St. PETER'S
INSTITUTE OF HIGHER EDUCATION & RESEARCH
DEEMED TO BE UNIVERSITY U/S 3 OF THE UGC ACT 1956
AICTE Approved and ISO 9001:2015 Certified

B.Sc. MICROBIOLOGY

(Approved by UGC)

(I to IV SEMESTERS)

REGULATIONS AND SYLLABI
CHOICE BASED CREDIT SYSTEM

REGULATIONS – 2024

(Effective from the Academic Year 2024-25)

St. Peter's Institute of Higher Education and Research

REGULATION 2024

B.Sc. MICROBIOLOGY

CHOICE BASED CREDIT SYSTEM

VISION & MISSION OF THE INSTITUTION

Vision

To achieve, Academic Excellence in Engineering, Technology and Science through Teaching, Research and Extension to Society

Mission

By generating, preserving and disseminating knowledge through rigorous academic study, inquisitiveness to understand and explore nature, entrepreneurship with creativity and innovation

VISION & MISSION OF THE DEPARTMENT

VISION

- To emerge as a dynamic center of excellence in Microbiology and to flourish in both national and international scene

MISSION

- To conduct high quality research in Microbiology
- To effectively transform our theoretical knowledge and practical skills in Microbiology to the industry and to the common public.
- To impart technical skills with integrity and ethical standards in students.

PROGRAMME OUTCOMES (POs)

PO1 Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO2 Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO3 Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO4 Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO5 Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO6 Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

PO7 Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes

PO8 Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO-1: Introduce advanced techniques and ideas required in developing area of Microbiology

PEO-2: Enhance the students' ability to develop interdisciplinary knowledge.

PEO-3: Gain the knowledge of Microbiology through theory and practical

PEO-4: Understand and apply the knowledge of Microbiology for understanding the scientific phenomenon in the aspects of Microbiology

PEO-5: Understand and apply analytical techniques for evaluating the various biochemical systems.

PEO-6: Understand good laboratory practices (GLP) and biosafety.

PEO-7: Develop research oriented skills.

PEO-8: Make aware and handle the sophisticated instruments/equipments.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO-1: Ability to understand the concepts and applications in the field of advanced techniques andideas required in developing area of Microbiology

PSO-2: Ability to understand the scientific phenomenon in microbial enzymes, metabolism and proteins

PSO- 3: Ability to apply the learning from the courses and develop applications for real world research problems.

St. PETER'S INSTITUTE OF HIGHER EDUCATION AND RESEARCHB.Sc. (MICROBIOLOGY) PROGRAMME
REGULATIONS AND SYLLABI UNDER CHOICE BASED CREDIT SYSTEM
(Effective from the Academic Year 2024-2025)

REGULATIONS (2024)

Regulations – 2024 is applicable to the students admitted to the Degree of Bachelor of Science (B.Sc.) Microbiology (Six Semesters) programme effective from the academic year 2024- 2025.

NOMENCLATURE

- **Programme** : Refers to the Bachelor of Science in Microbiology Stream that a student has chosen for study.
- **Course** : Refers to the course (Subject) that a student would have to undergo during the study in the Institution
- **Batch** : Refers to the Starting and Completion year of a Programme of study. Eg. Batch of 2024–2028 refers to students belonging to a 4 years Degree programme admitted in 2024 and completing in 2028.
- **Department** : Each Programme of the Institution is grouped under a Department. Eg. M.Sc Microbiology is grouped under Departments of Microbiology. This Department offers various Undergraduate and Postgraduate programmes in Sciences like B.Sc (Microbiology), M.Sc (Microbiology).
- **Dean** : Refers to the Head of Arts and Science & Management Studies Programmes.
- **HoD** : Refers to the Head of a Department (HoD) offering various UG and PG programmes. He / She will be the Head of all staff members and Students belonging to the Department

QUALIFICATION FOR ADMISSION

Qualification for admission will be as per the criterion specified by the appropriate agencies of the Government of India.

- Candidates who passed the Higher Secondary Examination with Biology, Physics and Chemistry conducted by the Government of Tamil Nadu or its equivalent in the relevant subjects as recognized by the Institute or any other equivalent Examination thereto wherever prescribed are eligible for admission to Three Year B.Sc. (MY) Programme.

I-SEMESTER

Course Code	Course Title	Hrs/Week			Credits	Marks		
		L	T	P		CIA	ESE	Total
24MBU101	**Major Core-1** General Microbiology	4	0	0	4	40	60	100
24MBU111	**Major Practical-1** General Microbiology lab	0	0	4	2	40	60	100
24BCU103	**Minor Stream-I** Biochemistry-I	2	0	0	2	40	60	100
24BCU113	**Minor Practical-1** Biochemistry-I Lab	0	0	3	2	40	60	100
24MBU141	**Skill Enhancement Course-I** Recombinant DNA Technology	3	0	0	3	40	60	100
24MBU161	**Multidisciplinary Course-1** Introduction to Cell Biology	3	0	0	3	40	60	100
24TAU151/ 24HIU151/ 24TEU151/ 24FRU151	**Ability Enhancement course L1** – Tamil/Hindi/Telugu/French	3	0	0	2	40	60	100
24ENU151	**Ability Enhancement course E1** – English - I	3	0	0	2	40	60	100
Total		**18**	**0**	**7**	**20**	**320**	**480**	**800**

Minor Stream - I

Course Code	Course Title	Hrs/Week			Credit	Marks		
		L	T	P		CIA	ESE	Total
24BCU103-A	Biochemistry-I	2	0	0	2	40	60	100
24BCU103-B	Chemistry-I	2	0	0	2	40	60	100

Multidisciplinary Course-1

Course Code	Course Title	Hrs/Week			Credit	Marks		
		L	T	P		CIA	ESE	Total
24MBU161-A	Introduction to Cell Biology	3	0	0	3	40	60	100

24MBU161-B	Biostatistics	3	0	0	3	40	60	100

II-SEMESTER

Course Code	Course Title	Hrs/Week			Credits	Marks		
		L	T	P		CIA	ESE	Total
24MBU201	**Major Core-II** Immunology	4	0	0	4	40	60	100
24MBU211	**Major Practical-II** Immunology Lab	0	0	4	2	40	60	100
24BCU204	**Minor Stream-II** Biochemistry-II	2	0	0	2	40	60	100
24BCU213	**Minor Practical-II** Biochemistry-II Lab	0	0	2	2	40	60	100
24BOU261	**Multidisciplinary Course-II** Fermentation Technology	4	0	0	3	40	60	100
24MBU241	**Skill Enhancement Course-II** Computational Biology	3	0	0	3	40	60	100
24TAU251/ 24HIU251/ 24TEU251/ 24FRU251	**Ability Enhancement course L2**, Tamil/Hindi/Telugu/French	3	0	0	2	40	60	100
24ENU251	**Ability Enhancement course E2**, English – II	3	0	0	2	40	60	100
Total		**19**	**0**	**6**	**20**	**320**	**480**	**800**

Minor Stream - II

Course Code	Course Title	Hrs/Week			Credit	Marks		
		L	T	P		CIA	ESE	Total
24BCU204-A	Biochemistry-II	2	0	0	2	40	60	100
24BCU204-B	Chemistry-II	2	0	0	2	40	60	100

Multidisciplinary Course-II

Course Code	Course Title	Hrs/Week			Credit	Marks		
		L	T	P		CIA	ESE	Total
24BOU202-A	Fermentation Technology	4	0	0	3	40	60	100
24BOU202-B	Plant Biotechnology	4	0	0	3	40	60	100

III-SEMESTER

Code	Course Title	Hrs/Week			Credits	Marks		
		L	T	P		CIA	ESE	Total
24MBU301	**Major Core-III** Molecular biology	5	0	0	5	40	60	100
24MBU311	**Major Practical - III** Molecular biology lab	0	0	4	2	40	60	100
24BCU303	**Minor Stream-III** Bioinstrumentation	4	0	0	3	40	60	100
24BCU312	**Minor Practical-III** Bioinstrumentation Lab	0	0	4	2	40	60	100
24MBU341	**Skill Enhancement Course-III** Biotechnology	3	0	0	3	40	60	100
24BOU362	**Multidisciplinary Course-III** Plant Biotechnology	3	0	0	3	40	60	100
24MBU331	**Value Added Course -I** Vermitechnology	1	0	1	2	40	60	100
Total		**16**	**0**	**9**	**20**	**280**	**420**	**700**

Minor Stream - III

Course Code	Course Title	Hrs/Week			Credit	Marks		
		L	T	P		CIA	ESE	Total
24BCU303-A	Bioinstrumentation	3	0	0	2	40	60	100
24BCU303-B	Biophysics	3	0	0	2	40	60	100

Multidisciplinary Course-III

Course Code	Course Title	Hrs/Week			Credit	Marks		
		L	T	P		CIA	ESE	Total
24BOU303-A	Plant Biotechnology	3	0	0	3	40	60	100
24BOU303-B	Fermentation Technology	3	0	0	3	40	60	100

IV-SEMESTER

Code	Course Title	Hrs/Week			Credits	Marks		
		L	T	P		CIA	ESE	Total
24MBU401	**Major Core-IV** Soil and Agricultural Microbiology	5	0	0	5	40	60	100
24MBU411	**Major Practical - IV** Soil and Agricultural Microbiology lab	0	0	4	2	40	60	100
24MBU402	**Major Core-V** Microbial Genetics	4	0	0	5	40	60	100
24MBU412	**Major Practical - V** Microbial Genetics Lab	0	0	4	2	40	60	100
24MBU403	**Minor Stream-IV** Biostatistics	2	0	0	2	40	60	100
24MBU413	**Minor Stream-IV** Biostatistics Lab	0	0	4	2	40	60	100
24MBU431	**Value Added Course -II** Mushroom Cultivation	2	0	0	2	40	60	100
Total		**13**	**0**	**12**	**20**	**280**	**420**	**700**

Minor Stream - IV

Course Code	Course Title	Hrs/Week			Credit	Marks		
		L	T	P		CIA	ESE	Total
24MBU403-A	Biostatistics	3	0	0	2	40	60	100
24MBU403-B	Bioinformatics	3	0	0	2	40	60	100

SEMESTER I

24MBU101	General Microbiology	L	T	P	C	TOTAL MARKS
		4	0	0	4	100

PREREQUISITES: NIL

COURSE OBJECTIVES:

The main objectives of this course are to:

1	Students can learn the concepts of Microbiology and its history.
2	Students can understand the techniques and instruments involved to study the structure and functions of microorganisms.
3	Students can understand the importance of nutritional requirement of microorganisms and its optimization process.
4	Students can learn the techniques and principles of controlling the microorganisms.
5	Students will gain knowledge on industrially important microorganisms and their applications.

