Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Biotechnology

Curriculum

For the Academic Year 2022-23

Under CBCS

Two Year Degree Programme in Biotechnology

(Four Semester Programme)

(CC / DSE / SEC)

PG First Year

Semester I and II

Syllabus Approved by Board of Studies in Biotechnology with effect from June, 2022

Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)
Department of Biotechnology

1. Introduction:

Biotechnology is technology based on biology - biotechnology harnesses cellular and biomolecular processes to develop technologies and products that help to improve our lives and health of our planet. Taking into consideration of the importance of Biotechnology,Rajarshi Shahu Mahavidyalaya, Latur (Autonomous), have taken an initiative to introduce a new emerging field as a Post Graduate Programme in Biotechnology under the Faculty of Science. M.Sc. Biotechnology is a Two year Post Graduate degree program which is started in the academic year 2005-06.

The syllabus was designed according to employability needs in the field of biotechnology. After designing syllabus, we have taken online feedback on curriculum from the academia and Industry expert. The feedback is analyzed, recommendation is reviewed and necessary changes are made in the syllabus by members of BOS. The Board of Studies in biotechnology follows the systematic process in design and development of the curriculum. In the design and development of curriculum, the regulation and guidelines of curriculum frame work stipulated by apex bodies such as Parent University, State Government guidelines and UGC. The programme outcome is given in the curriculum and displayed on college website so that students can look for it before taking admission. The learning objectives and course outcome of course are given in the syllabus of respective course and communicated to students at the beginning of programme.

2. Title of the Programme: **M.Sc. Biotechnology**

3. Learning Objectives of the Programme:

The main objective is to create biologically and technologically skilled minds for the understanding theoretical and practical knowledge essential for implementation from LAB to LAND further it will useful to find the solutions of various interacting biological phenomenon. It helps effectively to inculcate scientific temper and social attitude to solve various problems in the field of science.

The member of Board of Studies from various organizations of repute has a strong recommendation for job oriented syllabus to be included. Accordingly, the necessary changes have been effectively implemented in Curriculum.

4. Programme Specific outcomes/ Programme Outcomes:

At the end of the program the student will be able to

- integrate basic principles of common analytical techniques of protein molecular structures to engage in hands-on practices for implementation of such techniques to facilitate the development of biopharmaceutical manufacturing.

- induce the understandings of basic principles of process units operations of industrial products with hands-on practices for implementation of such techniques to facilitate the development of biopharmaceutical manufacturing.
- gain fundamental knowledge of molecular biotechnology, protein expression, and structural biology for the development of new products having clinical application.
- plan, conduct, execute and write-up a proposal of original research Practical skills.
- integrate fundamental concepts of leadership, entrepreneurship and innovation, financial decision making and marketing to business enterprises.
- equip the students with the skills required for carrying out research in cutting edge areas of life sciences
- make the students competent for dealing with the future problems and challenges of regional and global interest in overall development of society
- promote the entrepreneurship for self-growth and sustainability with the aim of promoting lab to land practices in, clinical, agriculture, food, nano and animal biotechnology

5. Local, Regional and Global relevance of Syllabus:

Curriculum developed and implemented have relevance to the local, regional and global developmental needs which is reflected in Programme Specific Outcomes/ Programme Outcomes and Course Outcomes of the Programmes offered by the College.

Global and local focus has slowly shifted to using knowledge of life Science for innovative technology development that is being used for betterment of human life. Many fundamental and advanced research fields come under the umbrella of Biotechnology e.g. Biochemistry, Animal Biotechnology and Immunology and Immuno-techniques etc.

6. Duration of the Course: **Two years**

7. Eligibility of the Course: **B.Sc. Science**

8. Strength of the Students: **90**

9. Fees for Course: **As per University/College rules.**

10. Admission / Selection procedure: **Admission by merit through Registration**

11. Teacher's qualifications: As per UGC/University/College rules

12. Standard of Passing: As per UGC/University/College rules

13. Nature of question paper with scheme of marking:

As per UGC/University/College rules

14. List of books recommended: Included in syllabus

15. Laboratory Equipment's, Instruments, and Measurements etc.:

The department of biotechnology has well equipped laboratories with all necessary and advance instrumentation facility.

16. Rules and regulations and ordinance if any: As per UGC/University/College rules

17. Course duration: Each theory course is of 60 Contact hours

18. Medium of the language: English

Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)
Department of Biotechnology
Choice Based Credit System
Course Structure of M.Sc. Biotechnology First Year

M. Sc. I [Biotechnology] Semester I

Code No.	Course Title	Hours/ Week	Marks (100)		Credits	Marks
			In Sem	End Sem		
P-CDB-134	Cell and Developmental Biology	04	40	60	04	100
P-BIO-135	Biochemistry	04	40	60	04	100
P-MIP-136	Microbial Physiology	04	40	60	04	100
P-BET-137	Bioinstrumentation and Emerging Technologies	04	40	60	04	100
P-LAC-138	Lab Course I	04	20	30	02	50
P-LAC-139	Lab Course II	04	20	30	02	50
P-LAC-140	Lab Course III	04	20	30	02	50
P-LAC-141	Lab Course IV	04	20	30	02	50
	Total Credits/Marks	**32**			**24**	**600**

M.Sc. I [Biotechnology] Semester II

Code No.	Title of the Course	Hours/ Week	Marks (100)		Credits	Marks
			In Sem	End Sem		
P-MOB-232	Molecular Biology	04	40	60	04	100
P-IMI-233	Immunology and Immunotechniques	04	40	60	04	100
P-BIB-234	Bioinformatics and Biostatistics	04	40	60	04	100
P-BIE-235	Bioprocess Engineering	04	40	60	04	100
P-LAC-236	Lab Course V	04	20	30	02	50
P-LAC-237	Lab Course VI	04	20	30	02	50
P-LAC-238	Lab Course VII	04	20	30	02	50
P-LAC-239	Lab Course VIII	04	20	30	02	50
P-Sem-240	Seminar	O3	50		02	50
	Total Credits/Marks	**35**			**26**	**650**

Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)
M.Sc. Biotechnology (Semester Pattern)
I Semester

Course Title: Cell and Developmental Biology Course Code: P-CDB-134
Marks: 100 Lectures: 60 Credit:04

Learning Objectives:

- To understand the structures and functions components of cell organelles.
- To know the communication between cells and related cell signaling.
- To understand the basics of cell cycle and cell division.
- To understand molecular insight of Development Biology

Course Outcomes:

On the successful completion of the course, students will be able to-

- describe cell organelles and related functions of the cell.
- understand the cell signaling concepts and its significance.
- explain the process of cell division and cell cycle.
- discuss the developmental biology of model organisms.

Unit I: (20 L)

Cell organelles

Cell theory and its significance, Structure and function of the cell membrane, Fluid-Mosaic Model and its components, Membrane Potential, Structure and function of the cell wall, Structure and function of cell organelles (Nucleus, chloroplasts, mitochondria, Endoplasmic Reticulum, Golgi Apparatus, ribosomes, Lysosomes, peroxisomes), Cytoskeleton and microtubules.

Unit II: (14 L)

Cell signaling

Cell Signaling: Introduction, Stages of cell signaling, Signal transduction: Concept, Factors determining signal transduction pathways, Signal amplification process, Signal molecules, Receptors: Intracellular receptors and Cell surface receptors, Cell Signaling in Plants.

