RAJARSHI SHAHU MAHAVIDYALAYA (AUTONOMOUS), LATUR

M. Sc. (SEMESTER PATTERN)

M. Sc. SECOND YEAR

SEMESTER- III

SUBJECT: MICROBIOLOGY

CURRICULUM (CBCS)

Effective progressively from June 2020

RAJARSHI SHAHU MAHAVIDYALAYA (Autonomous), LATUR

Program: M.Sc. Microbiology

C.B.C.S

Course Structure

M. Sc. Second Year

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

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

RAJARSHI SHAHU MAHAVIDYALAYA(AUTONOMOUS) , LATUR

M. Sc. Second Year Semester III

MICROBIOLOGY

COURSE –IMMUNOLOGY

COURSE CODE: P-IMU-384

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

Course objectives:

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

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Course outcome:

After successful completion of course students are able to

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

Unit I: Organs and Cells of Immune System (11)

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 and immunological functions.

1.3. Lymphoid cells - B- lymphocytes and T lymphocytes - maturations, activation and 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 haematopoiesis, Granulocytes -Neutrophile, Basophile, Eosinophile -immune response generated against parasite by granulocytes.

1.5. Mast cell - Structure, function in innate immunity and acquired immunity. Dendritic cell - structure and function.

Unit II: Immunogens and Immunoglobulin (12)

2.1 Types of antigens - Exogenous, Endogenous, Autologus, Xenogenic and Allogenic. General properties of antigens -Molecular size, chemical composition, foreignness, specificity, haptens, super antigens and adjuvants: Freund, complete and 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. (12)

3.1 Genetic model for Ig structure, Germ line and somatic variation models, Dryer and Bennett two gene models, K chain genes, λ chain genes, Heavy chain genes, VH gene segments.

3.2 Gene rearrangement in VH region -In light chain, In heavy chain, Mechanism of variables region DNA rearrangement.

3.3 Generation of antibody diversity, Regulation of Ig gene transcription

Unit IV: Major and Minor Histocompatibility Complexes. (10)

4.1 MHC class-I, MHC class-II - Structure of molecules, gene organization. Genetic polymorphism of molecule, Peptide interaction with molecule, MHC and immune
responsiveness, MHC and susceptibility to infectious diseases.

4.2 Minor MHA - structure, role and genetics, HLA system, Antigen processing and presentation.

4.3 Hypersensitivity, Immunology of Tumors, Immunodeficiency diseases, autoimmune diseases, Immunomodulation / Immunological tolerance.

REFERENCES:

1) A handbook of practical immunology by G. P. Talwar, Vikas Publishing House, New Delhi.
2) Genes VII by Benjamin Lewin, Oxford University Press.
3) Immunology (2nd edition) by C. Vaman Rao, Narosa publication.
4) Immunology (2nd edition) by Janis 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.

LAB. COURSE-IX
IMMUNOLOGY
(Course Code: P-LAC-388)

Marks 50 (Credit: 02) Hours 45

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Specific Program Outcome:

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

Specific Course Outcome:

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

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

1. Antigen – Antibody reactions
   a. Agglutination –
   b. SlideTest – Widal test
   c. Tube test - Dreyer's technique
   d. Bordet Durham's technique
   e. Precipitation - Slide - VDRL, RPR, RA
   f. Complement fixation test - Coomb's test (demonstration)
2. Radial Immunodiffusion
3. Immunohaematology.
   a. DLC, TLC, RBC count
   b. Blood grouping .

4.Separation of serum proteins by electrophoresis.

5. Preparation of 'H' antigen of *S. typhi* by Craigies tube method.
6. Preparation of 'O' antigen of *S. typhi* by phenol agar method.

RAJARSHI SHAHU MAHAVIDYALAYA, LATUR

M. Sc. Second Year Semester III

MICROBIOLOGY

COURSE TITLE –ADVANCED MOLECULAR BIOLOGY

COURSE CODE: P-AMB-385

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

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

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

Course outcomes:

After successful completion of course students are able to

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

Unit I: Basic tools of r DNA Technology (10)

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

1.2 Restriction endonucleases type I, II, III, restriction modification system: nomenclature and classification of type II endonucleases (S1 nuclease).

