Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya Latur (Autonomous)

Department of Microbiology

M. Sc. II

Microbiology

Curriculum (CBCS)

Academic Year: 2023-24

Rajarshi Shahu Mahavidyalaya (Autonomous), Latur

Department of Microbiology

Curriculum Structure

M.Sc. II Semester III

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-BIE-386	Bioprocess Engineering	04	40	60	4
	Elective P-QUB-387 (A) P-CMB-387 (B)	 Quantitative Biology Or Clinical Microbiology	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-BPE-386)	04	20	30	2
	P-LAC-391	Lab. Course-XII (Based on Theory Paper P-QUB-387)	04	20	30	2
		TOTAL		625		25
SEM-IV	P-FET-477	Fermentation Technology	04	40	60	4
	P-MPM-478	Medical and Pharmaceutical Microbiology	04	40	60	4
	P-BIO-479	Bioinstrumentation	04	40	60	4
	(Elective) P- BPG-480 (A) P-MMB-480(B)	Bioinformatics, proteomics and genomics Or Marine Microbiology	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-FET-477and P-MPM-478)	04	20	30	2
	P-LAC-498	Lab. Course-XIV(Based on Theory paper P-BIO-479and P- BPG-480)	04	20	30	2
	P-DIS-499	Dissertation	04	40	60	4
		TOTAL		625		25

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 astechnicians. Suitable for different government and non-governmental and privatecompanies

ii. 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

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

Learning objectives:

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

Course outcome:

After successful completion of course students are able to

1 Explain and categorize different types of lymphoid organs as primary and secondary lymphoid organs.
2 Analyze Immunogen and immunoglobulin, Organization and Expression of Immunoglobulin genes, and MHC.
3 Differentiate between different types of antigens and their role in disease causing.
4 Differentiate between MHC class I and class II structure of molecules Role of MHC in susceptibility of infection.

Unit I: Organs and Cells of Immune System 15 H

1.1 Primary lymphoid organs, thymus, bone morrow- 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 andimmunological functions.

1.3. Lymphoid cells - B- lymphocytes and T lymphocytes - maturations, activationand differentiation. Receptor on B and T cells. Null cells, γ δ 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 hematopoiesis, 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, Xenogeneic and Allogenic. General properties of antigens - Molecular size, chemical composition, foreignness, specificity, haptens, super antigens and adjuvants: Freund, completeand incomplete adjutant s, 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. Idiotype 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 andBennett 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 ofvariables 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. Geneticpolymorphism 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 andpresentation.

4.3 Hypersensitivity, Immunology of Tumors, Immunodeficiency diseases, autoimmunediseases, 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 Kuby, 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
LAB. COURSE-IX
Based on Theory
Paper
IMMUNOLOGY
(Course Code: P-LAC-388)

Teaching Hours 30 Marks 50 (Credit: 02)

Learning objectives :

- To Understand diverse Microbiological processes. Basic skills such as culturing microbes, maintaining microbes, safety issues related to handling of microbes, GoodMicrobiological 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.

Course Outcome:

After successful completion of this course student will acquire skills to performdifferent 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.

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, Marks: 100

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 ingenetic engineering and hybridization techniques.
- Compose polymerase chain reaction and apply PCR for molecular diagnosis of viralbacterial pathogens.
- Describe methods of DNA insertion into host cell and construction of cDNA. Applyplant transformation technology.

Unit I: Basic tools of r DNA Technology 15H

1.1 Enzymes used with their types, mode of activity and examples: NucleasesExonucleases (BAL 31 nuclease, Exonuclease I, III), Endonucleases.

1.2 Restriction endonucleases type I, II, III, restriction modification system: nomenclatureand 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 (Polynucleotidekinase, Phosphatase, Methylase, Topoisomerase and Ribonucleases).

1.5 Cloning Vectors (their structure, genealogy and derivatives): Plasmids (pBR 322 andpUC18). 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, DNApolymerase, variations in PCR and its applications.

2.2 PCR in gene recombination, deletion, addition, overlap extension and SOEing, sitespecific 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 situhybridization). 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 Rias plasmids vectors. Factors affecting expression in plants and animal cells, strategies tocreate 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 bygain 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 (geneticand physical maps). DNA chip Technology and Microarrays (a brief account).