UNIT 1:	**History of Microbiology**	**12**

History and Scope of Microbiology-Spontaneous generation theory-Major contributions of Microbiologists -Classification & Nomenclature of Microorganisms -Structure of Prokaryotic & Eukaryotic cell

UNIT 2:	**Microscopy & its Applications**	**12**

Microscopy-Principle & Applications-Simple & Compound microscope-Bright & Dark field-Phase contrast-Electron microscope-SEM-TEM-Fluorescence-Staining techniques-Specimen preparation for electron microscopy

UNIT 3:	**Microbial growth & Nutrition**	**12**

Culture media-Types of media: simple media, enriched media, selective media, differential media, transport media. Classification of media-Components of media and its role in microbial growth-Growth curve- Pure culture techniques-preservation of microorganisms

UNIT 4:	**Control of Microorganisms**	**12**

Sterilization techniques-Principle-Methods of sterilization-Physical & Chemical- mode of action-Phenol co-efficient test

UNIT 5:	**Applications of Microorganism in Industry**	**12**

An introduction to Microbes in industry-Food-fermentation, Textile-enzymes, Antibiotics-penicillin,Biogas-Biofertilizer-VAM, blue green algae, Bio-remediation, Biopesticide

60 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students will be able to:

CO1:	understand the discovery and invention in Microbiology and its development
CO2:	understand to use the microscope and its application in studying the structure of cells
CO3:	understand the nutritional requirement of the microorganisms and optimizing process
CO4:	understand the effective controlling measures against microorganism
CO5:	apply industrially important microorganisms in producing commercially and medicinally important products

TEXT BOOKS

1.	Prescott LM, Harley JP and DA Klein (2005). Microbiology. Sixth edition, International edition, McGraw Hill.
2.	Pelczar TR, Chan ECS and Kreig NR (2006). Microbiology. Fifth edition, Tata McGraw-Hill INC. New York.
3.	Dubey RC and Maheswari DK (2012). A1text of Microbiology (Revised edition). S. Chand and Company Ltd., New Delhi.

4.	Robert F Boyd (1984). General Microbiology. Times mirror / Mosby college publishers.
REFERENCES	
1.	Davis BD, Delbecco R, Eisen HN and Ginsburg HS (1990). Microbiology. Fifth edition, Harper & Row, New York.
2.	Heritage J, Evans EGV and Killington RA (1996). Introductory Microbiology. Cambridge University Press.
3.	Larry Mc Kane and Judy Kandel (1996). Microbiology- Essentials and applications. Second edition, Mc Fraw Hill Inc, Newyork.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1:	3	3	2	2	1	1	1	2	3	2	3
CO2:	3	3	2	2	1	1	1	2	3	2	3
CO3:	3	3	2	2	1	1	1	2	3	2	3
CO4:	3	3	2	2	1	1	1	2	3	2	3
CO5:	3	3	2	2	1	1	1	2	3	2	3
CO	3	3	2	2	1	1	1	2	3	2	3

1 - LOW, 2 - MEDIUM, 3 - HIGH

24BCU103	BIOCHEMISTRY-I	L	T	P	C	TOTAL MARKS
		2	0	0	2	100

PREREQUISITES: NIL

COURSE OBJECTIVES:

The main objectives of this course are to:

1	Students can acquire knowledge in the structure and function of biomolecules.
2	Students can understand the basics of Biochemistry.
3	Students can gain knowledge in the field of Structural biochemistry
4	Students can understand the properties of lipids.
5	Students will gain knowledge on various nucleic acids.

UNIT 1:	**Chemistry of Carbohydrates**	**12**

Definition and Classification of carbohydrates, linear and ring forms (Haworth formula) Formonosaccharides for glucose and fructose. Disaccharides – sucrose and lactose. Physical properties – muta rotation and kilianicynohydrin synthesis. Chemical properties-Oxidation, reduction, osazoneformation. Disaccharide-sucrose and lactose - occurrence, structure; Physical and chemical properties. Polysaccharides: starch and cellulose-occurrence, structure, physical and chemical properties

UNIT 2:	**Chemistry of aminoacids**	**12**

Definition and classification of aminoacids, common properties of aminoacids, amphoteric nature, isoelectricpoint, iselectric pH and Zwitter ion. Reaction with ninhydrin, 1-fluoro-2, 4-dinitronitrobenzene (FDNB) and Sieg Fried-s carbamino reaction

UNIT 3:	**Chemistry of Proteins**	**12**

Classifications-shape and size, solubility and physical properties and functional properties. Physical properties: salting in and salting out, denaturation, peptide bond. Structure of protein: primary, secondary, tertiary and quaternary. N-terminal determination-Edman-s and Dansyl chloride method. C-terminal determination-Van-Slyke reaction, Phosgene reaction

UNIT 4:	**Chemistry of Lipids**	**12**

A-8 10Definition, classification and functions. Occurrence, chemistry and biological functions-simple lipids: tertiary compound lipids (e.g.phospholipids), derived lipids: steroids (e.g. cholesterol). Saturated fatty acids: Butyric, arachidic and stearic acid. Unsaturated fattyacids: Oleic, linoleic and linolenic acid. Physical property - emulsification. Chemical properties-saponification, rancidity,definition of acid number, saponification number, iodine number and Reichert-Meissl number. Bile acid and bile salt functions.

UNIT 5:	**Chemistry of Nucleic acids**	**12**

Definition, nucleoside, nucleotide and polynucleotide. Double helical model of DNA and its biological functions. Structure of RNA: tRNA, mRNA and rRNA-occurrence, chemistry and its biological functions. Differences between DNA and RNA properties: cot curve and cot value, Tm, hypo and hyperchromicity.

60 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students will be able to:

CO1:	Gain knowledge in the structure of carbohydrates.
CO2:	Understand the importance of aminiacids.
CO3:	Acquire knowledge in fundamentals of proteins.
CO4:	Become familiar with the lipid biochemistry.
CO5:	Analyse chemical properties of nucleic acidss.

TEXT BOOKS

1.	Murray RK, Grammer DK. Harper's Biochemistry. Twenty fifth edition, McGraw Hill, Lange

	Medical Books.
2.	Kannan C. Biomolecules. MJP Publishers, Chennai.
3.	Jain JL, Sunjay Jain, Nitin Jain. Fundamentals of Biochemistry. S. Chand & Company.
4.	Amit Krishna De. Biochemistry. S. Chand & Co., Ltd.
REFERENCES	
1.	Nelson DL, Lehninger MM. Principles of Biochemistry. Cox, Macmillan Worth Publishers.
2.	Voet D and Voet JG (2011). Biochemistry. Fourth edition, CBS Publishers and Distributors.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1:	3	3	3	1	3	2	3	3	3	3	3
CO2:	3	3	3	1	3	2	3	3	3	3	3
CO3:	3	3	3	1	3	2	3	3	3	3	3
CO4:	3	3	3	1	3	2	3	3	3	3	3
CO5:	3	3	3	1	3	2	3	3	3	3	3
CO	3	3	3	1	3	2	3	3	3	3	3

1 - LOW, 2 - MEDIUM, 3 - HIGH

24MBU111	General Microbiology Lab	L	T	P	C	TOTAL MARKS
		0	0	4	2	100

PREREQUISITES: NIL

COURSE OBJECTIVES:

The main objectives of this course are to:

1	Students can learn the Sterilization techniques.
2	Students can understand the isolation techniques of microorganisms.
3	Students can understand the principles of Microscopy and various staining techniques.
4	Students can identify various microorganisms.
5	Students will gain knowledge in identifying unknown microorganisms.

UNIT 1: **12**

Cleaning of glass wares Sterilization principle and methods- moist heat- dry heat and filtration methods. Media preparation: liquid media, solid media, agar slants, agar plates, basal, enriched, selective media preparation- quality control of media, growth supporting properties, sterility check of media.

UNIT 2: **12**

Pure culture techniques: streak plate, pour plate, decimal dilution. Culture characteristics of microorganisms: growth on different media, growth characteristics and description. Demonstration of pigment production.

UNIT 3: **12**

Microscopy: light microscopy, bright field microscopy, dark field microscopy. Motility demonstration: hanging drop, wet mount preparation, dark field microscopy, semi-solid agar, Craigie's tube method. Staining techniques: smear preparation, simple staining, Gram's staining, acid fast staining, staining of Metachromatic granules.

UNIT 4: **12**

Morphology of microorganisms: morphological variations in algae, morphology of fungi, slide culture technique. Antibiotic sensitivity testing: Disc diffusion test- quality control with standard strains. Micrometry: Demonstration ofsize of yeast and fungal filaments

UNIT 5: **12**

Physiology characteristics: IMViC test, H2S, Oxidase, catalase, urease test. Carbohydrate fermentation test, maintenance of pure culture, paraffin method, stab culture, maintenance of mold culture.

60 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students will be able to:

CO1:	Handling of microorganisms.
CO2:	Isolate and analyse microorganisms.
CO3:	Develop skills to work in a microbiology laboratory.
CO4:	Understand the physiology of microorganisms
CO5:	Able to identify various different microorganisms

TEXT BOOKS

1.	Prescott LM, Harley JP and Klein DA (2005). Microbiology. Sixth edition, International edition, McGraw Hill.
2.	Pelczar TR, Chan ECS and Kreig NR (2006). Microbiology. Fifth edition, Tata McGraw-Hill INC. New York.
3.	Sundararaj T (2002). Microbiology Laboratory Manual. First edition, Mrs. Aswathy Sundararaj Publication, Chennai.
4.	Robert F Boyd (1984). General Microbiology. Times mirror / Mosby college publishers.