1.3 DNA polymerase (E. coli DNA pol. I, T7 DNA Pol., Klenow fragments, Thermostable DNA Pol., Terminal Transferase and Reverse Transcriptase).

1.4 DNA ligation (Linkers and Adaptors). DNA Manipulating enzymes (Polynucleotide kinase, Phosphatase, Methylase, Topoisomerase and Ribonucleases).

1.5 Cloning Vectors (their structure, genealogy and derivatives): Plasmids (pBR 322 and pUC18). Bacteriophage lambda (λ), Cosmids , Phasmids and Phagemids as vectors.

1.6 Artificial chromosome vectors (YACs, BACs, PACs, and MACs). Animal virus derived vectors, SV40vaccina/bacculo and retroviral vectors. Expression vectors, Shuttle vectors, Integrative vectors.

1.6 Gene probes: development and labeling of DNA and RNA probes.

Unit II: Nucleic acid amplification, Sequencing and Hybridization Techniques (12)

2.1 Polymerase Chain Reaction (PCR) -Primer design, fidelity of thermal enzymes, DNA polymerase, variations in PCR and its applications.

2.2 PCR in gene recombination, deletion, addition, overlap extension and SOEing, site specific mutagenesis,PCR in molecular diagnostics, viral and bacterial detection.

2.3 Methods of nucleic acid detection, sequencing methods (enzymatic DNA sequencing, chemical DNA sequencing, principles of automated DNA sequencing, RNA sequencing, thermal cycle dideoxy DNA sequencing, and pyrosequencing).

3.3 Methods of nucleic acid hybridization (Southern blotting, Northern blotting, in situ hybridization). DNA fingerprinting, chromosome walking and jumping.

Unit III: Cloning and Screening methodologies (12)

3.1. Insertion of foreign DNA into the host cells: transformation, transfection: chemical and physical method, liposomes, microinjection, electroporation, biolistic, somatic cell fusion, gene transfer by pronuclear microinjection.

3.2 Cloning and expression in yeast (Saccharomyces, and pichia), animal and plant cells. Plant transformation technology: Basic of tumor formation, hairy root, features of Ti and Ri plasmids, mechanism of DNA transfer, role of virulence gene, use of Ti and Ri as
plasmids vectors. Factors a ffecting expression in plants and animal cells, strategies to create knockout (KO) cells and transgenic animals.

3.3 cDNA and genomic cloning, expression cloning, jumping and hopping libraries, phage display. Construction of cDNA and genomic DNA libraries. Screening libraries with gene probes, colony hybridization, plaque hybridization, screening by gain of function, immunological screening.

Unit IV: Applications of rDNA technology and Legal issues (11)

4.1 Molecular Markers- types and applications. Construction of molecular maps (genetic and physical maps). DNA chip Technology and Microarrays (a brief account).

4.2 Applications of recombinant DNA technology in medicine, agriculture, Forensic and veterinary sciences.

4.3 Engineering microbes for the production of antibiotics, enzymes, Insulin, growth hormones, monoclonal antibodies etc. Human genetic engineering and Gene therapy - methods of gene therapy, gene therapy in treatment of diseases, Stem cell therapy, Future of stem cell therapy, gene targeting. Gene silencing in bacteria. CRISPR- Cas systems for editing and targeting genome.

4.4 Science and the constitution - ethical, legal and environmental issues associated with rDNA Technology.

REFERENCES

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

LAB. COURSE-X
ADVANCED MOLECULAR BIOLOGY
(COURSE CODE: P-LAC -389)

Marks 50(Credit: 02) Hours 45

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

RAJARSHI SHAHU MAHAVIDYALAYA, LATUR

M. Sc. Second Year

Semester III

MICROBIOLOGY

COURSE TITLE: MICROBIAL DIVERSITY AND EXTREMOPHYLES

COURSE CODE: P-MDE-386

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

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

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

Course outcomes:

After successful completion of course students are able to

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

Unit I: Biodiversity and Thermophiles (14)

1.1 Introduction to microbial diversity, the fundamental similarity of all living things, facets of microbial diversity, Types-Bacterial, Archael, Eucaryal, Characteristics and Classification of Archae (Methanogens).

