot, Scatter plot, survival curves) and diagrammatic (Simple bar diagram, percentage bar diagram, multiple bar diagram, sub - divided bar diagram and pie diagram) representation of data.
- 1.2 Measures of central tendency: Arithmetic mean, mode, and median. Empirical relationship between mean, median and mode. Quartile and percentile.
- 1.3 Measures of Dispersion: Range, Standard deviation, variance and coefficient of variance. Standard Error and its significance.
- 1.4 Measures of Skewness and Kurtosis.

Unit II: Tests of Significance and Designing of Experiment (15)

- 2.1 Tests of Significance: The concept of Null and alternative hypothesis. Parametric and non- parametric tests of significance (Chi square, t - test, F - test, H test, U test, and Z test). Correlation and Regression: Bi variate data and scatter diagram, Simple (linear) correlation and regression, Coefficient of correlation and regression and their properties.

- 2.2. Probability: Definition, Elementary properties, Types, Rules of probability. Its applications to biological problems. Probability distributions - Binomial, Poisson, Normal (Only definitions and problems).
- 2.3. Analysis of Variance: ANOVA. Experimental designs- Completely Randomized Design, Randomized Block Design. Latin square design. Factorial designs.

Unit III: Computer: Introduction and applications (15)

- 3.1. Introduction: Organization of computers. Classification of computers. Concept of hardware and software. Operating System (command line and WIMP).
Elementary ideas about programming languages and application packages for microbiologists. LIMS.
- 3.2. MS Office softwares and their applications: MS word, MS PowerPoint, and MS excel.
Applications of these softwares in Microbiology.
- 3.3. Computer based statistical techniques and statistical packages (Basics and Introduction in Short): Features of statistical softwares (free open source) Examples: SAS University Edition, Scilab, Statistical Lab, Dataplot and SOFA (Statistics Open For All) for various applications in Bioresearch.

Unit IV: Research Methodology (15)

- 4.1 Introduction: Definition, Importance and meaning of research. Qualities of a good researcher. Characteristics of research. Types of research. Steps in research. Identification and selection of research problems. Formulation of hypothesis. Literature search: Information sources.
- 4.2 Scientific writing: Basic concepts of scientific writing. Scientific Documents: Definition and types- Research papers, review papers, conference reports and proceedings, project reports, theses, book reviews, research proposal, and dissertation. Basic structure of a Research Article: IMRAD format. Essentials features of abstract, introduction, review of literature, materials, methods, results and discussion, conclusion and outcome. Effective illustration - tables and figures. Reference styles - Harvard and Vancouver systems. Citation tools used in research (e.g. Mendeley).
- 4.3 Legal aspects of scientific authorship: Copyright considerations, Plagiarism and plagiarism detection softwares. Presenting and publishing research. Bibliometric measures (Impact factor & h - index).

REFERENCES

- 1) Biostatistical methods by John M. Lachin. John Wiley & Sons.
- 2) Biostatistics- 7th edition by Wayne W. Daniel. John Wiley & Sons.
- 3) Sampling methods by Murthy M.N., Indian Statistical Institute, Kolkata.
- 4) Biostatistics by Arora and Malhan, Himalaya Publishing House
- 5) Fundamentals of Biostatistics (5th) by Bernard Rosner, Ed. Duxbury Thomson
- 6) Fundamentals of biostatistics by Irfan A Khan, Atiya Khanum. Ukaaz Publications.
- 7) Statistics for biologist by Campbell R.C (1974). Cambridge University Press, UK.
- 8) Statistics in biology Vol: 1 by Bliss, C.I.K (1967) Mc Graw Hill, New York.
- 9) Design and analysis of experiments by Montgomery D.C., John Wiley & Sons
- 10) How computer work (2000) by Ron White. Tech Media.
- 11) How the internet work (2000) by Preston Garlla Tech. Media.
- 12) Practical statistics for experimental biologist by Alastair C. Wardlaw. Wiley.
- 13) Research methodology methods and statistical techniques by Santosh Gupta. Deep & Deep Publications.
- 14) Research methodology methods and techniques by C.R. Kothari. New Age International.
- 15) Research methods in Biological sciences by Palanisamy S. and M. Shanmugavelu. 1997. Palani Paramount publications, Tamilnadu. India
- 16) From Research to Manuscript- A Guide to Scientific Writing by Michael Jay Katz. Springer
- 17) How to write and publish a Scientific paper by R.A.Day
- 18) Scientific English: A Guide for Scientists and Other Professionals, Day, Robert; Sakaduski, Nancy (2011). Third Edition. ABC-CLIO.