Unit III: **(14 L)**

Cell Cycle and Cell division

Cell cycle: Introduction, Phases of the cell cycle, Molecular basis of cell cycle - Cell cycle regulation, Cell Cycle checkpoints, Apoptosis: Apoptosis vs Necrosis, Mechanism of Apoptosis, Mitosis: Stages and Significance, Meiosis: Stages and Significance.

Unit IV: **(12 L)**

Development Biology

Introduction to developmental Biology, Fertilization: Gametogenesis, fertilization and early development, Development of model organism – Drosophila, Plant Development: Microsporogenesis, Megasporogenesis, Embryogenesis, Development of model organism - Arabidopsis.

Recommended Textbooks and References:

1. Lodish et al.(2004). Molecular Cell Biology (Scientific American Book)
2. Alberts et al. (2002). The Biology of the Cell
3. Cooper &Hausman .(2004). The Cell – A Molecular Approach
4. Maheaswari, P. (1950). An introduction to embryology of Angiosperms. Mc Graw Hill.
5. Dodd, H.I., and Dodd, J.M. , (1978). The biology of metamorphosis , In Physiology of amphibia, Vol. 3, Academic press, N.Y
6. Gilbert, S.F., (1997). Developmental Biology, 5th Edn, Sinauer, Associates, Massachusettes.
7. Tamarin, R., (1991). Principles of Genetics, 3rd edition.
8. Vasudeva Rao. (1994). Developmental Biology: A modern synthesis, Oxford & IBH, New Delhi
9. De Robertis, E.D.P. and Robertis, E.M.F. (1991). Cell and molecular biology. Lea and Febiger
10. Balinsky, B.I., (1965). An Introduction to embryology, W.B. Saunders company
11. Bodemer, L.W., (1968). Modern Embryology, Winston Inc. USA
12. George, M. Malacinski (ed) (1988), Developmental genetics of higher organisms, Macmillan Publishing Co.

Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)
M.Sc. Biotechnology (Semester Pattern)
I Semester

Course Title: Cell and Developmental Biology Course Code: P-CDB-134
Marks: 100 Lectures: 60 Credit:04

Learning Objectives:

- To understand the structures and functions components of cell organelles.
- To know the communication between cells and related cell signaling.
- To understand the basics of cell cycle and cell division.
- To understand molecular insight of Development Biology

Course Outcomes:

On the successful completion of the course, students will be able to-

- describe cell organelles and related functions of the cell.
- understand the cell signaling concepts and its significance.
- explain the process of cell division and cell cycle.
- discuss the developmental biology of model organisms.

Unit I: (20 L)

Cell organelles

Cell theory and its significance, Structure and function of the cell membrane, Fluid-Mosaic Model and its components, Membrane Potential, Structure and function of the cell wall, Structure and function of cell organelles (Nucleus, chloroplasts, mitochondria, Endoplasmic Reticulum, Golgi Apparatus, ribosomes, Lysosomes, peroxisomes), Cytoskeleton and microtubules.

Unit II: (14 L)

Cell signaling

Cell Signaling: Introduction, Stages of cell signaling, Signal transduction: Concept, Factors determining signal transduction pathways, Signal amplification process, Signal molecules, Receptors: Intracellular receptors and Cell surface receptors, Cell Signaling in Plants.

Unit III: **(14 L)**

Cell Cycle and Cell division

Cell cycle: Introduction, Phases of the cell cycle, Molecular basis of cell cycle - Cell cycle regulation, Cell Cycle checkpoints, Apoptosis: Apoptosis vs Necrosis, Mechanism of Apoptosis, Mitosis: Stages and Significance, Meiosis: Stages and Significance.

Unit IV: **(12 L)**

Development Biology

Introduction to developmental Biology, Fertilization: Gametogenesis, fertilization and early development, Development of model organism – Drosophila, Plant Development: Microsporogenesis, Megasporogenesis, Embryogenesis, Development of model organism - Arabidopsis.

Recommended Textbooks and References:

13. Lodish et al.(2004). Molecular Cell Biology (Scientific American Book)
14. Alberts et al. (2002). The Biology of the Cell
15. Cooper &Hausman .(2004). The Cell – A Molecular Approach
16. Maheaswari, P. (1950). An introduction to embryology of Angiosperms. Mc Graw Hill.
17. Dodd, H.I., and Dodd, J.M. , (1978). The biology of metamorphosis , In Physiology of amphibia, Vol. 3, Academic press, N.Y
18. Gilbert, S.F., (1997). Developmental Biology, 5th Edn, Sinauer, Associates, Massachusettes.
19. Tamarin, R., (1991). Principles of Genetics, 3rd edition.
20. Vasudeva Rao. (1994). Developmental Biology: A modern synthesis, Oxford & IBH, New Delhi
21. De Robertis, E.D.P. and Robertis, E.M.F. (1991). Cell and molecular biology. Lea and Febiger
22. Balinsky, B.I., (1965). An Introduction to embryology, W.B. Saunders company
23. Bodemer, L.W., (1968). Modern Embryology, Winston Inc. USA
24. George, M. Malacinski (ed) (1988), Developmental genetics of higher organisms, Macmillan Publishing Co.

Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)
M.Sc. Biotechnology (Semester Pattern)
I Semester

Course Title: Lab Course I	**Course Code: P-LAC-138**
Marks: 50	**Credit:02**

Learning Objectives:

- To understand different cells and cell diversity.
- To understand the structures and purposes of basic components of cells.
- To understand cell division in plants and animals.
- To help in understanding the basics of cell organelles with practical experience.

Course Outcomes:

On the successful completion of the course, students will be able to-

- separate and characterize subcellular components of cells.
- Use cellular techniques in research and diagnostics.
- identify and describe the cellular structure of organs and tissues from prepared slides, and outline the principles of histochemical staining.
- perform experimental techniques as instructed making accurate observations; record, analyze and interpret data.

Practicals:

1. Cellular diversity
2. Cellular permeability
3. Study of Mitosis (root tips)
4. Study of Meiosis (anthers)
5. Lipid solubility of membrane.
6. Study of karyotypes.
7. Isolation of chloroplast.
8. Analysis of chlorophyll amount by Spectrophotometer.
9. Isolation of Mitochondria.
10. vital staining of Mitochondria.
11. Vital staining of lipid and glycogen bodies.
12. Cell types of plants- Microtomy/ maceration of various tissue explants and identification.
13. Buccal smear- Identification of Barr body.

Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)
M.Sc. Biotechnology
I Semester

Course Title: Biochemistry **Course Code: P-BIO-135**
Max. Marks: 100 **Lectures: 60** **Credits: 04**

Learning Objectives:

- To learn about the importance of bioenergetics, buffers and Biological interactions.
- To study structure, classification and functional importance of Biomolecules.
- To study fundamentals of structures and interactions present in various biomolecules that help in functioning and organization of living cell.
- To understand biochemical pathways for synthesis and breakdown of complex biomolecules and metabolic disorders that arises out of malfunction of metabolic pathways.

Course Outcomes:

On the successful completion of the course, students will be able to-

- describe redox couples and redox potentials.
- demonstrate the structural and functional role of biomolecules essential for cellular reactions.
- know how the simple precursors give rise to large biomolecules such as proteins, carbohydrates, lipids and nucleic acids.
- explain the physiological significance of anabolic and catabolic pathways used to drive cellular functions.