4.2 Applications of recombinant DNA technology in medicine, agriculture, Forensic andveterinary 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 associatedwith rDNA Technology.

REFERENCES

1) DNA cloning: A practical approach by D.M. Glover and D.D. Harmes, 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 IndiaLtd.
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. Academicpress 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 Scientificpublishers, Oxford.
10) Molecular biotechnology: principles and application of Recombinant DNA II byBernard 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. DavidH., Gelfand John J. Sninsky, Academic Press.
13) PCR technology- principles and application for DNA amplification by Henry AErilch (Ed) Stockton Press. 1989.
14) Route maps in gene technology by M.R. Walker and R. Rapley, Blackwellscience, Oxford.
15) Molecular cloning by Sambrook J, Fritsch E.F and Maniatis, cold spring harborlaboratory 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. JohnWiley 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 it's 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.

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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 it's 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 – BIOPROCESS ENGINEERING
COURSE CODE: (P-BIE-386)
Periods/Week: 4, Credits: 4, Total Periods: 60 Max. Marks: 100, CIA- 40, ESE- 60

Course objectives:

-
- Understand ancient microbial practice that is fermentation.
- Understand industrial utilization of microbial fermentation processes.
- Understand upstream and downstream practices.
- Understand process of isolation and manipulation of industrially important microbes.
- Understand methods of separation of final fermented products.

Course outcomes:

After successful completion of course students are able to

- Describe basic modern design of bioreactors.
- Describe different types of cultures and its requirements.
- Describe importance of upstream and downstream processes.

Unit I: Introduction to Industrial Bioprocess Engineering and Bioreactors 15 H

1.1 Bioprocess engineering and industrial microbiology.
1.2 Batch growth (growth pattern and kinetics in batch culture, Environmental factors affecting growth kinetics), Monod's equation.
1.3 Continuous culture, Chemostat and Turbidostat (Construction and Working).
1.4 Basic design of bioreactor.
1.5 Bioreactor Configuration-Different parts of the bioreactor, Baffles, Impellers, Foam separators, Air spargers, Culture vessel, Cooling and heating devices, Probes for on-line monitoring
1.6 Different types of bioreactor-Batch, Continuous flow stirred tank bioreactor, Packed bed bioreactor, bubble column bioreactor, Fluidized bed bioreactor, Trickle bed bioreactor. (Their basic construction and working, and distribution of gases.)
1.7 Atomization in fermentation technology.

Unit II: Mass Transfer and Sterilization 15 H

2.1 Transport phenomena in bioprocess system: Gas liquid mass transfer in cellular systems,
2.2 The oxygen requirement in industrial fermentation.
2.3 Determination of Kla values, Gassing out techniques.
2.4 Aeration/Agitation and its importance.
2.5 Medium sterilization,
i) The Design of Batch sterilization processes calculation of Del factor.
ii) The design of continuous sterilization processes

Unit III: Upstream processing **15 H**

3.1 Screening and strain development program, maintenance of stock culture.

3.2 Formulation of media, Development of Inoculum.

3.3 Sterilization of fermentation media bioreactors, Media.

3.4 Scale up of the fermentation process from shake flask to industrial level.

3.5 Solid state fermentation process.

Unit IV: Down Stream Processing **15 H**

4.1 Downstream processes: Introduction,

4.2 Separation of particulates material- Filtration, Centrifugation, Sedimentation,

4.3 Emerging technologies for cell recovery.

4.4 Product isolation, Extraction, Solvent extraction, Aqueous two phase system, sorption, Precipitation, Reverse osmosis, Ultra filtration.

4.5 Recent trends in Product recovery:

REFERENCES:

1. James E. Bailey and David F Ollis, Biochemical Engineering Fundamentals, McGraw Hill Publication.
2. Shuler and FikretKargi, Bioprocess Engineering basic concepts, 2nd edition, Prentice Hall publication.
3. Stanbury PF, Whitekar, A And Hall S J, Principles of fermentation Technology, Pergam on Press.
4. Peppler and Perlmen, Microbial Technology, Vol I and II, Academic Press.
5. Cruger and Cruger, Biotechnology: A text Book of Industrial Microbiology.