M. Sc. Second Year, Semester III
MICROBIOLOGY
LAB. COURSE-XII
Based on Quantitative Biology
(Course Code: P-LAC-391)

Teaching Hours:30

Marks 50 (Credit: 02)

Course Objectives:

- To study data validation by using statistical analysis.
- To study implementation of statistical formulas to different types of data.
- To learn computer application.

Specific Course Outcomes:

- Students apply statistical knowledge and to correlate statistically extracted value by performing knowledge based practical.
 - Students Also acquires skill to represent data by using the computer knowledge of MS Word, Excel and power point presentation.
-

- 1) Representation of statistical data by
 - a) Histogram
 - b) Ogive curve
 - c) Pie diagram.
 - 2) Determination of statistical averages/central tendencies.
 - a) Arithmetic mean
 - b) Median
 - c) Mode.
 - 3) Determination of measure of dispersion.
 - a) Mean deviation.
 - b) Standard deviation and coefficient of variation.
 - c) Quartile deviation.
 - 4) Tests of significance-Applications of following.
 - a) Chi-square test.
 - b) t-test
 - c) Standard error
 - 5) Find out the Karl Pearson coefficient of correlation for the problem given by your subject expert.
 - 6) Creating files, folders and directories.
 - 7) Application of computers in biology using MS-office.
 - a) MS-word
 - b) Excel
 - c) Power point.
 - 8) Data presentation and analysis using MS Excel/Open Source free Statistical Packages:
 - a) Plotting graphs – bar charts, line graphs, pie charts, adding error bars
 - b) Statistical analysis of data – Students t test, ANOVA, Chi square test, F test
 - 9) An introduction to Internet, search engines, websites, browsing and downloading.
 - 10) Writing any of the scientific document with standard format.
 - 11) Make extensive literature review/survey of any topic of your interest.
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**RAJARSHI SHAHU MAHAVIDYALAYA (Autonomous),
LATUR
Program: M.Sc. Microbiology
C.B.C.S
Course Structure
M. Sc. Second Year**

Semester	Course code	Title of the Course	Hours/ Wk	Marks		Credits
				In Sem	End Sem	
SEM-IV	P-FET-493	Fermentation Technology	04	40	60	4
	P-MPM-494	Medical and Pharmaceutical Microbiology	04	40	60	4
	P-EEM-495	Ecology and Environmental Microbiology	04	40	60	4
	P- BPG-496	Bioinformatics ,proteomics and genomics (Elective)	04	40	60	4
	P-LAC-492	Seminar based on theory papers	01	25		1
	P-LAC-497	Lab. Course-XIII (Based on Theory paper P-MIB-451 and P-MIB-452)	04	20	30	2
	P-LAC-498	Lab. Course-XIV(Based on Theory paper P-MIB-453 and P-MIB-454)	04	20	30	2
	P-DIS-499	Dissertation	04	40	60	4
	TOTAL				625	

RAJARSHI SHAHU MAHAVIDYALAYA (Autonomous), LATUR

M. Sc. Second Year Semester IV
MICROBIOLOGY

COURSE – FERMENTATION TECHNOLOGY

COURSE CODE: P-MIB-451

Total Teaching Hours :60

Credits: 4, Marks: 100

Course Objectives:

1. To understand versatile fermentation process of microbes.
2. To understand economical importance of multiple fermentation products.
3. To understand and use of fermented products in therapies.
4. To understand importance of intellectual property rights and patents .