REFERENCES

1.	Ketchum PA (1984). Microbiology: Concepts and Applications. John Wiley and Sons, New York.
2.	Balows A, Hauser Jr KL, Isenberg HD, Shalomy HJ (1991). Manual of Clinical Microbiology, ASM, Washington D.C.
3.	Larry Mc Kane and Judy Kandel (1996). Microbiology- Essentials and applications. (2nd edition). Mc Fraw Hill Inc, New york.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1:	3	3	3	1	3	2	3	3	3	3	3
CO2:	3	3	3	1	3	2	3	3	3	3	3
CO3:	3	3	3	1	3	2	3	3	3	3	3
CO4:	3	3	3	1	3	2	3	3	3	3	3
CO5:	3	3	3	1	3	2	3	3	3	3	3
CO	3	3	3	1	3	2	3	3	3	3	3

1 - LOW, 2 - MEDIUM, 3 - HIGH

24MBU141	Basics of Recombinant DNA Technology	L	T	P	C	TOTAL MARKS
		3	0	0	3	100

PREREQUISITES:

COURSE OBJECTIVES:

The main objectives of this course are to:

1	Students will be able to understand the concepts of rDNA Technology and its history
2	Students will be able to understand the features and types of restriction enzymes
3	Students will be able to understand the characteristics and types of vector DNA used in transfer of DNA
4	Students will be able to understand the Gene transfer technology
5	Students will be able to gain knowledge on various applications of rDNA technology

UNIT 1:	**INTRODUCTION TO rDNA TECHNOLOGY**	**6**

Recombinant DNA Technology - Definition, Objectives, History and Enzyme tools.

UNIT 2:	**RESTRICTION ENZYMES**	**6**

Restriction enzymes - Nomenclature, Types - Endonucleases and Exonucleases, Features, types of cuts - blunt end, Sticky end.

UNIT 3:	**VECTOR DNA**	**6**

Vector DNA - Types, Characteristics and Practical features, Ti plasmid - structure and properties.

UNIT 4:	**TECHNIQUES**	**6**

Recombinant DNA Technology - Procedure, Gene transfer technology, Screening and Selection of Recombinants.

UNIT 5:	**APPLICATIONS**	**6**

Applications - Genetically modified products -Bt cotton, Therapeutic products - Human insulin, Disease diagnosis - Gene therapy.

30 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students will be able to:

CO1:	Understand the history and objectives of rDNA technology
CO2:	apply restriction enzymes in genetic engineering
CO3:	understand the importance of vector DNA
CO4:	understand the gene transfer methods with the screening and selection of recombinants
CO5:	Apply rDNA technology in various fields

TEXT BOOKS

1.	Lodish, Harvey et al. (2005). Molecular Cell Biology. Fifth edition.
2.	Cooper GM and Hansman RE (2007). The Cell: A Molecular Approach. Fourth edition, ASM Press.
3.	Alberts Bruce et al. (2002). Molecular Biology of the Cell. Fourth edition, Garland Science (Taylors Francis).
4.	Brown TA (2020). Gene Cloning and DNA Analysis: An Introdution. Eighth edition, Wiley Blackwell.

REFERENCES

1.	Clark DP and Pazdernik NJ (2015). Biotechnology. Second edition. Academic Cell.
2.	Monika Jain (2012). Recombinant DNA technology. First edition, Alpha Science International.

3.	Keya Chaudhuri (2012). Recombinant DNA Technology. The Energy and Resources Institute, TERI.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1:	3	3	2	2	2	3	2	2	3	2	3
CO2:	3	3	2	2	2	3	2	2	3	2	3
CO3:	3	3	2	2	2	3	2	2	3	2	3
CO4:	3	3	2	2	2	3	2	2	3	2	3
CO5:	3	3	2	2	2	3	2	2	3	2	3
CO	3	3	2	2	2	3	2	2	3	2	3

1 - LOW, 2 - MEDIUM, 3 - HIGH

24MBU161	INTRODUCTION TO CELL BIOLOGY	L	T	P	C	TOTAL MARKS
		3	0	0	3	100

PREREQUISITES:

COURSE OBJECTIVES:

The main objectives of this course are to:

1	Students canlearn the structure of cell
2	Students can understand the Structure, Function and localization of cellular organelles
3	Students can understand the concepts in cell division and its regulation
4	Students can learn the Structure and functions of macromolecules.
5	Students will gain knowledge on cell signalling and cell-cell communication.

UNIT 1: CELL STRUCTURE **9**

Prokaryotic and Eukaryotic Cell organization, structure of organelles, extra cellular matrix and cell junctions. Cell motility and shape, Biomembranes and the sub-cellular organization of eukaryotic cells, various types of transport across cell membrane.

UNIT 2: CELL ORGANELLES AND FUNCTION **9**

Structure, Functions and Localization of Nucleus, Mitochondria, Lysosomes, Endoplasmic reticulum, Golgi apparatus, vesicles, centrosomes, cell membranes, ribosomes, cytosol, chloroplasts, flagella, cell wall.

UNIT 3: CELL DIVISION **9**

Prokaryotic and Eukaryotic cell cycle; cell growth and extracellular signals, molecular basis of cell cycle regulation and division – mitosis, meiosis, cell cycle regulation, Cancer cells and apoptosis. Oncogenes and proto-Oncogenes. Signal Transduction, cell to cell interaction

UNIT 4: MACROMOLECULES **9**

Structure, Functions and Localization of Nucleic acids, Proteins, Carbohydrates and Lipids – basic units, architectural hierarchy and organization

UNIT 5: CELL SIGNALLING **9**

Cell signalling-Hormone-receptor interactions, G protein-coupled receptors and their effectors, Second messengers, Receptor tyrosine kinases, MAP kinase pathways.

45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students will be able to:

CO1:	Understand the structural organization of cell
CO2:	Understand the basics of cellular machinery
CO3:	Understand the concepts in cell cycle and its regulation
CO4:	Understand Structure and functions of macromolecules
CO5:	Gain knowledge on cell signalling and cell interactions

TEXT BOOKS

1.	Cooper GM and Hansman RE (2007). The Cell: A Molecular Approach. Fourth edition, ASM Press.
2.	Alberts, Bruce etal. (2002). Molecular Biology of the Cell, Fourth edition, Garland Science (Taylors Francis).
3.	Sadava DE (2004). Cell Biology: Organelle Structure and Function, Panima Publishing.

REFERENCES

1.	Lodish H, Berk A, Zipursky SL, Matsudaira P, Baltimore D and Darnell J (2012). Molecular Cell Biology. Seventh edition, WH Freeman & Company

	(New York).
2.	Wallace Marshall, Janet Iwasa and Gerald Karp (2019). Karp's Cell and Molecular Biology. Ninth edition, Wiley Publishers (New York).

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1:	3	3	1	1	2	3	3	1	3	2	3
CO2:	3	3	1	1	2	3	3	1	3	2	3
CO3:	3	3	1	1	2	3	3	1	3	2	3
CO4:	3	3	1	1	2	3	3	1	3	2	3
CO5:	3	3	1	1	2	3	3	1	3	2	3
CO	3	3	1	1	2	3	3	1	3	2	3

1 - LOW, 2 - MEDIUM, 3 - HIGH

SEMESTER II

24MBU201	IMMUNOLOGY	L	T	P	C	TOTAL MARKS
		4	0	0	4	100

PREREQUISITES:

COURSE OBJECTIVES:

The main objectives of this course are to:

1	Students will be able to understand the cells involved in immune response
2	Students will be able to understand mechanism of immune responses
3	Students will gain knowledge about various immunotechniques
4	Students will gain knowledge about basics of immune response
5	Students can understand the principles and types of vaccines

UNIT 1:	**INTRODUCTION TO IMMUNOLOGY**	**12**

History of immunology organs & cellsofimmunesystem, Types of immunity-Innate, Acquired, Humoral & cell mediated immunity. Antigens–properties.

UNIT 2:	**MECHANISM OF IMMUNE RESPONSES**	**12**

Immunity to different organisms- defence strategy, antigen presentation. Complement pathways – Classical and Alternate; Immunoglobulins-types – structure and functions. Theory of antibody formation

UNIT 3:	**IMMUNOTECHNIQUES**	**12**

Antigen-Antibody reactions - agglutination, precipitation, immuno-electrophoresis, Coomb's test, Blood grouping, ELISA, RIA.

UNIT 4:	**IMMUNE RESPONSE**	**12**

Hypersensitivity reactions – types. Autoimmunity - mechanism, autoimmune diseases. Major histocompatibility complex – structure and types, HLA tissue typing

UNIT 5:	**VACCINES**	**12**

Vaccines: Principles, types, preparation and immunization schedules. Immuno deficiency diseases, Transplantation immunology and tumor immunology

60 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students will be able to:

CO1:	understand the basics of human immune system
CO2:	understand the immune response against antigens
CO3:	understand the applications of antigen antibody interactions
CO4:	understand the various abnormal immune responses
CO5:	Gain knowledge about vaccination, transplantation and tumor immunology.

TEXT BOOKS

1.	Ajoy Paul (2018). Text Book of Immunology, Books & Allied Pvt. Ltd.
2.	Dubey RC & Maheshwari DK (2010). A text Book of Microbiology. S. Chand & Co.
3.	Tizard IR (2017). Immunology - An Introduction. Tenth edition, WB Saunders, Philadelphia.
4.	Janis Kuby (2019). Immunology. Eighth edition, WH Freeman, NY

REFERENCES

1.	Delves PJ, Martin SJ, Burton DR, Roitt IM. (2011). Roitt's Essential Immunology. Twelfth edition, Wiley- Blackwell.
2.	Travers J (1997). Immunobiology - the immune system in health and disease. Third edition, Current Biology Ltd. London.