M. Sc. Second Year
Semester III
MICROBIOLOGY
Lab. Course-VIII
Based on Theory Paper: Bioprocess engineering
(Course Code: P-LAC-390)
Total Teaching Hours:30 **Marks 50(Credit: 02)**

Course Objectives

Learning objectives of the Lab course are

- Understand isolation techniques of industrially important microbes and the effect of different physical parameter on it.
- Understand effect of various culture on fermentation process.
- Understand isolation and estimation of enzyme, protein and amino acid.

Course outcomes

After successful completion of course student will be able to

- Isolate industrially important microbes.
- Study different types of culture methods.
- Isolation and estimation of biomolecules**.**

Experiments

1. Isolation of Industrially important microorganisms for microbial processes.
2. Determination of Thermal Death Point (TDP) and Thermal Death Time (TDT) of microorganisms for design of a sterilizer.
3. Cultivation and determination of growth curve of bacteria E. coli in batch reactor/flask.
4. Continuous cultivation of bacteria in laboratory (Chemostat)
5. Study of mixed culture and its comparison with the pure culture (growth pattern).
6. Designing of batch bioreactor.
7. Determination of Oxygen Absorption rate as a function of flask size.
8. Determination of Oxygen Absorption rate as a function of RPM on shaker.
9. Determination of KLa.
10. Fermentative production and recovery of amino acid (Glutamic acid).
11. Fermentative production and recovery of alkaline protease.
12. Estimation of amino acids.
13. Estimation of Alkaline protease.

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M. Sc. Second Year

Semester III

MICROBIOLOGY

PAPER XII (Elective: A) – 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.

Unit I: Introductory biostatistics and Measures of Central Tendency 15 H

1.1 Introductory biostatistics: Sampling. Data collection and presentation: Types ofdata, 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 diagramand pie diagram) representation of data.

1.2 Measures of central tendency: Arithmetic mean, mode, and median. Empiricalrelationship between mean, median and mode. Quartile and percentile.

1.3 Measures of Dispersion: Range, Standard deviation, variance and coefficient ofvariance. Standard Error and its significance.

1.4 Measures of Skewness and Kurtosis.

Unit II: Tests of Significance and Designing of Experiment 15H

2.1 Tests of Significance: The concept of Null and alternative hypothesis. Parametric andnon- 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 RandomizedDesign, Randomized Block Design. Latin square design. Factorial designs.

Unit III: Computer: Introduction and applications 15 H

3.1. Introduction: Organization of computers. Classification of computers. Concept ofhardware and software. Operating System (command line and WIMP).
Elementary
ideas about programming languages and application
packages formicrobiologists. LIMS.
3.2. MS Office softwares and their applications: MS word, MS PowerPoint, and MSexcel.
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 H

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 featuresof 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 (5^{th}) by Bernard Rosner, Ed. Duxbury Thomson
6) Fundamentals of biostatistics by Irfan A Khan, Atiya Khanum. UkaazPublications.
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 AgeInternational.
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 MichaelJay 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 valueby performing knowledge based practical.
- Students Also acquires skill to represent data by using the computerknowledge of MS Word, Excel

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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 yoursubject 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

M. Sc. Second Year

Semester III

PAPER XII (Elective B) – Clinical Microbiology

COURSE CODE: P-CMB-387

Total Teaching Hours: 60 Periods/Week: 4, Credits: 4, Max. Marks: 100

Learning Objectives:

LO 1. To study host parasite interactions.
LO 2. To study important Bacterial , protozoan, fungal diseases in human being
LO 3. To study important viral diseases.
LO 4. To learn methods used for diagnosis of diseases.

Course outcomes:

After successful completion of course students are able to

CO 1. Describe host parasite relationships, virulence of pathogen and mode of transmission of infection.
CO 2. Explain aetiology ,pathogenesis , symptomatology and treatment of Bacterial , protozoan, fungal disease.
CO 3. Explain aetiology ,pathogenesis , symptomatology and treatment of viral diseases.
CO 4. Describe methods of diagnosis of diseases.