Course Outcomes:

The students will be able to

1. Understand and explain different types of fermentation and industrial production of citric acid, lactic acid, enzymes, amino acid and alcoholic beverages, beer, wine.
 2. Understand about antibiotics and their production.
 3. Understand modern trends of microbial productions such as bio plastics, biopolymer, biofertilizer, bioinsecticides. Able to design and construct model of biogas production.
 4. Use techniques of enzyme immobilization and its application in food pharmaceutical and chemical industries. Students become aware of procedure of IPR patents trademarks, copyrights.
-

Unit-I Microbial Fermentations

15

- 1.1 Metabolic pathways and metabolic control mechanisms.
- 1.2 Industrial production of citric acid, lactic acid, acetic acid.
- 1.3 Industrial production of Acetone- butanol, Lysine and Glutamic acid.
- 1.4 Alcoholic beverages, distilled beverages.
- 1.5 Industrial production of enzymes (alpha amylase, lipase, xylase, pectinases, proteases)
- 1.5 Some industrial techniques for whole cell and enzyme immobilization.
- 1.6 Application and advantages of cell and enzyme immobilization in pharmaceutical, food and fine chemical industries.

Unit-II Microbial production of therapeutic compounds

15

- 2.1 Microbial production of antibiotics Beta-Lactam Antibiotics ,aminoglycosides, ansamycines (Rifamycin),

- 2.2 Industrial production of Peptide antibiotics (Quinolinones),
- 2.3 Microbial Transformation and Steroids and Sterols.
- 2.4 Vit.B-12 and riboflavin fermentation.

Unit- III Modern trends in microbial production

15

- 3.1 Modern trends in microbial production of bioplastics (PHB,PHA), Biopolymer (dextran, alginates, xanthan, pullulan).
- 3.2 Biofertilizer (nitrogen fixer *Azotobacter*, phosphate solubilising microorganisms)
- 3.3 Single cell protein production
- 3.4 Useful features of biofuels. The substrate digester and the microorganisms in the process of biogas production (Biomethanation).
- 3.5 Production of bioethanol from sugar, molasses, starch and cellulosic materials.
- 3.6 Microbial production of hydrogen gas, biodiesel from hydrocarbons.

Unit-IV Intellectual Property Rights (IPR), Patents

15

- 4.1 Intellectual Property Rights (IPR), Patents, Trademarks, copyrights, secrets, Patenting of biological materials, International co-operation, Obligations with patent applications, Trademarks and geographical indications
- 4.2 Implication of patenting, current issues, hybridoma technology etc.
- 4.3 IPR and plant genetic resources (PGRs) Patenting of higher plants and animals, transgenic organisms and isolated genes, patenting of genes and DNA sequences, plant breeders right and farmers rights.

M. Sc. Second Year Semester IV
MICROBIOLOGY
Lab. Course-XII
Based on Fermentation Technology
(Course Code: P-MIB-451)

Total Teaching Hours :30

Marks:50(Credit: 02)

Course Objectives:

1. To study different methods of production of different microbial ,antibiotics, enzymes, amino acids
2. To understand methods of production of SCP.
3. To understand methods of production of biofertilizers.

Course Outcomes:

1. Students able to design experiments for production of valuable bioproducts in the laboratory.
 2. Students Also acquires skill and can design production of biofertilizers.
-

1. Production and characterization of citric acid using *A. niger*.
2. Microbial production of glutamic acid.
3. Production of rifamycin using *Nocardia* strain.
4. Comparison of ethanol production using various organic wastes/raw materials. (Free cells / immobilized cells).
5. Laboratory scale production of biofertilizers. (Nitrogen fixer/ Phosphate solubilizers/ Siderophore producers).
6. Microbial production of dextran by *Leuconostoc mesenteroids*.
7. Microbial production of hydrogen gas by algae.
8. Enzymatic clarification of fruit juices.
9. Culturing of Chlorella / Spirulina.

REFERENCES:

1. Annual report in fermentation processes by D. Pearlman, Academic Press
2. Biology of industrial microorganisms by A. L. Demain.
3. Biotechnology. A Text Book of Industrial Microbiology by Creuger and Creuger.Sinaeur associates.
4. Fundamentals of Biochemical Engineering by Bailey and Ollis.
5. Genetics and Biotechnology of Industrial Microorganisms by C. L. Hershnergey, S.W. Queener and Q. Hegeman. Publisher ASM.Ewesis ET. Al 1998 Bioremediation Principles.Mac Graw Hill.
6. Industrial microbiology by G. Reed (ed), CBS publishers (AVI publishing comp.).