3.	Clark WR. (1991). The Experimental Foundations of Modern Immunology. Third edition. John Wiley and Sons Inc.
4.	Rose NR, Friedman H and Fahey JL. 1986. Manual of Clinical Laboratory Immunology. Third edition. ASM.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1:	3	3	2	2	2	3	3	1	3	1	3
CO2:	3	3	2	2	2	3	3	1	3	1	3
CO3:	3	3	2	2	2	3	3	1	3	1	3
CO4:	3	3	2	2	2	3	3	1	3	1	3
CO5:	3	3	2	2	2	3	3	1	3	1	3
CO	3	3	2	2	2	3	3	1	3	1	3

1 - LOW, 2 - MEDIUM, 3 - HIGH

24BCU204	BIOCHEMISTRY II	L	T	P	C	TOTAL MARKS
		2	0	0	2	100

PREREQUISITES:

COURSE OBJECTIVES:

The main objectives of this course are to:

1	Students will understand the significance of biomolocules in biological systems.
2	Students will understand the important biochemical diseases.
3	Students will gain knowledge about biochemistry of enzymes.
4	Students will gain knowledge about basics of molecular biology.
5	Students can understand the functions of vitamins and minerals.

UNIT 1:	Metabolism	**12**

Glycolysis,TCA cycle, HMP shunt and its energy yield.Deamination, transamination reaction, SGOT and SGPT.Urea cycle,Biosynthesis of fatty acids, beta oxidation.

UNIT 2:	Metabolic Disorders	**12**

Jaundice, hypoxia, glycogen storage diseases,pentosuria, ketosis, lipidosis, edema, gout. Dehydration: definition,causes, symptom and prevention.

UNIT 3:	Enzymes	**12**

Definition, classification of enzymes with one example. Mechanism of enzyme action. Lock and key mechanism, induced fit theory. Property: specificity. Isoenzyme: Definition with one example.Factors affecting enzyme activity: pH, temperature and substrate concentration. Michaleis- Menton equation. Enzyme inhibition:competitive, uncompetitive and non competitive. Biological functionsof enzymes.

UNIT 4:	Molecular Biology	**12**

Replication: Definition, types, mode of action of replication, mechanism of replication. General mechanism of transcription and translation. Genetic code. DNA and RNA act as genetic material.

UNIT 5:	Vitamins and Minerals	**12**

A brief outline of occurrence and biological function of Vitamins and minerals (Na, K, Cl, Ca, P, I , Fe, Mg & S)

60 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students will be able to:

CO1:	Understand the active roles played by enzymes in biological systems.
CO2:	Understand the importance role of metabolism.
CO3:	Conceptual knowledge of properties, structure, function of enzymes, enzyme kinetics and their regulation ,enzyme engineering, Application of enzymes in large scale industrial processes
CO4:	Elucidate the bioenergetics and microbial metabolic pathways
CO5:	Cognizant about the metabolic pathways of industrially importantfermentation products.

TEXT BOOKS

1.	Murray RK, Grammer DK. Harper's Biochemistry. Twenty fifth edition, McGraw Hill, Lange Medical Books.
2.	Kannan C. Biomolecules. MJP Publishers, Chennai.
3.	Jain JL, Sunjay Jain, Nitin Jain. Fundamentals of Biochemistry. S. Chand & Company.
4.	Amit Krishna De. Biochemistry. S. Chand & Co., Ltd.

REFERENCES

1.	Nelson DL, Lehninger MM. Principles of Biochemistry. Cox, Macmillan Worth Publishers.
2.	Voet D and Voet JG (2011). Biochemistry. Fourth edition, CBS Publishers and Distributors.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1:	3	3	3	2	3	3	3	3	3	1	3
CO2:	3	3	3	2	3	3	3	3	3	1	3
CO3:	3	3	3	2	3	3	3	3	3	1	3
CO4:	3	3	3	2	3	3	3	3	3	1	3
CO5:	3	3	3	2	3	3	3	3	3	1	3
CO	3	3	3	2	3	3	3	3	3	1	3

1 - LOW, 2 - MEDIUM, 3 - HIGH

24MBU211	IMMUNOLOGY LAB	L	T	P	C	TOTAL MARKS
		0	0	4	2	100

PREREQUISITES:

COURSE OBJECTIVES:

The main objectives of this course are to:

1	Students will understand the techniques of agglutination and precipitation reactions
2	Students will gain practical knowledge on immunological techniques
3	Students will gain knowledge about various immunotechniques
4	Students will gain knowledge about basics of immune response
5	Students can understand the principles and types of hypersensitivity reactions

UNIT 1:		**12**

Blood groups and typing - Coombs's test. Precipitation reaction inA-8 14Gel-Outchelony double diffusion, Single Radial Immuno diffusion. VDRL, RPR. Agglutination reactions: Slide and Tube methods RBC agglutination IHA, TPHA Bacterial.

UNIT 2:		**12**

Complement fixation test. Titration of amboceptor and complement (demonstration only). Immuno fluorescene, (Demonstration only), ELISA

UNIT 3:		**12**

Isolation of Buffy coat, using heparin lymphocytes (T cells, B cells), Enumeration of different cell types, Peripheral blood cell counts, absolute cell counts.

UNIT 4:		**12**

Antibody productions in rabbits against sheep RBC and its titration (Demonstration). Anaphylactic reactions in guinea pigs. Arthus reaction in rabbits (Demonstration).

UNIT 5:		**12**

Skin tests, both immediate and delayed hypersensitivity reactions to egg proteins, bacterial, fungal antigens

60 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students will be able to:

CO1:	Learn the techniques in immunology.
CO2:	Learn the different types of cells in the immune system.
CO3:	Demonstrate the immunoassay and diagnostic test
CO4:	Acquaint with concepts in prokaryotic, eukaryotic, and viral genetics
CO5:	Gain knowledge about vaccination, transplantation and tumor immunology.

TEXT BOOKS

1.	Olwyn MR Westwood, Frank C Hay (2008). Practical Immunology. Fourth edition, Wiley-Blackwell Publishers
2.	Tobili Y Sam - Yellowe (2021). Immunology: Overview and Laboratory Manual First edition, Springer
3.	Tizard IR (2017). Immunology An Introduction. Tenth edition, WB Saunders, Philadelphia.
4.	Janis Kuby (2019). Immunology. Eighth edition, WH Freeman, NY

REFERENCES

1.	Janice Speshock (2021). Immunology Lab Manual. Third edition., Kendall Hunt Publishing Company
2.	Clark WR (1991). The Experimental Foundations of Modern Immunology Third edition. John Wiley and Sons Inc.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1:	3	3	3	2	3	3	3	3	3	1	3
CO2:	3	3	3	2	3	3	3	3	3	1	3
CO3:	3	3	3	2	3	3	3	3	3	1	3
CO4:	3	3	3	2	3	3	3	3	3	1	3
CO5:	3	3	3	2	3	3	3	3	3	1	3
CO	3	3	3	2	3	3	3	3	3	1	3

1 - LOW, 2 - MEDIUM, 3 - HIGH

24BOU261	BASICS OF FERMENTATION TECHNOLOGY	L	T	P	C	TOTAL MARKS
		4	0	0	3	100

PREREQUISITES:

COURSE OBJECTIVES:

The main objectives of this course are to:

1	Students will be able to understand the history and scope of fermentation technology
2	Students will be able to understand the basic instrumentation of fermentors
3	Students will gain knowledge about the various types of fermentors
4	Students will gain knowledge about different phases of cell growth
5	Students can understand the various applications of Fermentation technology

UNIT 1:	**INTRODUCTION**	**9**

History and scope of Fermentation technology, an overview of traditional and modern applications, various (upstream and down stream) unit operations involved in fermentation process.

UNIT 2:	**FERMENTATION PROCESSES**	**9**

General requirements of fermentation processes, main parameters to be monitored and controlled in fermentation processes, aerobic and anaerobic fermentation processes and their applications.

UNIT 3:	**FERMENTORS**	**9**

Fermentors - basic instrumentation, types - Air lift fermentors, Stirred tank, Packed bed fermentors.

UNIT 4:	**CELL GROWTH AND FERMENTATION**	**9**

Phases of cell growth, Growth associated (primary) and non- growth associated (secondary) product formation.

UNIT 5:	**INDUSTRIAL PRODUCTION**	**9**

Production of microbial enzymes, production of beverages - beer, wine, microbes in baking- production of baker yeast, production of dairy products.

45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students will be able to:

CO1:	understand the various unit operations involved in Fermentation technology
CO2:	understand the general requirements of fermentation processes
CO3:	understand the basic instrumentation and types of fermentors
CO4:	understand phases of cell growth and product formation
CO5:	Apply fermentation technology in industrial production

TEXT BOOKS

1.	Patel AH (2011). Industrial Microbiology. Second edition, Laxmi Publications
2.	Stanbury PF and Whitaker A (1984). Principles of fermentation Technology. Pergamon Press.
3.	Shuler ML and Kargi F (2002). Bioprocess engineering – Basic concepts. Prentice Hall of India.
4.	Casida LE (2022). Industrial Microbiology. Second edition, New Age International Publishers.