Unit I Host parasite relationships.

1. Early discovery of pathogenic microorganisms.
2. Development of medical microbiology as a discipline.
3. Normal microbial flora of the human body and their importance.
4. Host parasite relationships: Definitions: infection, invasion, pathogen, virulence and pathogenicity , toxigenicity, Aggressive factors of pathogen
5. Quantitative measures of virulence: minimal lethal dose (MLD), LD 50 , ID 50, TCID 50.depolymerising enzymes, organotrophism.
6. Transmission and spread of infection. carrier, types of carriers. Course of infection.
7. Molecular diagnosis of diseases: basic principles and techniques involving nucleic acid in relation to laboratory evaluation of disease.

Unit II: Important Bacterial , protozoan, fungal diseases of human beings

(Short description of causal agent, pathogenesis, diagnosis and treatment)

1. Bacterial diseases: Staphylococcal infections , Typhoid, Cholera, Syphilis, Gonorrhoeae , Tuberculosis, Diphtheria, Tetanus, Botulism, Meningitis, Pneumonia, Enteritis.
2. Introduction to protozoan, fungal and helminthes diseases: Malaria, Kalaazar, Giardiasis, , toxoplasmosis & leishmaniasis;
3. Superficial, subcutaneous, systemic and opportunistic mycoses .

Unit III Important viral diseases of human beings

Study of important viral diseases with reference to causative agent, pathogenesis,

symptoms, transmission, control measures, epidemiology and diagnosis.

1. Hepatitis, influenza, rabies, polio, chicken pox, Mumps and Measles, herpes, dengue fever, AIDS and viral cancers.
2. An overview of emerging and re emerging viral diseases: Ebola, SARS, Hanta and Chikungunya.

Unit IV Diagnostic tests and drug resistance

1. Principle of different diagnostic tests (ELISA, Immunofluorescence, agglutination based tests).
2. Modern approaches for diagnosis of infectious diseases: Basic concepts of gene probes, dot hybridization and PCR assays.
3. Antimicrobial therapy; Antibiotics and their classification, Mechanism of action of various chemotherapeutic agents (antibacterial, antifungal and antiviral).
4. Antimicrobial resistance: Multidrug efflux pumps, X- MDR M. tuberculosis, Methicillin-resistant S. aureus (MRSA), various methods of drug susceptibility testing.

References:

1) Medical Microbiology. N.C.Dey and T.K. Dey. Allied agency, Culcutta.
2) Microbiology by Davis, Dulbecco, Eisen Harper and Row Maryland.
3) Text book of Microbiology by R. Anantharayanan, C.K. Jayaram Panikar, OrientLongman, Mumbai.
4) Medical microbiology by Chakraborthy.
5) Medical Microbiology: Prep Manual for Under Graduates by Nagoba, Elsevier.
6) Manual of Clinical Microbiology, Karen C. Carroll (Editor), Michael A. Pfaller ASM publications.
7) Essentials of Medical Microbiology by Apurba Sankar Sastry and Sandhya Bhat K, Jaypee Brothers Medical Publishers.
8) Basic Medical Microbiology E-Book, Patrick R. Murray ·2017 Els,evier Health Sciences

M. Sc. Second Year, Semester III

MICROBIOLOGY

LAB. COURSE-XII. Based on Clinical Microbiology(Elective B)

(Course Code: P-LAC 391)

Teaching Hours:30 Marks 50 (Credit: 02)

Learning Objectives:

- To study normal flora of host.
- To study cultural and biochemical characteristics of pathogens
- To study virulence factors of pathogens.
- To learn different methods for diagnosis of diseases.