7. Manual of Industrial Microbiology and Biotechnology 2nd edition by Davis J.E. and Dmain A. L. ASM Publication.

RAJARSHI SHAHU MAHAVIDYALAYA(Autonomous), LATUR

M. Sc. Second Year Semester IV

MICROBIOLOGY

**COURSE – MEDICAL AND PHARMACEUTICAL
MICROBIOLOGY**

COURSE CODE: P-MIB-452

Total Teaching Hours :60 Periods/Week: 4,Credits: 4 Marks: 100, CIA- 40, ESE- 60

Course Objectives:

1. To understand different antimicrobial substance and their mode of action
2. To understand maintenance of antimicrobial substance
3. To working of biosensors and its application.
4. To understand different parameters and safety measures for use of antimicrobial agents.

Course Outcomes:

The students able to

1. Student have the knowledge and mechanism of action of antibiotics, synthetic antimicrobial agents, chemical disinfectants, antiseptic and preservatives. Also have knowledge of antibiotic resistance in bacteria
 2. Student able to evaluate microbial production and spoilage of pharmaceutical products. Design manufacturing procedure. Derive pharmaceuticals products by microbial fermentation process
 3. Able to understand government regulatory practices, application of biosensor and microbial enzyme in pharmaceuticals.
 4. Able to recognize good manufacturing practices and good laboratory practices. Apply quality assurance and quality management in pharmaceuticals. Use safety in microbiology.
-

Unit-I Antibiotics, synthetic antimicrobial agents

15

- 1.1 Antibiotics and synthetic antimicrobial agents (Aminoglycosides, β lactams, tetracyclines, ansamycins, macrolid antibiotics).
- 1.2 Antifungal antibiotics, antitumour substances. Peptide antibiotics, chloramphenicol, sulphonamides and quinolinone antimicrobial agents. Chemical disinfectants, antiseptics and preservatives.
- 1.3 Mechanism of action of antibiotics (inhibitors of cell wall synthesis, nucleic acid and protein synthesis). Molecular principal of drug targeting.

- 1.4 Drug delivery system in gene therapy. Bacterial resistance to antibiotics, quionolinones. Mode of action of bacterial killing by quinolinones. Mode of action of non-antibiotic antimicrobial agents.
- 1.5 Penetrating defenses –How the antimicrobial agents reach the targets (cellular permeability barrier, cellular transport system and drug diffusion).

Unit-II Microbial production and spoilage of pharmaceutical products 15

- 2.1 Microbial production and spoilage of pharmaceutical products (sterile injectable, non-injectable, ophthalmic preparation and implants) and their sterilization.
- 2.2 Manufacturing procedure and in process control of pharmaceuticals. Other pharmaceuticals produced by microbial fermentations (streptokinase, streptodornase).
- 2.3 New vaccine technology, DNA vaccines, synthetic peptide vaccines, multivalent subunit vaccines.
- 2.4 Vaccine clinical trials.

Unit- III Regulatory practices, biosensors and applications in pharmaceuticals 15

- 3.1 Financing R & D capital and market outlook, IP, BP, USP.
- 3.2 Government regulatory practices and policies, FDA perspective.Reimbursement of drug and biological, legislative perspective.
- 3.3 Rational drug design.Immobilization procedures for pharmaceutical applications (liposomes).Macromolecular, cellular and synthetic drug carriers.
- 3.4 Biosensors in pharmaceuticals. Applications of microbial enzymes in pharmaceuticals.

Unit-IV Quality assurance and validation 15

- 4.1 Good manufacturing practices (GMP) and Good laboratory practices (GLP) in pharmaceutical industry.
- 4.2 Regulatory aspects of quality control. Quality assurance and quality management in pharmaceuticals ISO, WHO and US certification.
- 4.3 Sterilization control and sterility testing (heat sterilization, D value, z value, survival curve, radiation, gaseous and filter sterilization).
- 4.4 Chemical and biochemical indicators. Design and layout of sterile product manufacturing unit (Designing of microbiology laboratory).Safety in microbiology laboratory.