Unit I: **(16 L)**

Bioenergetics and Nucleic acids

Principles of Bioenergetics: Introduction, Thermodynamic principles, Gibbs free energy, Relationship of Standard free energy to enthalpy, entropy and equilibrium constant, High energy compounds, ATP as universal currency of free energy, Redox Reactions and free energy change in redox reactions.Structure of atom, Henderson- Hassel-balch equation pH, buffers, stabilizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.).**Nucleic acids:**Structureand properties of nucleic acid Bases, Nucleosides, Nucleotides, Sugar Puckering Polynucleotides, Chargaff's rules, biologically important nucleotides, Physical and chemical properties of RNA/DNA, Comparison between A, B and Z DNA.Nucleic acid metabolism: Biosynthesis of purines and pyrimidines, De-novo and Salvagepathways, biodegradation of purines and pyrimidines.

Unit II: **(13 L)**

Carbohydrates

Introduction, Monosaccharides: Properties and functions with example, Derived sugars- Sugar acids, Sugar alcohols, Glycosides, Amino sugars. Disaccharides-structures of Maltose, Lactose, Sucrose, Polysaccharides structure and properties of homo and hetero polysaccharides with examples (Starch, Glycogen, Cellulose,

Chitin, Glycosaminoglycans).Carbohydrate metabolism (Energetics and regulation): Glycolysis, Citric acid cycle, Pentose phosphate pathway, Gluconeogenesis.

Unit III: (15 L)

Lipids and Vitamins

Lipids: Classification- Structure, properties, reactions and biological functions of lipids., Triacyl glycerol and Waxes, Phospholipids, Sphingolipids and glycolipids, Steroids-cholesterol-bile salts, steroid hormones. Metabolism of Lipids: Beta oxidation of Fatty acids-activation, transport to mitochondria, Biosynthesis of saturated and unsaturated fatty acids and cholesterol.

Vitamins: Water soluble vitamins and their coenzyme forms (Niacin, Riboflavin, Pantothenic acid, Thiamine, Pyridoxal, Vitamin B12, Folic acid, Glutathione) ,Fat soluble vitamins (A, D, E, and K).

Unit IV: (16 L)

Amino acids and Proteins

Amino acids: Classification, structure and properties of amino acids, reactions of amino acids, peptide bond, Titration of amino acids, General aspects of amino acid metabolism: Transamination, Deamination, urea cycle and its regulation**Proteins:** Peptide and Polypeptide, Structural organizations of proteins (primary, secondary, tertiary and quaternary), conformational analysis, Ramachandran's plot, Simple and Conjugated Proteins, Fibrous and Globular Proteins (Collagen, Keratin, Elastin, Myoglobin, Hemoglobin etc).

Recommended Textbooks and References:

1. Jain, J.L., Jain, S. and Jain, N.,(2005), Fundamentals of Biochemistry, S. Chand and Company Ltd.
2. Deb, A.C.,(2016). Fundamentals of Biochemistry, New Central Agency, Calcutta
3. Nelson, D.L., Cox, M.M. Lehninger. (2008). Principles of Biochemistry 5th editionPub.WH Freeman Co.
4. Berg JM, Tymoczko JL and Stryer L, (2005). Biochemistry 6th Edition, WH Freeman and Company.
5. Voet, D., Voet J.G. (2004). Biochemistry 3rdEdition,John Wiley & Sons, Inc.
6. Zubey, G.L. Parson, W.W., Vance, D.E. (1994). Principles of Biochemistry WmC Brown publishers. Oxford
7. David E Metzler (2003). Biochemistry, The Chemical reactions of Living Cells Vol. 1. 2nd Edition, Elsevier Academic Press (2003).
8. Ed. R.K. Murray, D.K. Granner, P.A. Mayes and V.W. Rodwell (). Harper's Biochemistry ,Appleton and Lange, Stamford, Connecticut
9. Conn and Stumpf(1967). Outlines of Biochemistry, New York Wiley
10. Plummer DT (1988). An Introduction to Practical Biochemistry, Tata McGraw-Hill Publishing Company Limited .
11. Kuchel, P.W., Ralston Schaums, G.B. Outlines of Biochemistry 2nd edition Pub: Tata.
12. Elliott, W.H., Elliott, D.C. (2005).Biochemistry and Molecular Biology 3rd Indian edition, Pub.Oxford press.

Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)
M.Sc. Biotechnology
I Semester

Course Title: Lab course II **Course Code: P-LAC-139**
Marks: 50 **Credit: 02**

Learning Objectives:

- To teach how to prepare standard solutions and Buffers.
- To make understand to analyze the given Biomolecules qualitatively and quantitatively.
- To understand how to analyze biomolecules by separation techniques.
- To understand qualitative estimation of biomolecules.

Course Outcomes:

On the successful completion of the course, students will be able to-

- prepare different solutions and buffers.
- estimate the unknown concentration of Biomolecules
- use current biochemical techniques to plan and carry out experiments.
- analyze biomolecules by separation techniques

Practicals:

1. Calibration of instruments and verification of Lambert-Beer's Law
2. Preparation of Standard solutions
3. Preparation of buffers
4. Determination of pK values of amino acid
5. Determination of acid value, Saponification number and iodine Number of fatty acids
6. Estimation of protein by Lowry, Biuret and Bradford methods.
7. Estimation of amino acid by Ninhydrin method.
8. Estimation of sugar by Anthrone and DNSA method.
9. Estimation of DNA and RNA by Spectrophotometric method
10. Purification of compound by Column Chromatography

Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)
M.Sc. Biotechnology (Semester Pattern)
I Semester

Course Title: Microbial Physiology **Course Code: P-MIP-136**
Marks: 100 **Lectures: 60** **Credit: 04**

Learning Objectives:

- To study and understand the microbial world and its diversity.
- To understand pure culture techniques and media required for microbial growth.
- To learn bacterial growth curves and kinetics
- To acquire knowledge on basic aspects of bacterial respiration and photosynthesis.

Course Outcomes:

On the successful completion of the course, students will be able to-

- describe basic structure and functions of microbes and relationship to the environment.
- get acquainted with pure culture techniques.
- explain microbial growth kinetics.
- discuss bacterial metabolism.

Unit-I: (16L)

Microbial World

Discovery of the microbial world by Antony van Leeuwenhoek; Controversy over spontaneous generation; Role of microorganisms in transformation of organic matter and in the causation of diseases; identification and classification of microorganisms

Morphology and fine structure of microorganisms:

Bacteria: Purple and green bacteria, cyan bacteria, Homoacetogenic bacteria. Acetic acid bacteria, Budding and appendaged bacteria, Spirilla, Spirochetes, Sheathed bacteria, Pseudomonads; Lactic and propionic acid bacteria, Endospore forming rods and cocci, Mycobacterium, Rickettsias, Chlamydias and Mycoplasma. **Archaea:** Halophiles, Methanogens, Thermoplasma, Ferroplasma and Hyper-thermophilic archaea.**Eukarya:** Algae, Fungi, Slime molds and Protozoa. **Viruses:** Bacterial, Plant and Animal; Viroids and Prions

Unit-II: (14L)

Pure Culture Techniques

Development of pure culture methods; Enrichment culture methods; Culture collection; Maintenance and preservation of Microorganisms

Microbial Nutrition- Nutritional types; Requirement of Nutrients for microbes and classification of microorganisms based on carbon, energy and electron sources viz. Photoautotrophs; Photo

organotrophs; Chemo-lithotrophs (ammonia, nitrate Sulfur, hydrogen, iron oxidizing bacteria); Chemo-organotrophs.

Unit-III : (15L)

Microbial Growth

The definition of growth, mathematical expression of growth, growth curve, measurement of Growth and growth yields; Synchronous growth; Continuousand batch cultures; Physical factors influencing growth: Temperature; PH; Atmospheric Pressure; Salt Concentration. Chemical factors: heavy metal (copper), surfactants. Growth is affected by Environmental factors like temperature, acidity, alkalinity, water availability and oxygen.