Course Outcomes: After completion of this course , student will be able to-

- Design experiment for isolation of normal flora of host.
- Perform laboratory diagnosis of diseases by culturing in the laboratory
- Determine presence of virulence factors of pathogens.
- Perform serodiagnosis of diseases

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1. To study normal micro-flora of Skin, Respiratory tract, Gastro-intestinal tract.
2. To study cultural characteristics of pathogenic bacteria on various selective and differential media.
3. To study virulence factors of Staphylococcus aureus :Haemolysin and coagulases.
4. To study antimicrobial susceptibility of pathogens.
5. To determine the minimal inhibitory concentration (MIC) of an antibiotic on bacteria and Fungi.
6. Determination of Blood group and Rh factor.
7. Serological tests: Immuno- electrophoresis, Sandwich ELISA,
8. To perform immune diffusion test -Ochterlony double diffusion, agglutination test.
9. Haemoglobin estimation
10. Total red blood cell count, total white blood cell count,

References

1) Medical Microbiology. N.C.Dey and T.K. Dey. Allied agency, Culcutta.
2) Microbiology by Davis, Dulbecco, Eisen Harper and Row Maryland.
3) Text book of Microbiology by R. Anantharayanan, C.K. Jayaram Panikar, OrientLongman, Mumbai.
4) Medical microbiology by Chakraborthy.
5) Medical Microbiology: Prep Manual for Under Graduates by Nagoba, Elsevier.
6) Manual of Clinical Microbiology, Karen C. Carroll (Editor), Michael A. Pfaller ASM publications.
7) Essentials of Medical Microbiology by Apurba Sankar Sastry and Sandhya Bhat K, Jaypee

Brothers Medical Publishers.

8) Basic Medical Microbiology E-Book, Patrick R. Murray ·2017 Els,evier Health Sciences

RAJARSHI SHAHU MAHAVIDYALAYA (Autonomous), LATUR

M. Sc. Second Year

Semester IV

MICROBIOLOGY

COURSE TITLE – 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 ofcitric 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 ofbiogas production.
4. Use techniques of enzyme immobilization and its application in food pharmaceuticaland chemical industries. Students become aware of procedure of IPR patents trademarks, copyrights.

Unit-I Microbial Fermentations **15 H**

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 H**

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 H

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 theprocess 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 H

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 thelaboratory.
2. Students Also acquires skill and can design production ofbiofertilizers.

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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. (Freecells / 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 andCreuger.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
   BioremediationPrinciples.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. andDmain A. L. ASM Publication.

RAJARSHI SHAHU MAHAVIDYALAYA(Autonomous), LATUR

M. Sc. Second Year Semester IV

MICROBIOLOGY

COURSE TITLE – MEDICAL AND PHARMACEUTICALMICROBIOLOGY

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 antimicrobialagents.

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 andmicrobial 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 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 andprotein 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 actionof non-antibiotic antimicrobial agents.

1.5 Penetrating defenses –How the antimicrobial agents reach the targets (cellularpermeability 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. Otherpharmaceuticals produced by microbial fermentations (streptokinase, streptodornase).

2.3 New vaccine technology, DNA vaccines, synthetic peptide vaccines, multivalentsubunit 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 ofdrug 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 inpharmaceuticals.

Unit-IV Quality assurance and validation 15

4.1 Good manufacturing practices (GMP) and Good laboratory practices (GLP) inpharmaceutical industry.

4.2 Regulatory aspects of quality control. Quality assurance and quality management inpharmaceuticals ISO, WHO and US certification.

4.3 Sterilization control and sterility testing (heat sterilization, D value, z value, survivalcurve, 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 microbiologylaborator

M. Sc. Second Year Semester: IV

MICROBIOLOGY

P-LAC -497 A

Based on Medical and Pharmaceutical Microbiology

Total Teaching Hours: 30 **Marks 50(Credit: 02)**

Course Objectives:

1. To study multiple screening procedure and statistical test for pharmaceuticalsubstances.
2. To study production of multiple antimicrobial substances. To learn antimicrobialactivity 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 microbialcontamination of pharmaceutical products.

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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 turbidometricassay methods.
4. Screening, Production and assay of therapeutic enzymes: GlucoseOxidase/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 damagingsubstances.
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 inpharmaceuticals.
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 NewYork.

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 NewYork.
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 byLippincott'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. CBSpublishers & 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. ASMWashington DC.