M. Sc. Second Year Semester: IV

MICROBIOLOGY

Lab. Course-XIV

Based on Medical and Pharmaceutical Microbiology

(Course Code: P-MIB-452)

Total Teaching Hours: 30

Marks 50(Credit: 02)

Course Objectives:

1. To study multiple screening procedure and statistical test for pharmaceutical substances.
2. To study production of multiple antimicrobial substances. To learn antimicrobial activity of commercially available synthetic chemicals.

Course Outcomes:

1. Students able to apply bioassay procedure to for pharmaceutical products.
 2. Students Also acquire knowledge and skills to check microbial contamination of pharmaceutical products.
-

1. Spectrophotometric/ Microbiological methods for the determination of Griseofulvin.
2. Microbial production and Bioassay of Penicillin.
3. Bioassay of Chloramphenicol/Streptomycin by plate assay method or turbidometric assay methods.
4. Screening, Production and assay of therapeutic enzymes: Glucose Oxidase/Asperginase/beta lactamase.
5. Treatment of bacterial cells with cetrimide, phenol, and detection of Leaky substances such as amino acids, nucleic acids as cytoplasmic membrane damaging substances.
6. Determination of MIC and LD50 of Ampicillin / Streptomycin.
7. Sterility testing by using *B. sterothermophilus*/ *B. subtilis*.
8. Testing for microbial contamination. Microbial loads from syrups, suspensions, creams, and
9. other preparations, Determination of D-value and Z-value for heat sterilization in pharmaceuticals.
10. Determination of antimicrobial activity of chemical compounds (like phenol, resorcinol and formaldehydes) Comparison with standard products.

REFERENCES:

1. Analytical Microbiology by Fredrick Kavanagh volume I &II. Academic Press New York.

2. Biotechnology – Expanding Horizon by B.D. Singh., First Edition, Kalyani Publication, Delhi. Biotechnology by H.J. Rhem& Reed, vol 4 VCH publications, Federal Republic of Germany.
3. Drug carriers in biology & medicine by Gregory Gregoriadis. Acedemic Press New York.
4. Good manufacturing practices for Pharmaceuticals By Sydney H. Willing, MurrayM. Tuckerman, Willam S. Hitchings IV. Second edition Mercel Dekker NC New York.
5. Lippincott’s illustrative Reviews: Pharmacology Edition: 02 Maryjnycck by Lippincott’s review Publisher Pheladelphia 1997.
6. Pharmaceutical Biotechnology by S. P. Vyas& V.K. Dixit. CBS publishers & distributors, New Delhi.
7. Pharmaceutical Microbiology by W. B. Hugo & A.R. Russel Sixth Edition. Blackwell Scientific Publications.
8. Pharmacognosy by Gokhle S.D., KoKate C.K. Edition: 18, Nirali Publication.
9. Principles of medicinal chemistry Vol. 1 by Kadam S.S., Mahadik K.R., Bothra K.G. Edition: 18, Nirali Publication.
10. Quality Assurance in Microbiology by Rajesh Bhatia, Rattan LalIhhpunjani. CBS publishers & distributors, New Delhi.
11. Quality control in the Pharmaceutical industry by Murray S. Cooper Vol. 2, Academic Press New York.
12. Quniolinone antimicrobial agents by David C. Hooper, John S. Wolfson. ASM Washington DC.

RAJARSHI SHAHU MAHAVIDYALAYA (Autonomous), LATUR

M. Sc. Second Year Semester IV

MICROBIOLOGY

COURSE– ECOLOGY AND ENVIRONMENTAL MICROBIOLOGY

COURSE CODE: P-MIB-453

Total Teaching Hours : 60/Week: 4,

Credits: 4, Marks: 100

CIA- 40, ESE- 60

Course Objectives:

1. To understand ecosystem structure.
2. To understand waste product management.
3. To understand microbial minerals and heavy metal leaching.
4. To understand importance of global environmental change and its solutions.

Course Outcomes: The students able to

1. Differentiate composition and structure of environment. Sketch Food chains, Food webs and Trophic structures, Ecological pyramid.
2. Appraise Need for water management, Sources of measurement of water pollution, waste types solid and liquid. Recognize & realize Waste treatments
3. Able to understand and Interpret Biodeterioration of paints, paper & Leather. Collect information about Microorganisms involved in recovery of Metals and Oil.
4. Express ideas about Global environmental problems, Impacts and Management.