REFERENCES

1.	Robert W. Hutkins (2018). Microbiology and Technology of Fermented

	Foods. Second edition, Wiley Blackwell
2.	El-mans EMT and Bryce CFA (2002). Fermentation microbiology and Biotechnology. Taylor and Francis group.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1:	3	3	2	2	2	3	2	3	3	3	3
CO2:	3	3	2	2	2	3	2	3	3	3	3
CO3:	3	3	2	2	2	3	2	3	3	3	3
CO4:	3	3	2	2	2	3	2	3	3	3	3
CO5:	3	3	2	2	2	3	2	3	3	3	3
CO	3	3	2	2	2	3	2	3	3	3	3

1 - LOW, 2 - MEDIUM, 3 - HIGH

24MBU241	BASICS OF COMPUTATIONAL BIOLOGY	L	T	P	C	TOTAL MARKS
		3	0	0	3	100

PREREQUISITES:

COURSE OBJECTIVES:

The main objectives of this course are to:

1	Students will be able to understand the history and types of databases
2	Students will be able to understand molecular basis of biomolecules
3	Students will gain knowledge about protein structure and databases
4	Students will gain knowledge about basic algorithms in computational biology
5	Students can understand the various applications of computational biology

UNIT 1: INTRODUCTION **9**

Introduction to Computational Biology and Bioinformatics: Nature and scope of Computational Biology and Bioinformatics, Bioinformatics databases, Type of databases, Nucleotide sequence databases, Primary nucleotide sequence databases-EMBL, GenBank, DDBJ; Secondary nucleotide sequence databases

UNIT 2: CHROMOSOME-GENOME-GENES-DATABASES **9**

Biomolecules- DNA, RNA, Protein and amino acids, Chargaff's Rules, Codon bias, GC content. Central Dogma: Replication, Transcription, Translation, Post transcriptional & post translational modifications, RNA processing, RNA splicing and RNA editing. Sense/coding and anti-sense/template strands, Genetic code, wobble hypothesis, Nucleotide sequence databases - NCBI

UNIT 3: PROTEINS AND DATABASES **9**

Protein structure and function, Protein Primary structure, Amino acid residues, Secondary, Tertiary, Quaternary Structure of Protein, Protein sequence databases- SwissProt/ TrEMBL, PIR, Sequence motif databases -Pfam, PROSITE, Protein structure databases, Protein Data Bank-SCOP, CATH, KEGG, Chembank, Sequence, structure and function relationship.

UNIT 4: BASIC ALGORITHMS **9**

Basic algorithms in Computational Biology, Introduction to sequence alignment - Local and global, pair wise and multiple, BLAST.

UNIT 5: APPLICATIONS **9**

Toxicogenomics, Pharmacogenomics- Pharmacogenetics, SNP, Personalized medicine, Metagenomics, Comparative genomics, Functional genomics, structural genomics, QTL, HGP

45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students will be able to:

CO1:	Understand the importance of Computational biology
CO2:	Understand the Central dogma of life
CO3:	Understand the structure of protein and its importance
CO4:	Understand the basic algorithms in computational biology
CO5:	Apply computational biology in various fields

TEXT BOOKS

1.	Ignacimuthu S (2005) Basic Bioinformatics First edition, Narosa Publishing House, New Delhi, India.
2.	Rastogi SC, Mendiratta N, Rastogi P (2013). Bioinformatics: Methods And Applications: (Genomics, Proteomics and Drug Discovery). PHI Learning Pvt. Ltd.
3.	Gopal S, Price R, Tymann P, Haake A (2000). Bioinformatics with Fundamentals of Genomics and Proteomics. Tata McGraw Hill Education Pvt. Ltd.

REFERENCES

1.	Deonier RC, Tavare S, Waterman M (2005). Computational genome analysis: an introduction. Springer.

2.	Orengo C, Jones DT, Thornton JM (2003). Bioinformatics: Genes, proteins and computers.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1:	3	3	2	2	2	3	3	3	3	1	2
CO2:	3	3	2	2	2	3	3	3	3	1	2
CO3:	3	3	2	2	2	3	3	3	3	1	2
CO4:	3	3	2	2	2	3	3	3	3	1	2
CO5:	3	3	2	2	2	3	3	3	3	1	2
CO	3	3	2	2	2	3	3	3	3	1	2

1 - LOW, 2 - MEDIUM, 3 - HIGH

SEMESTER III

24MBU301	MOLECULAR BIOLOGY	L	T	P	C	TOTAL MARKS
		5	0	0	5	100

PREREQUISITES:

COURSE OBJECTIVES:

The main objectives of this course are to:

1	Students will be able to understand the concepts of DNA.
2	Students will be able to understand the concepts of DNA, RNA synthesis and regulation.
3	Students will gain knowledge about processing of mRNA
4	Students will gain knowledge about regulation of transcription and translation
5	Students can understand the various methods involved in molecular biology

UNIT 1:	**Historical and conceptual background**	**12**

Discovery of DNA as genetic material, Griffith's experiment, Hershey and Chase experiment, Chargaff's rule, Structure of DNA, RNA and Protein

UNIT 2:	**DNA, RNAsynthesis and processing**	**12**

Basic mechanism of replication, DNA repair, transcription, formation of initiation complex, transcription activators and repressors, RNA polymerases, capping, elongation and termination, RNA processing, RNA editing, splicing, polyadenylation, post transcriptional regulation.

UNIT 3:	**Transcriptional and Translational regulation**	**12**

Structure and function of different types of RNA, Eukaryotic transcription factors, enhancers, silencers, insulators, chromatin structure.Translation and its regulation in prokaryote and eukaryotes, Post translational modification and protein stability.

UNIT 4:	**Gene Regulation**	**12**

Gene regulation in prokaryotes and eukaryotes, positive regulation, negative regulation, attenuation, gene regulation in lambda phage life cycle.

UNIT 5:	**Methods in Molecular biology**	**12**

Purification and Separation of nucleic acids, DNA amplification: PCR and Cell based DNA Cloning. Nucleic Acid Hybridization : Principle and application - Southern blotting, northern blotting, western blotting and microarrays

60 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students will be able to:

CO1:	Understand the structure, properties and function of genes in living organisms at the molecular level
CO2:	Gain knowledge about replication strategies and molecular mechanisms involved in transcription.
CO3:	Gain knowledge about molecular mechanisms involved in translation.
CO4:	Understand the concept of prokaryotic and eukaryotic gene regulation.
CO5:	Handle and independently work on lab protocols involving molecular techniques

TEXT BOOKS

1.	Brown TA (2020). Gene Cloning and DNA Analysis: An Introduction. Eighth edition, Wiley Blackwell.
2.	Click BR and Pasternark JJ (2010). Molecular Biotechnology: Principles and Applications of Recombinant DNA. Fourth edition, American Society for

	Microbiology
3.	Malacinski GM (2015). Freifelder's Essentials of Molecular Biology. Fourth edition, Jones and Bartlett.
4.	LewinB (2000).Genes VII. Oxford University Press, Oxford.
REFERENCES	
1.	Lodish H, Berk A, Zipursky SL, Matsudaira P, Baltimore, D and Darnell J (2012). Molecular Cell Biology. Seventh edition, W.H. Freeman & Company (New York).
2.	Marshall W, Iwasa J and Karp G (2019). Karp's Cell and Molecular Biology. Ninth edition, Wiley Publishers (New York).

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1 :	3	3	2	2	2	3	2	2	3	2	3
CO2 :	3	3	2	2	2	3	2	2	3	2	3
CO3 :	3	3	2	2	2	3	2	2	3	2	3
CO4 :	3	3	2	2	2	3	2	2	3	2	3
CO5 :	3	3	2	2	2	3	2	2	3	2	3
CO	3	3	2	2	2	3	2	2	3	2	3

1 - LOW, 2 - MEDIUM, 3 - HIGH

24MBU311	MOLECULAR BIOLOGY LAB	L	T	P	C	TOTAL MARKS
		0	0	4	2	100

PREREQUISITES:

COURSE OBJECTIVES:

The main objectives of this course are to:

1	Students will be able to understand the methods of Nucleic acid estimation.
2	Students will be able to understand the technique of isolation of DNA.
3	Students will gain knowledge about isolation of antibiotic resistant mutants.
4	Students will gain knowledge about procedure of preparation of competent cells.
5	Students can understand the transformation techniques of bacteria.

UNIT 1:		**12**

Estimation of DNA by diphenylamine method, Estimation of RNA by orcinol method.

UNIT 2:		**12**

Isolation of Plasmid DNA by Alkali lysis method, Isolation of Chromosomal DNA from Eukaryotic cells. Eg. Leaves.

UNIT 3:		**12**

Isolation of RNA from yeast, Purification of DNA and RNA, Isolation of antibiotic resistant mutants

UNIT 4:		**12**

Transformation of *E. coli*., Preparation of competent cells, Target DNA isolation and Purification

UNIT 5:		**12**

White and Blue method, Screening and Confirmation of Recombinant bacteria

60 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students will be able to:

CO1:	Understand the structure, properties and function of genes in living organisms at the molecular level
CO2:	Gain knowledge about replication strategies and molecular mechanisms involved in transcription.
CO3:	Gain knowledge about molecular mechanisms involved in translation.
CO4:	Understand the concept of prokaryotic and eukaryotic gene regulation.
CO5:	Handle and independently work on lab protocols involving molecular techniques

TEXT BOOKS

1.	Vennison SJ (2009). Laboratory Manual for Genetic Engineering. First Edition. PHI Publications
2.	Rajan S, Selvi R (2018). Experimental Procedures in Life Sciences.CBS Publishers

REFERENCES

1.	Masroor Ellahi Babar (2011). A Laboratory Manual of Molecular Biology, Lambert Academic Publishing Company.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	3	2	2	3	2	3
CO2	3	3	3	2	3	3	2	2	3	2	3
CO3	3	3	3	2	3	3	2	2	3	2	3
CO4	3	3	3	2	3	3	2	2	3	2	3
CO5	3	3	3	2	3	3	2	2	3	2	3
CO	3	3	3	2	3	3	2	2	3	2	3

1 - LOW, 2 - MEDIUM, 3 - HIGH

24BCU303	BIOINSTRUMENTATION	L	T	P	C	TOTAL MARKS
		4	0	0	3	100

PREREQUISITES:

COURSE OBJECTIVES:

The main objectives of this course are to:

1	Students will be able to understand the basics of acidity and alkalinity
2	Students will be able to understandvarious chromatography techniques
3	Students will gain knowledge about various electrophoretic techniques
4	Students will gain knowledge about the importance of colorimetry and spectroscopy
5	Students can understand the basics of electromagnetic radiations

UNIT 1: Basic laboratory Instruments: 9

Common laboratory equipment –anaerobic incubator – Biosafety Cabinent -Principle and working of pH meter, Laminar-air flow. Centrifugation:Types & principlesand their applications- Lyophilizer - Flow cytometry

UNIT 2: Chromatography: 9

General principles - adsorption and partition chromatography. Paper chromatography, Thin layer chromatography, Ion exchange, Affinity chromatography, Gel permeation chromatography, HPLC and GLC

UNIT 3: Electrophoretic Techniques: 9

Electrophoresis - General principles, Factors affecting electrophoretic mobility. Electrophoresis with paper, cellulose acetate and starch. Principle, instrumentation and applications of agarose gel electrophoresis and SDS-PAGE. Isoelectric focusing.