Unit-IV: (15L)

Bacterial Metabolism

Metabolic Diversity among Microorganisms; Photosynthesis in microorganisms; Role of Chlorophylls, carotenoids and phycobilins; Calvin cycle; anoxygenic and oxygenic photosynthesis; light and dark reaction**;**Chemolithotrophy; Methanogenesis and acetogenesis**Transport:**Passive and facilitated diffusion, Primary and secondary active transport, concept of uniport, symport and antiport; Solute transport; ABC transporters.

Recommended Textbooks and References:

1. Stainer, R. Y. Ingraham, E. A. Adelberg. (1999), General Microbiology, 4th Edition, The MacMillan Press Ltd.
2. M.T. Madigan, J. M. Martinko, Brock. (2010), Biology of Microorganisms, 13th Edition, Benjamin Cummings Ltd.
3. Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. (2002), Microbiology, 5th Edition, Tata McGraw Hill.
4. Gerhard Gottschalk.(2012), Bacterial metabolism, 2nd edition, Springer Science and Media Publication.
5. Moat, A.G. and Foster, W. (2002), Microbial Physiology, 4th Edition, John Wiley and Sons, New York.
6. Maloy, S.R., Cronan, J.E. Jr. and Freitelder, D. Jones. (1994), Microbial Genetics, 2nd Edition, Bartlett Publishers.
7. Cappuccino, J.G. and Sherman, N. Addison Wesley. (2014), Microbiology - A Laboratory Manual, 10th Edition,
8. Benson, H.J. WCB: Wm C. (2014), Microbiological Applications (A Laboratory Manual in General Microbiology), 13th Edition, Brown Publishers.

Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)
M.Sc. Biotechnology (Semester Pattern)
I Semester

Course Title: Lab Course III **Course Code: P-LAC-140**
Marks: 50 **Credit: 02**

Learning Objectives:

- To learn media preparation and sterilization
- To study isolation and maintenance of Microorganism.
- To provides hands-on pure culture and staining technique
- To studygrowth curve and effect of environmental factors on the growth of microorganisms.

Course Outcomes:

On the successful completion of the course, students will be able to-

- prepare solid and liquid media.
- isolate microbes by using pure culture techniques
- characterize microbes morphologically and biochemically
- perform growth kinetics

Practicals

1. Preparation of liquid and solid media for growth of microorganisms.
2. Culturing techniques of microbes: Slant and stab culture, tube culture, flask culture.
3. Isolation and maintenance of organisms by plating, streaking and serial dilution Methods. Slants and stab cultures. Storage of microorganisms.
4. Isolation of pure cultures from soil and water.
5. Bacterial Growth: Growth curve.
6. Measurement of bacterial population by turbidometry and serial dilution methods.
7. Effect of temperature, pH and carbon sources on growth.
8. Microscopic examination of microorganisms and study of organisms by Monochrome staining, Negative Staining and Gram staining.
9. Analysis of water for portability and determination of MPN.
10. Biochemical characterization of selected microbes.
11. Microscopic measurement of cell dimension and growth by cell counting, biochemical activity of bacteria.
12. Microbial growth experiments: viable count of culture and generation time determination.

Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)
M.Sc. Biotechnology (Semester Pattern)
I Semester

Course Title: Bioinstrumentation and Emerging Techniques
Course Code: P-BET-137
Marks: 100 **Lectures: 60** **Credit: 04**

Learning Objectives:

- To understand analytical techniques and equipment used in Biological sciences.
- To understand the basic principle and applications of microscopy and centrifugation.
- To acquire knowledge on the Chromatographic and electrophoretic method for the separation of biological molecules.
- To get knowledge about the emerging techniques in the field of biological sciences.

Course Outcomes

On the successful completion of the course, students will be able to-

- apply analytical techniques in the field of biological sciences.
- acquaint the knowledge of microscopy and centrifugations techniques.
- get proficiency in chromatography and spectroscopy techniques.
- get familiarize with emerging techniques.

Unit-I: **(12 L)**

Microscopy

Light microscope, Fluorescence microscope, Phase contrast microscope, Electron microscope, confocal microscopy.

Centrifugation: Principle of centrifugation, small bench top centrifuges, large capacity refrigerated centrifuges, High speed refrigerated centrifuges, preparative and analytical ultra-centrifuge.

Unit-II: **(17 L)**

Chromatography

Principles of chromatography, Types of Chromatography: size exclusion, Ion exchange, Affinity chromatography, High performance liquid chromatography(HPLC), Gas liquid chromatography(GLC), Reverse Phase Chromatography.**Electrophoresis**General principles, Electrophoresis of proteins: SDS-PAGE, Native gels, Gradient gel, Isoelectric focusing, 2-D gel electrophoresis (2-D PAGE), cellulose acetate electrophoresis, continuous flow-electrophoresis; Detection, estimation and recovery of proteins, Electrophoresis of nucleic acids: Agarose gel electrophoresis of DNA, DNA sequencing gels, Pulse-field gel

electrophoresis, electrophoresis of RNA, Capillary electrophoresis.

Unit-III: (**17 L)**

Spectroscopy and Radioactivity

Properties of electromagnetic radiation, interaction with matter, UV and Visible spectroscopy, Infrared and Raman spectroscopy, Electron spin resonance spectroscopy, Nuclear magnetic resonance spectroscopy, Circular Dichorism spectroscopy, Atomic spectroscopy. Lasers, Spectrofluorimetry, Luminometry, turbidometry and nephelometry.**Radioactivity**The nature of radioactivity, detection and measurement of radioactivity: Geiger Muller counter, Liquid Scintillation counter, safety aspects, applications of radioisotopes in biological sciences.

Unit IV: **(13L)**

Emerging Techniques

Mass Spectrometry, GC-MS and LC-MS. Flowcytometry, ELISA, Immunoblotting, X-ray crystallography. ICP-MS (Inductively Coupled Plasma Mass Spectrometry)

Recommended Textbooks and References:

1. Biophysical Chemistry (2009) Avinash Upadhyay, Kakoli Upadhyay, Nirmalendu Nath, (Himalaya Publishing House)
2. Principles and Techniques of Biochemistry and Molecular Biology, 5th Ed., (2005) Keith Wilson and John Walker, (Cambridge University press)
3. Principles and Techniques of Biochemistry and Molecular Biology, 6th Ed., (2005) Keith Wilson and John Walker, (Cambridge University press)
4. Essentials of Biophysics (2000) P. Narayanan, (New Age International Publications)
5. Biophysics (2007) Dr. Gurdeep K. ChatwalMrs Madhu Arora, Gurdeep R. Chatwal (Himalaya Publishing House)
6. Biophysics, Mohan P Arora (Himalaya Publishing House)

Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)
I Semester

Course Title: Lab Course IV **Course Code: P-LAC-141**
Marks: 50 **Credit: 02**

Learning Objectives:

- ToProvide Hands-on Microscopy and Centrifugation techniques.
- To Provide Hands-on separation and purification of Biomolecules.
- To get expertise in Western Blotting and ELISA techniques used for analysis of proteins.
- To understand working principle of emerging techniques.

Course Outcomes:

On the successful completion of the course, students will be able to-

- identify different specimens by using microscopy.
- Separate and purify biomolecules.
- Separate and identify biomolecules by using blotting techniques.
- Analyze the molecules based on functional groups.