RAJARSHI SHAHU MAHAVIDYALAYA, LATUR
M. Sc. Second Year
Semester IV
MICROBIOLOGY
COURSE TITLE – BIOINSTRUMENTATION **(ELECTIVE)**
COURSE CODE: P-BIO --479

Total Teaching Hours: 60 **Maximum Marks: 100 (Credit:4)**

Course Objectives:

- To introduce the basic concept and practices of biosafety in microbiology laboratory
- To provide knowledge about principle, working and applications of various chromatography, analytical, spectroscopic and radio isotopic techniques

Learning Outcomes:

The students able to

- Explain the various separation techniques and its instrumentation
- Define and explain various fundamentals of spectroscopy, qualitative and quantitative analysis and characterize functionalities of biomolecules by using spectroscopic techniques.
- Describe the principle and working of various radiation detectors

Unit-1: Laboratory techniques **15 H**

1.1Biosafety in microbiological laboratories
a. General safety measures
b. Personal protection
c. Chemical and Biological hazards
d. Spillage and Waste disposal, First aid
1.2Theory, Principle, Working and Applications of
a. pH meter
b. Laminar Air Flow
1.3Efficacy testing protocols for
a. Autoclave,
b. pH meter
c. Laminar Air Flow.
1.4Centrifuge machine types and Centrifugation
a. Differential
b. Rate zonal
c. Isopycnic
d. Density gradient,
1.5 Rotor types and Ultra centrifugation.

Unit 2: Chromatography Techniques **15H**

2.1Theory, Principle, Apparatus, Methods and Applications of
a. Paper Chromatography
b. Thin Layer Chromatography (TLC)
c. HPTLC
d. Gel Filtration Chromatography
e. Ion Exchange Chromatography
f. Affinity Chromatography
g. Gas Chromatography, and

h. HPLC.

Unit III: Electrophoretic Techniques **15H**

3.1Theory, Principle, Apparatus, Methods and Applications of

a. Paper Electrophoresis,

b. Polyacrylamide Gel Electrophoresis (PAGE),

c. Agarose Gel Electrophoresis.

3.2 Principle and Applications of

a. Iso-electric Focusing

b. Immuno Electrophoresis

c. Enzyme-Linked Immunosorbant Assay (ELISA)

3.4 Blotting Techniques

a. Southern Blotting

b. Northern Blotting

c. Western Blotting.

Unit IV: Spectroscopic and Radio-isotopic Techniques **15H**

4.1 Principle, Working, Instrumentation and Applications of

a. UV/Vis spectroscopy,

b. IR spectroscopy,

c. Atomic absorption spectroscopy,

d. NMR spectroscopy,

e. Mass spectroscopy,

4.2 Introduction to radioisotopes and their biological applications

4.3 Principles and Applications of

a. Geiger Muller (GM) counter

b. Solid and Liquid scintillation counter

c. Autoradiography

d. Radioimmunoassay (RIA)

REERENCES

1. Biochemistry. 6th Edition by Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Freeman, New York.

2. Biophysics: An Introduction by Cotterill, R. M. J. (2002). John Wiley & Sons, England.

3. Principles of protein X-ray crystallography by Drenth, J. (2007). 3rd Ed. Springer, Germany.

4. Biochemistry. 3rd edition by Garrett, R. H. and Grisham, C. M. (2004). Brooks/Cole, Publishing Company, California.

5. Understanding NMR Spectroscopy by Keeler, J. (2002). John Wiley & Sons, England.

6. Bioinformatics: sequence and genome analysis by Mount, D. W. (2001). Cold Spring Harbor Laboratory Press, New York.

7. Biophysics by Pattabhi, V. and Gautham, N. (2002). Kluwer Academic Publishers, NewYork and Narosa Publishing House, Delhi.

8. Principles and Techniques of Biochemistry and Molecular Biology by Wilson Keith and Walker John (2005), 6th Ed. Cambridge University Press, New York.

