RAJARSHI SHAHU MAHAVIDYALAYA (AUTONOMOUS), LATUR

M. Sc. (SEMESTER PATTERN)

M. Sc. SECOND YEAR
SEMESTER -IV

SUBJECT: MICROBIOLOGY

CURRICULUM (CBCS)

Effective progressively from June 2020

Rajarshi Shahu Mahavidyalaya (Autonomous), Latur

Program: M.Sc. Microbiology

Curriculum: (CBCS)
M. Sc. Part-II

Semester	Course code	Title of the Course	Hours/ Wk	Marks		Credits
				In Sem	End Sem	
SEM-III	P-MIB-351	Immunology	04	40	60	4
	P-MIB-352	Advanced Molecular Biology	04	40	60	4
	P-MIB-353	Microbial Diversity and Extremophiles	04	40	60	4
	P-MIB-354	Quantitative Biology **(Elective)**	04	40	60	4
	P-MIB-355	Seminar based on theory papers	01	25		1
	P-MIB-356	Lab. Course-IX (Based on Theory Paper P-MIB-351)	04	20	30	2
	P-MIB-357	Lab. Course-II (Based on Theory Paper P-MIB-352)	04	20	30	2
	P-MIB-358	Lab. Course-III (Based on Theory Paper P-MIB-353)	04	20	30	2
	P-MIB-359	Lab. Course-IV(Based on Theory Paper P-MIB-354)	04	20	30	2
	TOTAL			625		25
SEM-IV	P-MIB-451	Fermentation Technology	04	40	60	4
	P-MIB-452	Medical and Pharmaceutical Microbiology	04	40	60	4
	P-MIB-453	Ecology and Environmental Microbiology	04	40	60	4
	P-MIB-454	Bioinformatics ,proteomics and genomics **(Elective)**	04	40	60	4
	P-MIB-455	Seminar based on theory papers	01	25		1
	P-MIB-456	Lab. Course-XIII (Based on Theory paper P-MIB-451 and P-MIB-452)	04	20	30	2
	P-MIB-457	Lab. Course-XIV(Based on Theory paper P-MIB-453 and P-MIB-454)	04	20	30	2
	P-MIB-458	Dissertation		40	60	4
	TOTAL			625		25

Rajarshi Shahu Mahavidyalaya(Autonomous), Latur
M.Sc. Microbiology

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.

Learning Objectives of the Program:

1. The Board of Studies in Microbiology of this autonomous college designed the programm envisioning the following objectives.
2. To promote a clear, complete and advanced mastery in the discipline of Microbiology.
3. To provide basic ideology of biological sciences with special reference to Microbiology and its related branches.
4. To direct the students to explore the details of life forms at cellular and molecular level.
5. To encourage student's motivation and enthusiasm and to help them to appreciate the beauty of microbial life forms, their interactions with biotic and abiotic factors and their varied metabolic capabilities.
6. To inspire the students to explore the wonderful properties of microbial life in goodwill of sustainable development and protection of human life and environment.
7. 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.
8. 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

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 a broad range of 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.
9. Employability:

Skilled manpower suitable for academic and research institutions as technicians.
Suitable for different government and non-governmental and private companies

1. Duration of the Program:	Two years.
2. Eligibility for the Program:	B.Sc. Microbiology or one of the optional subject should be Microbiology at B.Sc. Level.
2. In take Capacity:	30
3. Fees for Program:	As per University/College rules.
4. Admission /Selection procedure:	Admission by merit through Registration
5. Standard of Passing:	As per BOE Norms.
6. Nature of question paper with scheme of marking:	As per BOE Norms.
7. List of book recommended:	Included in syllabus.
8.Rules and regulations and ordinance if any:	As per UGC/University/College rules
9.Medium of the language:	English

RAJARSHI SHAHU MAHAVIDYALAYA (Autonomous), LATUR

M. Sc. Second Year Semester IV

MICROBIOLOGY

COURSE – FERMENTATION TECHNOLOGY

COURSE CODE: P-MIB-451

Periods/Week: 4, 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 09

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 08

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 17

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 11

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.

Lab. Course-XII

FERMENTATION TECHNOLOGY

(Course Code: P-MIB-451)

Marks 50(Credit: 02) Hours 45

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

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 18

1.1 Antibiotics and synthetic antimicrobial agents (Aminoglycosides, β lactums, 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 09

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 09

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 09

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.

Lab. Course-XIV

MEDICAL AND PHARMACEUTICAL MICROBIOLOGY

(Course Code: P-MIB-452)

Marks 50(Credit: 02) Hours 45

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. s*ubtilis*.
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

Periods/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 08

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 12

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 17

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 Biremidiation of of xenobiotics in the environment: hydrocarbons, substituted hydrocarbons, Oil spills ,Pesticides.
3.6 Biosensors as environmental monitors

Unit-IV Ecology and Agricultural Microbiology 08

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

LAB. COURSE-XV
ENVIRONMENTAL MICROBIOLOGY
(Course Code: P-MIB-453)

Marks 50(Credit: 02) Hours 45

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, IVth Semester

MICROBIOLOGY

COURSE– MICROBIAL BIOINFORMATICS, GENOMICS AND PROTEOMICS

COURSE CODE: P-MIB-454

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

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 14

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 14

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 08

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 09

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.

LAB. COURSE-XVI
MICROBIAL BIOINFORMATICS, GENOMICS AND PROTEOMICS
(Course Code: P-MIB-454)

Marks 50(Credit: 02) Hours 45

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 Higgis.
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