Practicals

1. To study different type Microscopy
2. Separation and Estimation of Biomolecules (Centrifugation and Double Beam Spectrophotometry)
3. TLC, Paper Chromatography
4. Separation of proteins/ pigments using column/Affinity chromatography
5. Demonstration of techniques: gas chromatography, highperformance liquid Chromatography(HPLC)
6. Electrophoresis of DNA
7. Electrophoresis of proteins under native and denaturing conditions (PAGE)
8. To find out isoelectric point of amino acid
9. ELISA
10. Western blotting
11. Demonstration of FTIR

Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)
M.Sc. Biotechnology (Semester Pattern)
I Semester

Course Title: Bioinstrumentation and Emerging Techniques
Course Code: P-BET-137
Marks: 100 **Lectures: 60** **Credit: 04**

Learning Objectives:

- To understand analytical techniques and equipment used in Biological sciences.
- To understand the basic principle and applications of microscopy and centrifugation.
- To acquire knowledge on the Chromatographic and electrophoretic method for the separation of biological molecules.
- To get knowledge about the emerging techniques in the field of biological sciences.

Course Outcomes

On the successful completion of the course, students will be able to-

- apply analytical techniques in the field of biological sciences.
- acquaint the knowledge of microscopy and centrifugations techniques.
- get proficiency in chromatography and spectroscopy techniques.
- get familiarize with emerging techniques.

Unit-I: **(12 L)**

Microscopy

Light microscope, Fluorescence microscope, Phase contrast microscope, Electron microscope, confocal microscopy.

Centrifugation: Principle of centrifugation, small bench top centrifuges, large capacity refrigerated centrifuges, High speed refrigerated centrifuges, preparative and analytical ultra-centrifuge.

Unit-II: **(17 L)**

Chromatography

Principles of chromatography, Types of Chromatography: size exclusion, Ion exchange, Affinity chromatography, High performance liquid chromatography(HPLC), Gas liquid chromatography(GLC), Reverse Phase Chromatography.**Electrophoresis**General principles, Electrophoresis of proteins: SDS-PAGE, Native gels, Gradient gel, Isoelectric focusing, 2-D gel electrophoresis (2-D PAGE), cellulose acetate electrophoresis, continuous flow-electrophoresis; Detection, estimation and recovery of proteins, Electrophoresis of nucleic acids: Agarose gel electrophoresis of DNA, DNA sequencing gels, Pulse-field gel

electrophoresis, electrophoresis of RNA, Capillary electrophoresis.

Unit-III: (**17 L)**

Spectroscopy and Radioactivity

Properties of electromagnetic radiation, interaction with matter, UV and Visible spectroscopy, Infrared and Raman spectroscopy, Electron spin resonance spectroscopy, Nuclear magnetic resonance spectroscopy, Circular Dichorism spectroscopy, Atomic spectroscopy. Lasers, Spectrofluorimetry, Luminometry, turbidometry and nephelometry.**Radioactivity**The nature of radioactivity, detection and measurement of radioactivity: Geiger Muller counter, Liquid Scintillation counter, safety aspects, applications of radioisotopes in biological sciences.

Unit IV: **(13L)**

Emerging Techniques

Mass Spectrometry, GC-MS and LC-MS. Flowcytometry, ELISA, Immunoblotting, X-ray crystallography. ICP-MS (Inductively Coupled Plasma Mass Spectrometry)

Recommended Textbooks and References:

7. Biophysical Chemistry (2009) Avinash Upadhyay, Kakoli Upadhyay, Nirmalendu Nath, (Himalaya Publishing House)
8. Principles and Techniques of Biochemistry and Molecular Biology, 5th Ed., (2005) Keith Wilson and John Walker, (Cambridge University press)
9. Principles and Techniques of Biochemistry and Molecular Biology, 6th Ed., (2005) Keith Wilson and John Walker, (Cambridge University press)
10. Essentials of Biophysics (2000) P. Narayanan, (New Age International Publications)
11. Biophysics (2007) Dr. Gurdeep K. ChatwalMrs Madhu Arora, Gurdeep R. Chatwal (Himalaya Publishing House)
12. Biophysics, Mohan P Arora (Himalaya Publishing House)

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

II Semester

Course Title: Molecular Biology **Course Code: P-MOB-232**
Marks: 100 **Lectures: 60** **Credit: 04**

Learning Objectives:

- To understand genome organization in lower and higher organisms.
- To understand replication, mutation and repair events in both Prokaryotic and eukaryotic organisms.
- To understand central dogma of life and gene flow.
- To know gene regulation and its application.

Course Outcomes:

On the successful completion of the course, students will be able to-

- extend understanding of the molecular mechanisms via which genetic information is stored, expressed and transmitted among generations.
- understand the principles of inheritance at molecular level.
- understand the synthesis, structure, and function of nucleic acids replication inprokaryotes and eukaryotes.
- understand the flow of genetic information in populations and the relationship between genetics and evolutionary theory.

Unit I **(14L)**

Organization of Genome in Prokaryotes and Eukaryotes

Genome organization of Prokaryotes-Bacteria and virus system.

Genome organization of Eukaryotes- Structure and types of chromosome, chromatin and nucleosome, Variation in chromosome number, Concepts of ploidy, conditions and types of ploidy, variation in chromosome structure, Denaturation and Renaturation DNA, complex DNA structures, C-value paradox, Cot curve.

Unit II **(16L)**

DNA replication and Molecular basis of genome evolution

DNA as genetic material, Genome Replication in prokaryote, various modes of DNA replication, enzymes involved Initiation elongation and termination, & Eukaryotic organisms, Replication regulation in Eukaryotic, enzymes involved.

Mutations, causes types and effects, Hyper mutation, DNA Repair, Recombination: homologous, site specific, transposition

Unit III: **(14L)**

Gene expression in Prokaryotes and Eukaryotes

Transcription in Prokaryotes and Eukaryotes (Initiation, elongation and termination) Post transcriptional processing of m-RNA, t-RNA, r-RNA, RNA Stability &Half-life period.

Translation in prokaryotes and eukaryotes (Initiation, elongation and termination), post translational modifications of proteins- Chemical modification, protein folding and protein localization.

Unit IV: **(16L)**

Gene regulation in prokaryotes: - Operon concept, Lactose, Tryptophan and Arabinose. Role of cAMP and CRP in lac operon, tryptophan operon, Catabolite repression

Gene regulation in eukaryotes: -Conserved mechanism, activation and repressor role in gene regulation. Gene silencing, Signal integration.

Recommended Textbooks and References:

1. William S. Klug and Michael R. Cummins (2005) Concepts of Genetics (International Edition) Edition: Seventh
2. T.A. Brown, John Wiley (2002) Genome2 2nd Edition.
3. Lodish, Berk-Freeman (2003) Molecular Biology 7th edition Pub.Molecular Biology of the Cell
4. Benjamin A. Pierce (2010) A conceptual Approach; 6th edition Genetics:
5. Albert Bruce, (2005) Molecular Biology of the Cell, Garland Science Publication.
6. T.A Brown, John Wiley (2006) Genetics a Molecular Approach,
7. Veer Bala Rastogi (2015) Principal of Molecular Biology 2nd edition

Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)
M.Sc. Biotechnology
II Semester

Course Title: Lab course V **Course Code: P-LAC-236**
Marks: 50 **Credit: 02**

Learning Objectives:

- To provide Hands-on Nucleic acid isolation using various sources
- To study quantitative analysis of nucleic acids
- To provide Hands-on genome transformation.
- To study gene expression pattern

Course Outcomes:

On the successful completion of the course, students will be able to-

- develop skills in isolation and purification of genomic DNA, plasmid DNA and RNA.
- separate and purify nucleic acids based on charge.
- apply the skills of genome transformation in research.
- develop auxotroph's by using replica plating technique.