9. Proteins NMR Spectroscopy: Principles and Practice by Cavanagh John et.al. (1995), Academic Press
10. Molecular Biophysics: Structures in Motion by Daune M. and W. J. Duffin (1999), Oxford University Press.
11. Methods in Modern Biophysics by Nalting B. and B. Nalting (2003) Springer Verlag
12. Computational Analysis of Biochemical Systems by Voit E. O. (2000) Cambridge UniversityPress.
13. Physical Biochemistry: Applications to Biochemistry and Molecular Biology by Freilder, Freeman, San. Francisco, 1976
14. Biochemical Techniques: Theory and Practice by Robyt, John F.; White, Bernard J. Waveland Press, Inc., U.S.A. Published: 1990.
15. Principles of Instrumental Analysis by Douglas A. Skoog, F. James Holler, Timothy A. Nieman: (Saunders Golden Sunburst Series) published by Wadsworth Pub Co. 2007
16. Biophysical chemistry. Principles and techniques by Upadhyay A, Upadhyay K, Nath N: Himalaya Publishing House, Mumbai.1997.
17. Brocks Biology of Microorganisms (Eleventh Edition) by Michael T. Madigan, John M. Martinko (2006), Pearson Prentice Hall.

M. Sc. Second Year, Semester IV
MICROBIOLOGY
Lab. Course- XIII
Based on Theory paper: Bioinstrumentation
Course Code: P-LAC-497 B
Total Teaching Hours: 30 **Marks 50**
(Credit: 02)

Course Objectives:

- To provide practices of biosafety in microbiology laboratory
- To provide hands on of various instrumental techniques used in microbiological analysis Learning Outcomes:
- The students acquire expertise in various analytical techniques used in research and industries in the field of microbiology

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1. Efficacy testing of autoclave employing chemical and biological autoclave indicators.
2. Standardization of pH meter using standard buffers.
3. Studies on pH titration curves of amino acids/acetic acid and determination of pKa values and Handerson-Hasselbach equation.
4. Separation of bacterial lipids/amino acids/sugars/organic acids by TLC and Paper Chromatography.
5. Study of UV absorption spectra of macromolecules (protein, nucleic acid, bacterial pigments).
6. Paper Electrophoresis of proteins.
7. Separation of Proteins/Nucleic acids by gel electrophoresis.
8. Density gradient centrifugation.

RAJARSHI SHAHU MAHAVIDYALAYA, LATUR

M. Sc. Second Year,

Semester: IV

COURSE TITLE – MICROBIAL BIOINFORMATICS, GENOMICSand PROTEOMICS(Elective)

COURSE CODE: P-BPG -480

Total Teaching Hours: 60 /Week: 4, Credits: 4Max 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 microbialidentifications 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 inmicrobiology. 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 andapplications.

1.3 Database: Database management system (DBMS), biological databases andinformation resources, classification of biological databases.

1.4Sequence alignment: Pair wise alignment, global and local alignment, end-space freealignment, gap penalty. Similarity matrices (PAM, BLOSUM). Searching sequence databases using BLAST and FASTA.

1.5 Pair wise sequence alignment using dynamic

programming (Needleman-Wunsch andSmith-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 andEMBL), Ensembl.

2.2 Protein databases: Sequence database (PIR, Swiss-Prot, TrEMBL, Pfam, andPROSITE),

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 onthese algorithms- Clustal W and Mult Align. Multiple sequence alignment of relatedsequence: 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 tocultured and uncultured microbial community.

3.2 Methods for gene sequence analysis, types of genomics, gene functions, analysis ofgene 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 structureprediction. 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 automateddocking, de novo sequence. Introduction to Molecular Docking

REFERENCES:

1. Bioinformatics Methods and Protocols - Misener.
2. Bioinformatics - A Practical Guide to the Analysis of Genes and Proteins. 2nd Editionby 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 BlackwellPublishing.
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 ExpressionData 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, SpringerNature Switzerland AG
14. Functional Genomics. A Practical Approach Edited by Stephen P Hunt and RickLiveey (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 BlackwellPublishing
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

M. Sc. Second Year,
Semester: IV
LAB. COURSE-XIV
based on (A)
Microbial Bioinformatics, Genomics and Proteomics
(Course Code: P-LAC-498)

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 byperforming knowledge based practical.

2.Students Also acquires skill to represent data by usingthe Computer knowledge of MS Word, Excel and power point presentation.

Experiments

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

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