UNIT 4: Colorimetry & Spectrophotometry: 9

Basics of Electromagnetic Radiations - Energy, wavelength, wavenumber and frequency. Absorption and emission spectra. Light absorption and its transmittance, Beer-Lambert law. Colorimetry- Principle, instrumentation and applications. Visible and UV spectrophotometry – Principle, instrumentation and applications

UNIT 5: Radioisotopic techniques: 9

Use of radioisotopes in life sciences, radioactive labeling, principle and application of tracer techniques, detection and measurement of radioactivity using ionization chamber, proportionalchamber, Geiger- Muller and Scintillation counters, autoradiography and its applications.

45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students will be able to:

CO1:	Understand the mechanism of basic laboratory instruments and different centrifuges
CO2:	Understand the principle of chromatography techniques
CO3:	Understand the methods and applications of electrophoresis
CO4:	Understand the working of colorimetry and spectrophotometry
CO5:	Understand the applications of radioisoopes in lifesciences

TEXT BOOKS

1.	AvinashUpadhyay D K (2016). Biophysical Chemistry. Himalaya Publishing house.
2.	Wilson/Walker (2018). Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press
3.	Veerakumari L (2009). Bioinstrumentation. First edition, MJP Publishers.

REFERENCES

1.	Dua S (2010). Biochemical Methods of Analysis: Theory and Applications. Narosa.
2.	White BJ (2015). Biochemical Techniques - Theory And Practice. CBS Publishers & Distributors.

3.	Basha M (2020). Analytical Techniques in Biochemistry. Humana Press.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1:	3	3	2	2	2	3	3	3	3	2	3
CO2:	3	3	2	2	2	3	3	3	3	2	3
CO3:	3	3	2	2	2	3	3	3	3	2	3
CO4:	3	3	2	2	2	3	3	3	3	2	3
CO5:	3	3	2	2	2	3	3	3	3	2	3
CO	3	3	2	2	2	3	3	3	3	2	3

1 - LOW, 2 - MEDIUM, 3 - HIGH

24BCU312	Bioinstrumentation Lab	L	T	P	C	TOTAL MARKS
		0	0	4	2	100

PREREQUISITES: NIL

COURSE OBJECTIVES:

The main objectives of this course are to:

1	Students can understand the determination of pH, pKa values etc.,
2	Students can understand the chromatography and electrophoresis techniques.
3	Students can understand the principles of UV spectroscopy.
4	Students can learn about estimation of organic compounds.
5	Students will gain knowledge about working of instruments such as PCR,Fermentor etc.,

UNIT 1:		**9**

Studies on pH titration curves of amino acids/ acetic acid and determination of pKa values and Handerson-Hasselbach equation.

UNIT 2:		**9**

Separation of bacterial lipids/amino acids/sugars/organic acids byTLC or PaperChromatography.Separation of serum protein by horizontal submerged gel electrophoresis.

UNIT 3:		**9**

Study of UV absorption spectra of macromolecules (protein, nucleic acid, bacterial pigments).

UNIT 4:		**9**

Quantitative estimation of hydrocarbons/pesticides/organic solvents /methane by Gas chromatography.

UNIT 5:		**9**

Demonstration of PCR, DNA sequencer, Fermenter, Flow Cytometry.

45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students will be able to:

CO1:	Use basic laboratory instruments such as spectrophotometer, pH meter.
CO2:	Separate biomolecules by chromatographic techniques.
CO3:	Separate biomolecules using electrophoresis.
CO4:	Perform quantitative estimation techniques.
CO5:	Learn about the applications of fermentor, flow cytometry.

TEXT BOOKS

1.	Instrumental Methods of Analysis. 6th Edition byH.H. Willard, L.L. Merritt Jr. and others. 1986. CBS Publishers and Distributors.
2.	Instrumental Methods of Chemical Analysis. 1989 by Chatwal G and Anand, S.Himalaya Publishing House, Mumbai

REFERENCES

1.	Dua S (2010). Biochemical Methods of Analysis: Theory and Applications. Narosa.
2.	White BJ (2015). Biochemical Techniques - Theory And Practice. CBS Publishers & Distributors.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1:	3	3	3	1	3	2	3	3	3	3	3
CO2:	3	3	3	1	3	2	3	3	3	3	3
CO3:	3	3	3	1	3	2	3	3	3	3	3
CO4:	3	3	3	1	3	2	3	3	3	3	3
CO5:	3	3	3	1	3	2	3	3	3	3	3

CO	3	3	3	1	3	2	3	3	3	3	3

1 - LOW, 2 - MEDIUM, 3 - HIGH,

24MBU341	BIOTECHNOLOGY	L	T	P	C	TOTAL MARKS
		3	0	0	3	100

PREREQUISITES:

COURSE OBJECTIVES:

The main objectives of this course are to:

1	Students will be able to understand the basics of biotechnology
2	Students will be able to understand the steps in genetic engineering
3	Students will gain knowledge about plant biotechnology
4	Students will gain knowledge about basics of animal biotechnology
5	Students can understand the various applications of biotechnology

UNIT 1: Introduction to Biotechnology **9**

Biotechnology: Definition and scope, types and branches of biotechnology. Recombinant DNA technology- Definition, restriction endonucleases- types, role, recognition sequences, cleavage pattern, modification of cuts ends, vectors- plasmid, cosmid, phage. Enzymes used in rDNA technology, linkers, homopolymer tailing, end labeling and Synthetic oligonucleotides.

UNIT 2: Steps in genetic engineering **9**

Construction of genomic library. Synthesis of cDNA. Construction of cDNA library. Gene transfer methods- transformation, conjugation, transduction, microinjection and electroporation. Selection-selectable markers, chromogenic substrate and screening of clones- colony hybridization, screening with antibodies.

UNIT 3: Plant Biotechnology **9**

Plant tissue culture- basic requirements for culture, M S medium, callus culture, protoplast culture. Vectors – Ti plasmid (co-integration vector and binary vector), Viral vectors- TMV, CaMV and their applications. Transgenic plants – pest resistant, herbicide resistant and stress tolerant plants.

UNIT 4: Animal Biotechnology **9**

Vectors for gene transfer in animal cells - SV 40 Vector. Basics of transfection methods calcium phosphate precipitation, DEAE- dextran mediated transfection. Transgenic mice retro viral transfer and stem cell mediated transfer, applications. Embryonic stem cell definition, ES cell culture to produce differentiated cells, applications.

UNIT 5: Applications of Biotechnology **9**

Applications of Biotechnology. Production of ethanol, antibiotic- streptomycin, Enzyme - Proteases, Biogas, Biodiesel.

45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students will be able to:

CO1:	Understand about restriction enzyme, types and application, various enzymesinvolved in rDNA technology
CO2:	Understand the techniques involved in genetic engineering
CO3:	Understand the importance of biotechnology in agriculture
CO4:	Understand the methods used in the production of transgenic mice
CO5:	Apply biotechnology in various fields

TEXT BOOKS

1.	Brown TA (1999).Gene Cloning. Thirdedition. Chapman and Hall Publications, U.S.A.
2.	Thieman WJ and Palladino MA (2014). Introduction to Biotechnology. Third edition, Pearson publications
3.	Dubey RC (2014). Text book of Biotechnology. Fifth edition, S. Chand & Co.
4.	Sathyanarayana (2006). Biotechnology. Third edition, Books and allied Publishers.

REFERENCES

1.	Watson JD, Caudy AA, Myers RM, Witkowski J (2006). Recombinant DNA: Genes and

	Genomes - a Short Course. Third edition, W.H.Freeman & Co
2.	Glick BR, Pasternak JJ and Patten CL (2010). Molecular Biotechnology: Principles and Applications of Recombinant DNA. Fourth edition, ASM Press (Washington DC).
3.	Ralph Rapley (2021). Molecular Biology and Biotechnology. Seventh edition, Royal Society of Chemistry, UK.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1:	3	3	2	2	2	3	3	3	3	2	3
CO2:	3	3	2	2	2	3	3	3	3	2	3
CO3:	3	3	2	2	2	3	3	3	3	2	3
CO4:	3	3	2	2	2	3	3	3	3	2	3
CO5:	3	3	2	2	2	3	3	3	3	2	3
CO	3	3	2	2	2	3	3	3	3	2	3

1 - LOW, 2 - MEDIUM, 3 - HIGH

24BOU362	PLANT BIOTECHNOLOGY	L	T	P	C	TOTAL MARKS
		3	0	0	3	100

PREREQUISITES:

COURSE OBJECTIVES:

The main objectives of this course are to:

1	Students will be able to understand the genetic organisation of plant genome
2	Students will be able to understand the techniques in genetic engineering
3	Students will gain knowledge about transgenic plants and its applications
4	Students will gain knowledge about the regulation of gene expression in plants
5	Students can understand the various plant tissue culture techniques

UNIT 1:	**Introduction to Biotechnology**	**9**

Plant genome: Organization, structure of representative plant genes and gene families in plants – chloroplast genome organization of mitochondrial genome.

UNIT 2:	**Steps in genetic engineering**	**9**

Agrobacterium and crown gall tumors – Mechanism of T-DNA transfer to plants, Ti Plasmid vectors and its utility – Plant viral vectors. Symbiotic nitrogen fixation in Rhizobia.

UNIT 3:	**Transgenic Plants**	**9**

Seed storage proteins. Regeneration of gene expression in plant transgenic plants and applications – plant vaccine and plant development.

UNIT 4:	**Regulation of Gene Expression in plants**	**9**

Plant Hormones – IAA, GA and cytokinins – molecular basis of action – phytochrome – role in photomorphogeneisis – Regulation of gene expression – abscisic acid – and stress – induced promoter switches in the control of gene expression – Ethylene and fruit ripening.