Practicals:

1. Isolation of genomic DNA from bacteria.
2. Isolation of genomic DNA from animal and plant cells.
3. Isolation of plasmid DNA by using alkaline lysis method.
4. Agarose gel electrophoresis by using DNA markers for molecular wt. determination.
5. To study purity of DNA by Spectrophotometer.
6. Isolation of antibiotic resistant bacteria by gradient plate method.
7. Isolation of RNA from yeast cells.
8. Replica plating for transfer of bacterial colonies.
9. Genetic recombination (conjugation, transformation, transduction) in bacteria.
10. Study of mutations and DNA repair
11. Study of in vitro transcription and translation

Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)
M.Sc. Biotechnology
II Semester

Course Title: Immunology and Immuno-techniques **Course Code: P-IMI-233**
Marks: 100 **Lectures: 60** **Credit: 04**

Learning Objectives:

- To understand cells and organs of Immunology.
- To study basics of antigen, antibody and MHC molecules.
- To study clinical immunology with respect to various diseases.
- To study various immune-techniques of immunology.

Course Outcomes:

On the successful completion of the course, students will be able to-

- understand the working of cells and organs of immunology.
- explain the properties of antigen, antibody and MHC molecules.
- discuss the clinical aspects of immunology.
- describe various antigen-antibody reactions and their significance.

Unit I : **(14L)**

Introduction

The history of immunology, Hematopoiesis and Cells of Immune system, Mechanism of Innate Immune System, Mechanism of Adaptive Immune System: Humoral and cell-mediated Immunity.Types of Innate Immune System, Types of Adaptive Immune System, Primary lymphoid organs – Thymus, Bursa of Fabricius and Bone marrow, Secondary lymphoid organs – Spleen and Lymph node.

Unit II: **(12 L)**

Basics of Immunology

Antigen: Characteristics of antigen, types, Factors that Influence Immunogenicity, Epitopes, Haptens, Antigenicity and Immunogenicity, adjuvant and its types.

Antibody: General Structure of antibody molecule.Discovery of antibody structure by chemical and enzymatic methods.Antibodies Types- variation in structure of antibodies.Functions of the antibody molecules.Organization and Expression of

Immunoglobulin Genes. **MHC molecules:** Structure and types of MHC molecules.Antigen processing and presentation: Endocytic and cytosolic pathway.

Unit III: (15 L)

Clinical Immunology

Complement system: Alternative, Classical & Lectin pathway, Hypersensitivity: Hypersensitivity reactions and its types, Immunodeficiency Conditions: Primary immunodeficiency (SCID), Secondary immunodeficiency (AIDS)Autoimmunity: Organ specific autoimmune diseases and Systemic autoimmune diseases, Transplantation Technology**:** Types of graft (auto, Iso, Allo, and xeno graft), Autograft Acceptance vs allograft rejection, Vaccine Technology: Active and Passive Immunization. Type of Vaccines.

Unit IV (15 L)

Immuno-techniques

Precipitation reactions: Precipitation reactions in gel, precipitation reactions in fluids.Agglutination reactions: Mechanism with Example.Radioimmunoassay: Mechanism and Applications, Immuno-electron microscopy: Concept and Significance. Complement Fixation Test, Flow cytometry: Process and Applications, Enzyme Linked Immunosorbent Assay: Mechanism & Types, Western Blotting: Mechanism and Significance.

Recommended Textbooks and References:

1. Kuby, Judy Owen, Jenni Punt, Sharon Stanford., (2012). Immunology, WH Freeman Publishers,7th Edition.
2. Weir DM and Stewart, J.,(2000). Immunology, 10th Edn., Churchill Livingston, New York.
3. Tizard, Ian R., Immunology- An Introduction, 4th edition, Saunders College Publishing, New Delhi.
4. Sunil Kumar Mohanty, K Sai Leela. (2014) Textbook of Immunology, 2nd Edition, Jaypee Brothers Medical Publishers,.
5. Mark Peakman and DiegoVergani. (1997) 1st magazine, Basic and Clinical Immunology. Churchill Livingstone, New York.
6. RoittI.,(2017), Essential Immunology, 13 th edition, Blackwell Scientific Publications,
7. William E. Paul. (2012). Fundamental Immunology, Lippincott Williams and Wilkins; 7th edition,.
8. Anathanarayanan and Paniker. (2009). Text Book of Microbiology, 8th edition, Orient and Longman, New Delhi.

Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)
M.Sc. Biotechnology
II Semester

Course Title: Lab course VI **Course Code: P-LAC-237**
Marks: 50 **Credit: 02**

Learning Objectives:

- To study basic immunological techniques.
- To study various antigen-antibody reactions.
- To study cells &organs of Immunology.
- To provide hands-on experiments of Hematology.

Course Outcomes:

On the successful completion of the course, students will be able to-

- deliberate diagnosis of disease with help of kit based practicals.
- describe structure of cells and organs of immunology using microscopy.
- identify the pattern of ag – ab interactions.
- perform hematological experiments.

Practicals

1 Agglutination reaction
2 Latex agglutination
3 Immunoprecipitation
4 Radial immunodiffusion
5 Ouchterlony Double diffusion
6 Immuno-electrophoresis.
7 Rocket immune-electrophoresis.
8 Crossed antigen-antibody electrophoresis.
9 Blood film preparation and identification of cells
10 Microscopic observation of lymphoid organs
11 Widal
12 VDRL
13 Determination of bleeding time
14 Determination of clotting time
15 Western blotting.
16 Immunofluorescence.
17 complement fixation test

Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)
M.Sc. Biotechnology
II Semester

Course Title: Bioinformatics and Biostatistics **Course Code: P-BIB-234**
Marks: 100 **Lectures: 60** **Credit: 04**

Learning Objectives:

- To create awareness about importance of Biological Databases like NCBI, EMBL and PIR etc.
- To provide the information about Sequence similarity and identity of proteins by using sequence alignment method.
- To inculcate the new approaches to visualize protein structure by using computer technology.
- To study statistical techniques applied in analysis of data in biological science.

Course Outcomes:

On the successful completion of the course, student will be able to-

- acquaint the knowledge about preliminaries of Bioinformatics and its evolution.
- gain knowledge about the Codon bias analysis.
- understand the primary, secondary and tertiary structure prediction methods.
- analyze various forms of data using statistical tools.

Unit I : **(12L)**

Fundamentals of Bioinformatics

Definition and scope of Bioinformatics. Bioinformatics – an Overview, Definition and History. Information Networks – Internet in Bioinformatics, Evolution of Bioinformatics – Scope – Potentials of Bioinformatics, Human Genome Project, Introduction to Biological Databases: NCBI, EMBL, PIR, SWISS-Prot, PubChem

Unit II: **(14L)**

Sequence Alignment

Pairwise sequence alignments: Sequence similarity, identity, and homology. Global and local alignment. BLAST and application of Blast tool. Multiple sequence alignments: Application of multiple sequence alignment. Phylogenetic analysis: Definition and description of phylogenetic trees. Computational gene prediction methods, analysis of codon usage bias.