Unit-I Environment and Ecosystems

15

- 1.1 Definitions: biotic and abiotic environment .The microbial habitat.
- 1.2 Dispersal: Active and passive
- 1.3 Communities and ecosystems. Community succession (Pioneer, Successive, Climax), Competition as a Structuring Force in Succession ,Adaptation(Phenotypic and Genotypic)
- 1.4 Biomass and biofilms: Changes in community structure during biofilm succession
- 1.5 Quorum Sensing
- 1.6 Metagenomics.
- 1.7 Food chains, Food webs and Trophic structures, Ecological pyramid.
- 1.8 Primary production and energy flow : cycling of nutrients.

Unit-II Waste water and Solid Waste Treatment

15

- 2.1 Need for water management.
- 2.2 Sources of water pollution. Types of waste solid and liquid.

- 2.3 Waste characterization: physical, chemical and biological.
- 2.4 Waste treatments: Primary, Secondary and tertiary treatments.
- 2.5 Aerobic –Trickling filters, oxidation ponds.
- 2.6 Anaerobic– Anaerobic digestion, anaerobic filters & up flow anaerobic sludge.
- 2.7 Effluent treatment Schemes for Dairy, Distillery, Tannery, Sugar and Paper and textile.
- 2.8 Bioconversion of solid waste & utilization as fertilizer.
- 2.9 Bioaccumulation of heavy metal ions from industrial Effluents.

Unit- III Biodeterioration and Biotransformation

15

- 3.1 Concept of Biodeterioration.
- 3.2 Biodeterioration of paints, paper and leather.
- 3.3 Biochemistry and Microorganisms involved in recovery of Metals .
- 3.4 Microbial transformation of Mercury and Arsenic.
- 3.5 Biremediation of of xenobiotics in the environment: hydrocarbons, substituted hydrocarbons, Oil spills ,Pesticides.
- 3.6 Biosensors as environmental monitors

Unit-IV Ecology and Agricultural Microbiology

15

- 4.1 Plant growth promoting rhizobacteria(PGPR).
Mechanism of plant growth promotion.
- 4.2 Effect of inoculation with PGPR on the plant soil –microbe ecosystem
- 4.6 Interactions between PGPR and other microorganisms
- 4.7 PGPR: Bacillus, Diazotrophic bacteria, Pseudomonas, Cyanobacteria ,microalgae and AM Fungi
- 4.8 Biocontrol of plant diseases by genetically modified microorganisms

M. Sc. Second Year Semester IV
MICROBIOLOGY
LAB. COURSE-XV
Based on Environmental Microbiology
(Course Code: P-MIB-453)

Total Teaching Hours :30

Marks 50(Credit: 02)

Course Objectives:

- 1 To study microbial waste management.
- 2 To study microbial utilization of heavy metals and complex organic compound .
- 3 To learn multiple test for measure microbial activity in water.

Course Outcomes:

1. Students apply different test and methods for sewage treatment
 2. Students able to understand role of microbes in eradication of toxic substance from environment.
-

1. Physical analysis of sewage/industrial effluent by measuring total solids, total dissolved solids and total suspended solids.
2. Determination of indices of pollution by measuring: BOD/COD of different effluents.
3. Bacterial reduction of nitrate from ground waters
4. Isolation and purification of degradative plasmid of microbes growing in polluted environments.
5. Recovery of toxic metal ions of an industrial effluent by immobilized cells.
6. Utilization of microbial consortium for the treatment of solid waste [Municipal Solid Waste].
7. Biotransformation of toxic chromium (+ 6) into non-toxic (+ 3) by *Pseudomonas* species.
8. Tests for the microbial degradation products of aromatic hydrocarbons /aromatic compounds
9. Reduction of distillery spent wash (or any other industrial effluent) BOD by bacterial cultures.
10. Microbial dye decolourization/adsorption.