UNIT 5:	**Plant Tissue Culture Techniques**	**9**

Plant tissue culture – suspension cultured cells – haploid plants – Cloning of hosts – micropropagation – somatic embryogenesis – protoplast isolation and applications.

45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students will be able to:

CO1:	Develop basic knowledge about the plant genome and whole genome organization.
CO2:	Gain knowledge about the mechanisms of plant derived vectors and its functions.
CO3:	Gain basic knowledge about the applications of plant derived vaccines
CO4:	Gain basic knowledge about the applications of plant derived metabolites and hormones.
CO5:	Gain basic knowledge about the principles and different types of plant tissue culture.

TEXT BOOKS

1.	Chrispeels M J and sadava DF (1994). Plants, genes and agriculture. Jones and Bartlett.
2.	Narayanaswamy S (1994). Plant cell and tissue culture. Tata McGraw Hill Publishing Company limited, New Delhi.
3.	Grierson and Covey (1988). Plant Molecular biology. Blackie.

REFERENCES

1.	Trigiano RN and Gray DJ (1996). Plant tissue culture concepts and laboratoryexercise. CRC Press. BocaRatin, New York.
2.	Street HE (1977). Plant tissue culture. Blackwell Scientific Publications oxford, London.

CO'S-PO'S & PSO'S MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1:	3	3	2	2	2	3	2	2	3	3	3
CO2:	3	3	2	2	2	3	2	2	3	3	3
CO3:	3	3	2	2	2	3	2	2	3	3	3
CO4:	3	3	2	2	2	3	2	2	3	3	3
CO5:	3	3	2	2	2	3	2	2	3	3	3
CO	3	3	2	2	2	3	2	2	3	3	3

1 - LOW, 2 - MEDIUM, 3 - HIGH

24MBU331	VERMITECHNOLOGY	L	T	P	C	TOTAL MARKS
		1	0	1	2	100

PREREQUISITES:

COURSE OBJECTIVES:

The main objectives of this course are to:

1	Understand the role of microbes in increasing the soil fertility by the action of earthworms.
2	To gain knowledge on the Culturing techniques of earthworms
3	To gain knowledge on small scale vermicomposting
4	To gain knowledge on large scale vermicomposting
5	To study about Vermiculture products and their benefits in agriculture practice

UNIT 1: Types, Collection and Preservation of earthworms **3**

Types and basic characteristics of species suitable for vermicomposting; Role of earth worms in soil fertility, Biology of Lampito maruitti; Collection and Preservation of Earthworms; Flow sheet for vermi technology.

UNIT 2: Culturing techniques of earthworms and composting materials **3**

General method; Pot method; Wooden box method; Propagation; Factor affecting culturing of earthworm; Vermicomposting materials; Preliminary treatment of composting materials.

UNIT 3: Small scale techniques of Vermicomposting **3**

Indoor dual bin method; Bed method; Pit method; Heap method; Expandable worm tower assembly method; Hanging basket method; Physical, chemical and biological properties of vermicompost.

UNIT 4: Large scale techniques of Vermicomposting **3**

Outdoor dual bin; Raised cage; Dual pit; Commercial model; Trickling filter vermicomposting; Keep it simple and save plan.

UNIT 5: Vermiwash and Economics **3**

Chemical composition of vermiwash; Techniques of vermiwash production: Advantages of Vermicomposting; Prospects of vermi-culture as self-employment venture.

15 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students will be able to:

CO1:	Describe about the Types, Collection and Preservation of earthworms
CO2:	Illustrate culturing techniques of earthworms and composting materials
CO3:	Explain the techniques of Vermicomposting
CO4:	Illustrate large scale techniques of Vermicomposting
CO5:	Explain about Vermiwash production

TEXT BOOKS

1.	Ismail SS (2005). The Earthworm book. Second Revised Edition. Other India Press.
2.	Somani LL (2008). Vermicomposting and Vermiwash. Agrotech Publishing Academy, Udaipur.
3.	Talashilkar and Dosani (2005). Earthworm in Agriculture. Agrobios (India), Jodhpur.
4.	Ranganathan LS (2006). Vermibiotechnology - from soil health to human health-Agrobios, India.

REFERENCES

1.	National Institute of Industrial Research (2010). The Complete Technology Book on Vermiculture and Vermicompost, Published by National Institute of Industrial Research, Delhi- India.
2.	Sharma S et al. (2009). Earthworm and Vemitechnology – Review, Dynamic Soil and Dynamic Plant, Global Science Books.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1:	2	3	3	2	2	3	2	2	3	1	3
CO2:	2	3	3	2	2	3	2	2	3	1	3
CO3:	2	3	3	2	2	3	2	2	3	1	3
CO4:	2	3	3	2	2	3	2	2	3	1	3
CO5:	2	3	3	2	2	3	2	2	3	1	3
CO	2	3	3	2	2	3	2	2	3	1	3

1 - LOW, 2 - MEDIUM, 3 - HIGH

SEMESTER IV

24MBU401	SOIL AND AGRICULTURAL MICROBIOLOGY	L	T	P	C	TOTAL MARKS
		5	0	0	5	100

PREREQUISITES:

COURSE OBJECTIVES:

The main objectives of this course are to:

1	Students will understand the importance of soil and soil microbes
2	Students will understand various microbial associations
3	Students will gain knowledge about biogeochemical cycles
4	Students will gain knowledge about microbial interactions
5	Students can understand the various infections affecting plant

UNIT 1:	**Microbes and Lithosphere**	**12**

Microbes and Lithosphere: introduction to soil microbes, Soil Formation and Characterization (Physical and Chemical), Soil types and their microflora, Quantification of soil microorganisms (Bacteria, Fungi, Algae and Protozoa), Methods of studying ecology of soil Microflora.

UNIT 2:	**Microbial associations in phytosphere**	**12**

Microbial associations in phytosphere: rhizosphere – phyllosphere – spermosphere. Mycorrhiza – types and importance to agriculture – organic matter decomposition – humus formation

UNIT 3:	**Biogeochemical cycles**	**12**

Biogeochemical cycles : Biogeochemical cycles – carbon, nitrogen, phosphorus, sulphur cycles; nitrogen fixers – root nodule formation – nitrogenase, hydrogenase – biochemistry of nitrogen fixation

UNIT 4:	**Applicationsof microbial interactions**	**12**

Applications of microbial interactions: Decomposition, Biofertilizer - Plant response to biofertilizers application. Mass production of blue green algae, Azolla.Bioaccumulation, Bio pesticides, Biomining, Microbially induced corrosion, Xenobiotics.

UNIT 5:	**Plant infections**	**12**

Principles of plant infection and defense mechanisms. Disease Symptoms, Etiology, Epidemiology and Management of the following plant diseases: Mosaic disease of tobacco; Bunchy top of banana; Leaf roll of potato; Bacterial blight of paddy; Angular leaf spot of cotton, Late blight of potato; Powdery mildew of cucurbits; Leaf rust of coffee; Blight of maize/sorghum; Leaf spot of paddy, Grassy shoot of sugarcane.

60 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students will be able to:

CO1:	Appreciate the diversity of microorganisms and learn the abundance, distribution and significance of microorganism in soil.
CO2:	Learn about various plant microbe interactions.
CO3:	Learn the importance of biogeochemical cycles and mechanism of nitrogen fixation
CO4:	Apply plant microbe interactions in various fields such as biofertilizers, biopesticides
CO5:	Learn about different plant infections and integrated pest management

TEXT BOOKS

1.	CambellR(1983).MicrobialEcology.Second edition,BlackwellScientificPublications,London.
2.	Subba Rao NS (2017). Soil Microbiology. Fourth edition, Oxford and IBH Publishing Company
3.	MitchellR(1974).IntroductiontoEnvironmentalMicrobiology.Prentice–Hall.Inc. NewJersey.

4.	AtlasRMandBartha R(1992).MicrobialEcology:FundamentalsandApplications. Second edition,TheBenjamin/CummingsPublishingCo., RedwoodCity, CA.
REFERENCES	
1.	LynchJMandPoole NJ (1979).MicrobialEcology:A.ConceptualApproach. BlackwellScientificPublications,London.
2.	Tate RL (2020). Soil Microbiology. First edition, John Wiley & Sons, New Jersey

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1:	3	3	2	2	2	3	2	1	3	1	3
CO2:	3	3	2	2	2	3	2	1	3	1	3
CO3:	3	3	2	2	2	3	2	1	3	1	3
CO4:	3	3	2	2	2	3	2	1	3	1	3
CO5:	3	3	2	2	2	3	2	1	3	1	3
CO	3	3	2	2	2	3	2	1	3	1	3

1 - LOW, 2 - MEDIUM, 3 - HIGH

24MBU411	SOIL AND AGRICULTURAL MICROBIOLOGY LAB	L	T	P	C	TOTAL MARKS
		0	0	4	2	100

PREREQUISITES:

COURSE OBJECTIVES:

The main objectives of this course are to:

1	Students will understand the importance of soil and soil microbes
2	Students will understand various microbial associations
3	Students will gain knowledge about biogeochemical cycles
4	Students will gain knowledge about microbial interactions
5	Students can understand the various infections affecting plant

UNIT 1:	**Microbes and Lithosphere**	**12**

Methods to study soil microorganisms - Isolation and enumeration of Bacteria, Fungi, Bacteriophages, Algae, Protozoa etc., Microbiological test for fertility - Bacterial and Fungal

UNIT 2:	**Microbial associations in phytosphere**	**12**

Microbiological demonstration of soil enzymes – Amylase, Protease, Lipase, Gelatinase, etc.

UNIT 3:	**Biogeochemical cycles**	**12**

Isolation and identification of root nodule bacteria-Rhizobium (symbiotic), demonstration of rhizobium in the root nodule (CS of root nodule) Isolation and identification of Azotobacter (Asymbiotic).

UNIT 4:	**Applicationsof microbial interactions**	**12**

Isolation and identification of nitrogen fixing Cyanobacteria-Anabaena, Nostoc, etc., Demonstration of Azolla Demonstration of antagonistic activity –bacterial and fungal.