Unit III: **(16L)**

Structural Bioinformatics

Principles of Protein Structure and Classification: Properties of amino acids and peptide bonds, Ramachandran plot, Secondary structures, motifs and folds. Schematic representations and structure visualization of proteins structure, Protein Data Bank, Protein Structure Visualization; tools and analysis of protein structures. Protein Databank. Secondary structure prediction methods. Tertiary structure Prediction methods (Homology modeling, Fold recognition and ab-initio method).

Unit IV: **(18L)**

Biostatistics

Brief description and tabulation of data and its graphical representation, Measurement of central tendency and dispersion- mean, mode, median, range, Mean deviation, standard deviation, variance. Idea of two types of errors and level of significance. Tests of significance- F-Test, and chi-square test. Linear regression and correlation.

Recommended Textbooks and References:

1. Introduction to Bioinformatics Prentice Hall, 1999 Teresa Attwood, David Parry-Smith
2. Bioinformatics: The Machine Learning Approach MIT Press, c2001. Pierre Baldi, SørenBrunak
3. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, J. Wiley, c1998. Andreas D. Baxevanis, B.F. Francis Ouellette
4. Structural Bioinformatics Wiley, c2003. Projected Pub. Date: 0311 Philip E. Bourne, Helge Weissig
5. Bioinformatics for Dummies Wiley Pub., 2002. Projected Pub. Date: 0211 Jean-Michel Claverie, Cedric Notredame
6. Computational Molecular Biology: An Introduction, Wiley, 2000. Peter Clote, Rolf Backofen
7. Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids, Cambridge University Press, 1998 Richard Durbin, Sean R. Eddy, Anders Krogh, Graeme Mitchison
8. Khan and Khanum: Fundamentals of Biosatistics(low price Third Revised edition) ; Ukaaz Publication
9. Fundamental of Statistics: S.P.Gupta
10. Discovering Genomics, Proteomics, & Bioinformatics. Campbell &Heyer (2003) Pearson Education,
11. Bioinformatics, Methods of Biochemical Analysis Series Vol. 43, Baxevanis& Ouellette (2001) John Wiley & Sons,
12. Computational Molecular Biology.Pevzner, P.A. (2000) MIT Press,
13. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. Andreas D. Baxevanis& B. F. Francis Ouellette (2004). 3rd Edition. Wiley & Sons.

Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)
M.Sc. Biotechnology
II Semester

Course Title: Lab Course VII **Course Code: P-LAC-238**
Marks: 50 **Credit: 02**

Learning Objectives:

- To gain the knowledge about use of computer technology to predict protein structure and Function.
- To provide Hands-on Visualization of protein by using PDB, PyMol, JMol.
- To provide Hands-on Microarray Analysis.
- To study statistical methods used for analysis of data.

Course Outcomes:

On the successful completion of the course, student will be able to-

- get hands on approach to conduct experiments to find out protein sequence.
- get hands on approach to conduct experiments to identify protein motifs and SNP Analysis
- interpret the data by using Bioinformatics tools
- interpret and analyze the biological data using statistical tools

Practicals:

1. NCBI - Sequence Databases & Tools
2. Sequence Alignment & Analysis (BLAST, FASTA, Gene Prediction)
3. Structure Databases & Visualization (PDB, PyMol, JMol, Cn3D, STING)
4. Protein Function Prediction (sequence-based, structure-based)
5. Phylogenetic Analysis (CLUSTAL, PHYLIP)
6. Genome Viewers, SNP Analysis
7. Microarray Analysis
8. Protein Structure Prediction
9. Structure validation and Protein Data Bank
10. Structural and functional motifs in proteins
11. Anatomy of protein structures
12. Problems based on measures of central tendency and dispersion
13. Problems based on Correlation and regression
14. Problems based on Chi –square test
15. Problems based on Annova

Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)
M.Sc. Biotechnology
II Semester

Course Title: Bioprocess Engineering **Course Code: P-BIE-235**
Marks: 100 **Lectures: 60** **Credit: 04**

Learning Objectives:

- To understand the fluid statics and basic of bioprocess engineering.
- To understand basic idea of designing of Bioreactor, Growth and sterilization kinetics.
- To understand the measurement and control of Bioprocesses Parameters.
- To understandupstream and downstream processing techniques.

Course Outcomes:

On the successful completion of the course, students will be able to-

- acquaint fluid statics and material engineering.
- apply the knowledge to design bioreactor and study sterilization Kinetics.
- describe and apply downstream processing techniques in research and industry.
- explain growth kinetics and process control mechanism.

Unit I: **(12 L)**

Basic Chemical Engineering calculations

Material balance. Material balance with reactions. Material balance with recycle and purge. Energy balance. Enthalpy, specific heat, mean specific heat. Heat Balance. Heat of reaction and heat of solution. Material and Energy balance together.

Fluid statics: Classification of fluids, concept of Reynold's number, Rheological properties of fermentation process (Viscosity, cell concentration, product concentration etc), Fluid mechanics. Potential flow. Newtonian and non-Newtonian fluid (Bingham plastic, pseudo plastic, dilatants etc.), Heat and mass Transfer.

Unit II: **(13 L)**

Design of Fermentors and Sterilization Kinetics

Fermenters: Ideal Properties of Bioreactor, Components of the fermenters & theirspecifications: Body Construction, Agitator, Impeller, Baffles etc. Types of Bioreactors: (Packed-bed reactor, Air –lift, Trickle bed Photo bioreactors, Rotating Biological Reactors pneumatic)**Air & Media sterilization:**Air Sterilization Principles, Mechanisms of capture of particles in Air, Depth & Screen Filters, Sizing, Testing & validation of filters for air

Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)
M.Sc. Biotechnology
II Semester

Course Title: Bioinformatics and Biostatistics **Course Code: P-BIB-234**
Marks: 100 **Lectures: 60** **Credit: 04**

Learning Objectives:

- To create awareness about importance of Biological Databases like NCBI, EMBL and PIR etc.
- To provide the information about Sequence similarity and identity of proteins by using sequence alignment method.
- To inculcate the new approaches to visualize protein structure by using computer technology.
- To study statistical techniques applied in analysis of data in biological science.

Course Outcomes:

On the successful completion of the course, student will be able to-

- acquaint the knowledge about preliminaries of Bioinformatics and its evolution.
- gain knowledge about the Codon bias analysis.
- understand the primary, secondary and tertiary structure prediction methods.
- analyze various forms of data using statistical tools.

Unit I : **(12L)**

Fundamentals of Bioinformatics

Definition and scope of Bioinformatics. Bioinformatics – an Overview, Definition and History. Information Networks – Internet in Bioinformatics, Evolution of Bioinformatics – Scope – Potentials of Bioinformatics, Human Genome Project, Introduction to Biological Databases: NCBI, EMBL, PIR, SWISS-Prot, PubChem

Unit II: **(14L)**

Sequence Alignment

Pairwise sequence alignments: Sequence similarity, identity, and homology. Global and local alignment. BLAST and application of Blast tool. Multiple sequence alignments: Application of multiple sequence alignment. Phylogenetic analysis: Definition and description of phylogenetic trees. Computational gene prediction methods, analysis of codon usage bias.

Unit III: **(16L)**

Structural Bioinformatics

Principles of Protein Structure and Classification: Properties of amino acids and peptide bonds, Ramachandran plot, Secondary structures, motifs and folds. Schematic representations and structure visualization of proteins structure, Protein Data Bank, Protein Structure Visualization; tools and analysis of protein structures. Protein Databank. Secondary structure prediction methods. Tertiary structure Prediction methods (Homology modeling, Fold recognition and ab-initio method).