REFERENCES:

1. A Manual of Environmental Microbiology. 2nd Edition.2001 by Christon J. Hurst (Chief Editor), ASM Publications.
2. Advances in Waste Water Treatment Technologies. 1998. Volumes II and I by R. K. Trivedy. Global Science Publication.
3. Basic Principles of Geomicrobiology by A. D. Agate, Pune.
4. Biocatalysis and Biodegradation: Microbial transformation of organic compounds. 2000 by Lawrence P. Wacekett, C. Douglas Hershberger.ASM Publications.
5. Bioremediation by Baker K.H. And Herson D.S. 1994.MacGraw Hill Inc. N.Y.
6. Chemistry and Ecotoxicology of pollution. Edited by Des. W. Connell, G.J. Miller. WileyInterscience Publications.
7. Environmental Biotechnology by C. F. Forster and D.A., John Wase. Ellis Horwood Ltd. Publication.
8. Environmental Microbiology by Ralph Mitchell. A John Wiley and Sons.Inc.
9. Pollution: Ecology and Biotreatment by EcEldowney, S. Hardman D.J. and WaiteS. 1993. - Longman Scientific Technical.
10. Waste Water Engineering - Treatment, Disposal and Re-use by Metcalf and Eddy, Inc., Tata MacGraw Hill, New Delhi.
11. Waste Water Microbiology 2nd Edition by Bitton.

RAJARSHI SHAHU MAHAVIDYALAYA, LATUR
M. Sc. Second Year, Semester: IV
MICROBIOLOGY
**COURSE– MICROBIAL BIOINFORMATICS, GENOMICS
AND PROTEOMICS**
COURSE CODE: P-MIB-454

Total Teaching Hours:60 /Week: 4,
Max. Marks: 100, CIA- 40, ESE- 60

Credits: 4

Course Objectives:

1. To understand role bioinformatics in biological data analysis
2. To understand application biological database and various online tools.
3. To use of computer base software to manipulate genomic database.
4. To understand source of proteomics and genomics database.

Course Outcomes: After completion of this course students will -

1. understand various bioinformatics tools, databases available and sequence analysis. Gain knowledge on database concept, management, and retrieval along with utilization in gene and protein analysis.
2. Retrieve information from available databases and use them for microbial identifications and drug designing.
3. Gain ability to modify gene and protein structures in simulated systems.
4. Gain basic knowledge of statistics and tools used for several quantitative analyses in microbiology. Studying proteins. Proteomics databases.

Unit-I Basics of Bioinformatics

15

- 1.1 Introduction: Definition, history, components, and applications of bioinformatics.
- 1.2 Internet and bioinformatics. Data mining- Process, tasks, techniques and applications.
- 1.3 Database: Database management system (DBMS), biological databases and information resources, classification of biological databases.
- 1.4 Sequence alignment: Pair wise alignment, global and local alignment, end-space free alignment, gap penalty. Similarity matrices (PAM, BLOSUM). Searching sequence databases using BLAST and FASTA.

- 1.5 Pairwise sequence alignment using dynamic programming (Needleman-Wunsch and Smith-Waterman algorithms)

Unit-II Biological databases and Multiple sequence alignment

15

- 2.1 Biological databases: PubMed- the central repository for biological database. Metadatabase(Entrez-NCBI). Nucleic acid sequence databank (DDBJ, GenBank and EMBL), Ensembl.
- 2.2 Protein databases: Sequence database (PIR, Swiss-Prot, TrEMBL, Pfam, and PROSITE),
- 2.3 Structure database (PDB), Classification database (CATH and SCOPE).
- 2.4 Other biological databases (OMIM, ATCC, and KEGG).
- 2.5 Molecular visualizing tool (RasMol and MOLMOL)
- 2.6 Multiple sequence alignment: Progressive and iterative alignment and tools based on these algorithms- Clustal W and Mult Align. Multiple sequence alignment of related sequence: Position specific scoring matrices, profiles, PSI-BLAST, Markov Model or Markov chain
- 2.7 Phylogenetics: Molecular Evolution and Molecular Phylogenetics.
- 2.8 Phylogenetic tree-types constructions and basic tools for phylogenetic analysis.

Unit- III Microbial Genomics

15

- 3.1 Microbial Genome Structure and organization. Principles of microbial genomics such as sequencing, assembly, annotation of microbial genomes and its application to cultured and uncultured microbial community.
- 3.2 Methods for gene sequence analysis, types of genomics, gene functions, analysis of gene expression, significance of genome sequencing. Microbial genome projects, Human Microbiome Project.
- 3.3 DNA analyses for repeats (Direct and inverted), palindromes, folding programs. Benefits of Pharmacogenomics.