1.2 Classification, Hyper- thermophilic habitat and ecological aspects. Molecular basis of thermo - stability, Heat stable enzymes and metabolism, Genetics of thermophiles, Minimal complexity model systems.

1.3 Commercial aspects of thermophiles and application of thermoenzymes.

Unit II: Acidophiles and Alkalophiles (09)

2.1 Acidophiles- Classification, life at low pH, acido - tolerance, applications.

2.2. Alkalophiles-Isolation, Distribution and Taxonomy. Cell structures - Flagella, Cell wall, Cell membrane. Physiology - Growth conditions, Mutants, Antiporters and alkaliphily. Intracellular enzymes. Molecular biology- Alkalophiles as DNA sources, secretion vectors, promoters.

2.3. Enzymes of alkaliphiles and their applications.

Unit III: Psychrophiles (09)

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

3.2. Microbial diversity at cold ecosystem – snow and glaciers ice, subglacial environments, psychropiezophiles, permafrost, anaerobic and cyanobac teria in cold ecosystem, microalgae in Polar Regions.

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

Unit IV: Halophiles and Barophiles (14)

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

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

REFERENCES:

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

LAB. COURSE-XI

MICROBIAL DIVERSITY AND EXTREMOPHYLES

(Course Code: P-LAC-390)

Marks 50(Credit: 02) Hours 45

Course Objectives

Learning objectives of the Lab course are

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

Course Outcomes

After successful completion of course student will be able to

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

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

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M. Sc. Second Year Semester III

MICROBIOLOGY

PAPER XII – QUANTITATIVE BIOLOGY (Elective)

COURSE CODE: P-QUB-387

Periods/Week: 4, Credits: 4, Total Periods: 60 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 (10)

1.1 Introductory biostatistics: Sampling. Data collection and presentation: Types of data,

Methods of data collection. Graphical (Histogram, frequency polygon and o give curves, Box plot, Scatter plot, survival curves) and diagrammatic (Simple bar diagram, per centage bar diagram, multiple bar diagram, sub - divided bar diagram and pie diagram) representation of data.

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

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

1.4 Measures of Skewness and Kurtosis.

Unit II: Tests of Significance and Designing of Experiment (11)

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

2.2. Probability: Definition, Elementary properties, Types, Rules of probability. Its applications to biological problems. Probability distributions - Binomial, Poisson, Normal (Only definitions and problems).

2.3. Analysis of Variance: ANOVA. Experimental designs- Completely Randomized Design, Randomized Block Design. Latin square design. Factorial designs.

Unit III: Computer: Introduction and applications (12)

3.1. Introduction: Organization of computers. Classification of computers. Concept of hardware and software. Operating System (command line and WIMP). Elementary
ideas about programming languages and application packages for microbiologists. LIMS.

3.2. MS Office softwares and their applications: MS word, MS PowerPoint, and MS excel.
Applications of these softwares in Microbiology.

3.3. Computer based statistical techniques and statistical packages (Basics and Introduction in Short): Features of statistical softwares (free open source) Examples: SAS University Edition, Scilab, Statistical Lab, Dataplot and SOFA (St atistics Open For All) for various applications in Bioresearch.

Unit IV: Research Methodology (12)

4.1 Introduction: Definition, Importance and meaning of research. Qualities of a good
researcher. Characteristics of research. Types of research. Steps in research. Identification and selection of research problems. Formulation of hypothesis. Literature search: Information sources.

4.2 Scientific writing: Basic concepts of scientific writing. Scientific Documents: Definition and types- Research papers, review papers, conference reports and proceedings, project reports, theses, book reviews, research proposal, and dissertation. Basic structure of a Research Article: IMRAD format. Essentials features of abstract, introduction, review of literature, materials, methods, results and discussion, conclusion and outcome. Effective illustration - tables and figures. Reference styles - Harvard and Vancouver systems. Citation tools used in research (e.g. Mendeley).

4.3 Legal aspects of scientific authorship: Copyright considerations, Plagiarism and plagiarism detection softwares. Presenting and publishing research. Bibliometric measures (Impact factor & h - index).

REFERENCES

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

LAB. COURSE-XII
QUANTITATIVE BIOLOGY
(Course Code: P-LAC-391)

Marks 50 (Credit: 02) Hours 45

Course Objectives:

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

Specific Course Outcomes:

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

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

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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