Unit IV: **(18L)**

Biostatistics

Brief description and tabulation of data and its graphical representation, Measurement of central tendency and dispersion- mean, mode, median, range, Mean deviation, standard deviation, variance. Idea of two types of errors and level of significance. Tests of significance- F-Test, and chi-square test. Linear regression and correlation.

Recommended Textbooks and References:

14. Introduction to Bioinformatics Prentice Hall, 1999 Teresa Attwood, David Parry-Smith
15. Bioinformatics: The Machine Learning Approach MIT Press, c2001. Pierre Baldi, SørenBrunak
16. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, J. Wiley, c1998. Andreas D. Baxevanis, B.F. Francis Ouellette
17. Structural Bioinformatics Wiley, c2003. Projected Pub. Date: 0311 Philip E. Bourne, Helge Weissig
18. Bioinformatics for Dummies Wiley Pub., 2002. Projected Pub. Date: 0211 Jean-Michel Claverie, Cedric Notredame
19. Computational Molecular Biology: An Introduction, Wiley, 2000. Peter Clote, Rolf Backofen
20. Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids, Cambridge University Press, 1998 Richard Durbin, Sean R. Eddy, Anders Krogh, Graeme Mitchison
21. Khan and Khanum: Fundamentals of Biosatistics(low price Third Revised edition) ; Ukaaz Publication
22. Fundamental of Statistics: S.P.Gupta
23. Discovering Genomics, Proteomics, & Bioinformatics. Campbell &Heyer (2003) Pearson Education,
24. Bioinformatics, Methods of Biochemical Analysis Series Vol. 43, Baxevanis& Ouellette (2001) John Wiley & Sons,
25. Computational Molecular Biology.Pevzner, P.A. (2000) MIT Press,
26. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. Andreas D. Baxevanis& B. F. Francis Ouellette (2004). 3rd Edition. Wiley & Sons.

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

M.Sc. Biotechnology

II Semester

Course Title: Lab course VIII **Course Code: P-LAC-239**

Marks: 50 **Lecture:30** **Credit: 02**

Learning Objectives:

- To understand working of fermenter
- To provideHands -On upstream and downstream processing of industrial products.
- To provide Hands-on Screening of potent microorganism.
- To learn solution for growth and sterilization kinetics.

Course Outcomes:

On the successful completion of the course, students will be able to-

- perform Hands-on Screening of potent microorganism.
- perform Hands -On upstream and downstream processing of industrial products.
- solve problems related to fermentation kinetics.
- design small scale Bioreactor.

Practicals:

1. Study of Growth Kinetics of Bacteria and Yeast by turbidometry & SCP
2. Screening and maintenance of Industrially important microorganism- Acids, Antibiotics, Enzymes.
3. Study of scale up of fermentation
4. Study of design of bioreactor
5. Determination of TDP
6. Determination of TDT and design of sterilizer
7. Study of types of fermentation process (Surface and submerged)
8. Downstream process of industrial products (Intra & Extra cellular)
9. Problems based on: - Growth kinetics, fluid flow, Reynold's number
10. Visit to fermentation Industry

Summary of cross cutting issues:

Biotechnology is a collective term for a group of technologies that use biological matter or processes to generate new and useful products and processes. As such, it ranges in complexity and maturity from ancient brewing and bread-making techniques to genetic modification through hybridization and interbreeding of plants and animals, as well as the manipulation of individual genes in humans, animals, plants and micro-organisms. Biotechnology is a key technology for the new millennium. It has an immense range of applications in agriculture, medicine, food processing, environmental protection, mining, and even nanoelectronics.

It is expected to cover some critical issues in the designed curriculum for the development of Students. In our syllabus we tried to include following cross cutting issues.

Cross-cutting issues relevant to Professional Ethics, Gender, Environment and Sustainability, and Human Values into the curriculum:

Sr. No.	Course Name	Code	Relevant to Professional Ethics	Description
1	Cell and Development Biology	P-CDB-134	Professional Ethics	Expertise in cell culture techniques will create employability in Pathology labs and Research Institutes
2	Biochemistry	P-BIO-135	Professional Ethics	Expertise in cell Biochemistry will create employability in Pathology labs
3	Microbial Physiology	P-MIP-136	Professional Ethics	Students can get jobs as technician in different labs
4	Bioinstrumentation and Emerging Techniques	P-BET-137	Professional Ethics	Student understands the Proper handling of instrument, which is essential in Research and Industry job.
5	Molecular Biology	P-MOB-232	Professional Ethics	help in getting absorb in various research organization, molecular labs and

				industry research and development sector
6	Immunology and immunotechniques	P-IMI-233	Professional Ethics	Expertise in immunological techniques will create employability in Pathology labs and Research Institutes
7	Bioinstrumentation and Biostatistics	P-BAB-234	Professional Ethics	Expertise in recent and advanced bioinstrumentations
8	Bioprocess Engineering	P-BIE-235	Professional Ethics	Students will get job in Fermentation Industries as process design engineer.

Curricula developed and implemented have relevance to the local, national, regional and global developmental needs

Sr. No.	**Course code**	**Course Name**	**Linkage with Local/National/Regional/Global development**
1	P-CDB-134	Cell and Developmental Biology	Research and Diagnostics
2	P-BIO-135	Biochemistry	Research and Qualitative and Quantitative analysis
3	P-MIP-136	Microbial Physiology	Research
4	P-BET-137	Bioinstrumentation and Emerging Technologies	Technical skills in Biology
5	P-MOB-232	Molecular Biology	Skills in Molecular Techniques
6	P-IMI-233	Immunology and Immuno Techniques	Skills in Immuno Techniques
7	P-BAB-234	Bioinformatics and Biostatistics	Data Base Generation, Analysis of Data

8	P-BIE-235	Bioprocess Engineering	QC and QA

Courses having focus on employability/ entrepreneurship/ skill development

Sr. No.	Name of the Course	Course Code	Activities/Content with a direct bearing on Employability/ Entrepreneurship/ Skill development			Year of introduction
			Employability	Entrepreneurship	Skill development	
1	Cell and Developmental Biology	P-CDB-134	Expertise in cell culture techniques will create employability in Pathology labs and Research Institutes		Student will get idea about cell culture Technology.	2022-23
2	Biochemistry	P-BIO-135	Expertise in cell Biochemistry will create employability in Pathology labs		Students will get idea about role of biomolecules essential for cellular reactions and physiological significance of anabolic and catabolic pathways used to drive cellular functions.	2017-18
3	Microbial Physiology	P-MIP-136	Students can get jobs as technician in different labs		Students will get thorough knowledge and understanding of core concepts of microbiology. Students will also get familiar with microbe handling techniques	2017-18

4	Bioinstrumentation and Emerging Technologies	P-BET-137	Student understands the Proper handling of instrument, which is essential in Research and Industry job.		Student develop the skill of instrument handling	2022-23
5	Molecular Biology	P-MOB-232	help in getting absorb in various research organization, molecular labs and industry research and development sector			2017-18
6	Immunology and immunotechniques	P-IMI-233	Expertise in immunological techniques will create employability in Pathology labs and Research Institutes		Student will be skilled in Immunotechniques	2017-18
7	Bioinformatics and Biostatistics	P-BAB-234	Expertise in Database Generation and Analysis will create Employability in Data Science	Working as an entrepreneur in Data Management	Skills in Data Analysis	2022-23
8	Bioprocess Engineering	P-BIE-235	Students will get job in Fermentation Industries as process	Students can establish their own Industry	They learn Kinetics, Process designing etc.	2017-18

			design engineer.			