Unit-IV Microbial Proteomics

15

- 4.1 Types of proteomics, tools for proteomics- separation and isolation of proteins, methods of studying proteins.
- 4.2 Protein Structure Visualization, Comparison, and Classification. Protein structure prediction. Homology or comparative modeling- Remote homology (Threading),
- 4.3 Protein function prediction- Introduction to the concepts of molecular modeling. Drug discovery, Structure based drug designing and virtual screening by automated docking, de novo sequence. Introduction to Molecular Docking.

M. Sc. Second Year , Semester: IV
MICROBIOLOGY
LAB. COURSE-XVI
based on
Microbial Bioinformatics, Genomics and Proteomics
(Course Code: P-MIB-454)

Total Teaching Hours :30

Marks 50(Credit: 02)

Course Objectives:

1. To study data validation by using statistical analysis.
2. To study implementation of statistical formulas to different types of data.
3. To learn computer application.

Course Outcomes:

1. Students apply statistical knowledge and to correlate statistically extracted value by performing knowledge based practical.
 2. Students Also acquires skill to represent data by using the Computer knowledge of MS Word, Excel and power point presentation.
-

1. Studies of public domain databases for nucleic acid and protein sequences.
2. Determination of protein structure (PDB) by using RASMOL software
3. Genome sequence analysis by using BLAST algorithm
4. Protein sequence analysis by using BLAST algorithm
5. To prepare Phylogenetic tree and Cladogram using CLUSTAL-W

REFERENCES:

1. Bioinformatics Methods and Protocols - Misener.
2. Bioinformatics - A Practical Guide to the Analysis of Genes and Proteins. 2nd Edition by Baxevanis.
3. Bioinformatics - from Genomes to drug. 2 volumes by Lenganer.
4. Bioinformatics 2000 by Higgins and Taylor OUP.
5. Bioinformatics and molecular evolution-P.G. Higgs & T. K. Attwood, 2005 Blackwell Publishing.
6. Bioinformatics by David Mount.
7. Bioinformatics by Prakash S. Lohar., MJP publisher.

8. Data Mining for Genomics and Proteomics-Analysis of Gene and Protein Expression Data by D. M. Dziuda ,Willey publishers
9. Genomics-Fundamentals and Applications by SupratimChoudhart& David B., Carlson
10. Bioinformatics: Sequence, structure and Data Bank: A Practical Approach by Higgs.
11. Computer analysis of sequence data by Colte.
12. Essential Bioinformatics by Jin Xiong 2006 Cambridge University press

13. Introduction to Bioinformatics in Microbiology by Henrik Christensen 2018, Springer Nature Switzerland AG
14. Functional Genomics. A Practical Approach Edited by Stephen P Hunt and Rick Liveey (OUP) 2000.
15. Introduction to Bioinformatics by Altwood.
16. Protein Engineering: Principles and Practice by Cleland.
17. Microarray- Gene expression Data analysis by Causton, Brazma 2003 Blackwell Publishing
18. Protein Biotechnology by Felix Franks. Humana Press, Totowa, New Jarsey.

Web sites for Proteomics and Genomics

- 1) www.geneprot.com.
- 2) www.hybrigenis.com
- 3) www.mdsproteomics.com
- 4) www.stromix.com
- 5) www.syrrx.com

LIST OF MAJOR INSTRUMENTS

Sr.no.	Equipments / Instruments	Unit
1	Quartz Distillation unit (Bhanu make)	1
2	Lab Fermenter 5 lit capacity make (DYNA biotech)	1
3	Distillation unit (Bhanu make)	1
4	Lab Fermenter 5 lit capacity make (DYNA biotech)	1
5	Orbital shaking incubator (CIS-24)with voltage stabilizer	1
6	Cooling centrifuge (C-24 BL) with voltage stabilizer	1
7	Deluxe laboratory centrifuge (R-8C)	1
8	Laminar air flow microfilt(microfilt make)	1
9	UV visible spectrophotometer	CIC
10	FTIR	CIC