UNIT 5:	**Plant infections**	**12**

Study of the following diseases: Tobacco mosaic; Bacterial blight of paddy; Downy mildew of bajra; Powdery mildew of cucurbits; Head smut of sorghum; Leaf rust of coffee; Leaf spot of paddy, Red rot of sugar cane, Root knot of mulberry.

60 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students will be able to:

CO1:	Isolate microorganisms from soil samples
CO2:	Enumerate microorganisms.
CO3:	Isolate and identify symbiotc and asymbiotic bacteria.
CO4:	Analyse plant diseases caused by microorganisms.
CO5:	Production of biofertilizers

TEXT BOOKS

1.	CambellR (1983). Microbial Ecology. Second edition. Blackwell Scientific Publications, London.
2.	Lynch JM and Poole NJ (1979).Microbial Ecology: A. Conceptual Approach. Blackwell Scientific Publications, London.
3.	Rheinheimer G (1980). Aquatic Microbiology. Secondedition, JohnWiley & Sons, NewYork.
4.	Atlas RM and BarthaR (1992). Microbial Ecology: Fundamentals and Applications. Second edition. The Benjamin/Cummings Publishing Co., Redwood City, CA.

REFERENCES

1.	Subhashini Vallabhaneni (2012) Soil Microbiology- A laboratory manual. LAP Lambert Academic Publishers

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1:	3	3	2	2	3	3	2	1	3	1	3
CO2:	3	3	2	2	3	3	2	1	3	1	3
CO3:	3	3	2	2	3	3	2	1	3	1	3
CO4:	3	3	2	2	3	3	2	1	3	1	3
CO5:	3	3	2	2	3	3	2	1	3	1	3
CO	3	3	2	2	3	3	2	1	3	1	3

1 - LOW, 2 - MEDIUM, 3 - HIGH

24MBU402	MICROBIAL GENETICS	L	T	P	C	TOTAL MARKS
		4	0	0	5	100

PREREQUISITES:

COURSE OBJECTIVES:

The main objectives of this course are to:

1	Students will understand the properties of DNA
2	Students will understand the basics of chromosomes and genes
3	Students will gain knowledge about different types of plasmids
4	Students will gain knowledge about mutations
5	Students can understand the mechanism and control of molecular recombination

UNIT 1: Introduction of DNA **12**

Historical perspectives of microbial genetics. Nucleic acid as genetic information carriers: experimental evidence. DNA – types, structure and properties- topology, super helicity, linking number

UNIT 2: Chromosomes **12**

Organization of genes and chromosomes: Definition of gene. Operon – Lac operon, Trp operon.Structure of chromatin and chromosomes - unique and repetitive DNA, heterochromatin, euchromatin, transposons.

UNIT 3: Plasmids **12**

Plasmids as extrachromosomal genetic elements; types and properties. Structure and replication of different plasmids: Col E1, F1 and Ti plasmids. Plasmid amplification and curing; Gene transfer mechanisms: Transformation, conjugation and transduction.

UNIT 4: Mutation **12**

Mutation and Mutagenesis – mechanisms, biochemical basis, mutagens. Molecular basis of spontaneous and induced mutations. Reversion and suppression. Environmental Mutagenesis and toxicity testing; Carcinogenecity - chemical carcinogenesis and their testing

UNIT 5: Recombination **12**

Molecular recombination - Mechanism, control and models. Transposition; regulatory sequences and transacting factors. Genetic mapping in *E. coli* and Yeast. Genetics of Lambda, M13, Mu, T4 and OX174. Genetic systems of yeast and Neurospora.

60 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students will be able to:

CO1:	Gain knowledge about stucture and types of DNA.
CO2:	Understand the organization of genes and chromosomes
CO3:	understand about plasmids and gene transfer mechanisms
CO4:	Understand about mutagenesis and carcinogenecity
CO5:	Understand about recombination, transposition and genetic mapping

TEXT BOOKS

1.	Old R and Primrose SB (1995). Principles of Gene Manipulation: An Introduction to Genetic Engineering. Fifth edition. Blackwell Scientific Publications, Oxford.
2.	Malacinski GM (2015). Freifelder's Essentials of Molecular Biology. Fourth edition, Jones and Bartlett.
3.	Veer Bala Rastogi (2020). Elements of Genetics. Eleventh Revised & Enlarged Edition, KNRN Publications, Meerut.
4.	Verma PS and Agarwal VK (1995). Genetics. Eighth edition, S. Chand & Co., New Delhi.

REFERENCES	
1.	Klug WS (2011). Concepts of Genetics. Tenth edition, Pearson publications, UK.
2.	Winter PC, Hickey GJ and Fletcher HL (2000). Instant notes in Genetics. Viva books Ltd.
3.	Gardener EJ (2006). Principles of Genetics. Eighth edition, Wiley - India Student Edition.
4.	LewinB(2000). Genes VII. Oxford University Press, Oxford.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1:	3	3	2	2	2	3	2	3	3	3	2
CO2:	3	3	2	2	2	3	2	3	3	3	2
CO3:	3	3	2	2	2	3	2	3	3	3	2
CO4:	3	3	2	2	2	3	2	3	3	3	2
CO5:	3	3	2	2	2	3	2	3	3	3	2
CO	3	3	2	2	2	3	2	3	3	3	2

1 - LOW, 2 - MEDIUM, 3 - HIGH

24MBU412	MICROBIAL GENETICS LAB	L	T	P	C	TOTAL MARKS
		0	0	4	2	100

PREREQUISITES:

COURSE OBJECTIVES:

The main objectives of this course are to:

1	Isolating genetic material from Bacteria
2	Estimation and confirmation of isolated DNA by AGE techniques
3	Isolation of other macro molecules and its purification strategy and estimation
4	Competent cells preparation and their selection mechanism
5	DNA amplification and separation

UNIT 1:		**12**

Isolation of genomic DNA from bacteria and demonstration in agarose gel electrophoresis. Isolation of plasmid DNA by alkali lysis method.

UNIT 2:		**12**

Estimation of DNA by diphenyl amine method. Determination of Tm value of DNA. Quantitation of nucleic acids by UV Spectrophotometer

UNIT 3:		**12**

Isolation of RNA from yeast. Estimation of RNA by orcinol method. Induced mutagenesis - Isolation of antibiotic resistant auxotrophic mutants.

UNIT 4:		**12**

Preparation of competent cells. Transformation and Blue-White selection for transformants.

UNIT 5:		**12**

DNA amplification by PCR. Separation of PCR amplified product on PAGE and determination of product size.

60 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students will be able to:

CO1:	To gain knowledge of isolation of biomolecules and analyzing for various parameters
CO2:	To apply techniques in problem solving and Evaluting the results of changes taken place in molecular level
CO3:	To understand the mechanism of how to prepare competent cells and selection mechanism for genetic transformation
CO4:	To understand the mechanism of protein synthesis, RNA synthesis in cells , mechanism enzymes and biochemical pathway
CO5:	To gain knowledge in cell to cell interaction and analyzing its mechanisms in knowledge about structure and types of DNA.

TEXT BOOKS

1.	Sarma PVGK (2021). A Practical Textbook of Genetic Engineering in Bacteria, Mjp Publishers
2.	Upendra Thapa Shrestha and NabarajAdhikari. A Practical Manual for Microbial Genetics. First edition.
3.	Rajan S, Selvi R (2018). Experimental Procedures in Life Sciences. CBS Publishers

REFERENCES

1.	Masroor Ellahi Babar (2011). A Laboratory Manual of Molecular Biology. Lambert Academic Publishing Company.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1:	3	3	3	2	3	3	2	3	3	3	2
CO2:	3	3	3	2	3	3	2	3	3	3	2
CO3:	3	3	3	2	3	3	2	3	3	3	2
CO4:	3	3	3	2	3	3	2	3	3	3	2
CO5:	3	3	3	2	3	3	2	3	3	3	2
CO	3	3	3	2	3	3	2	3	3	3	2

1 - LOW, 2 - MEDIUM, 3 - HIGH

24MBU403	BIOSTATISTICS	L	T	P	C	TOTAL MARKS
		2	0	0	2	100

PREREQUISITES:

COURSE OBJECTIVES:

The main objectives of this course are to:

1	To enable the learner to understand the principles of collection of data in biological experiments, proper statistical analysis of the data and its presentation.
2	To enable the learner to understand the importance of sample size and various variables that affect data.
3	To enable the learner to understand the importance of mean, standard error, standard deviation, significance in presenting the data.
4	To enable the learner to understand the concepts in hypothesis testing.
5	To enable the learner to understand the importance of regression and correlation.

UNIT 1: Data Collection and Presentation **12**

Data Collection and Presentation: Biological data management using statistical tools. Concepts of population and sample, sampling and designing experiments, Estimation of sample size for biological experiments, sources of errors. Sampling schemes – Simple Random sampling, Systemic sampling, Stratified sampling, Cluster sampling, Non probability sampling; Estimation of mean proportion and standard error in sampling, Types of numerical data; Modes of presenting data: Frequency distributions, Relative frequency.

UNIT 2: Analysis of variance **12**

Analysis of variance: Mean, median, mode; Co-efficient of variation and standard deviation; Range and interquartile range; Grouped mean and grouped variance; Frequency distributions; One-way ANOVA; Two-way ANOVA; AMOVA; student's t-test.

UNIT 3: Probability **12**

Probability: Operations on events, Venn diagrams, Conditional Probability; Probability distributions.

UNIT 4: Hypothesis testing **12**

Hypothesis testing: General concepts: Null hypothesis, alternative hypothesis, Rejection of hypothesis; Type I and Type II errors; P value and sample size estimation.

UNIT 5: Regression and Correlation **12**

Regression and Correlation: Chi Square Test – Observed and expected frequencies, Calculating p values, assumptions of a chi square goodness of fit.

60 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students will be able to:

CO1:	Understand the principles of collection of data in biological experiments, proper statistical analysis of the data and its presentation.
CO2:	Understand the importance of sample size and various variables that affect data.
CO3:	Understand the importance of mean, standard error, standard deviation, significance in presenting the data.
CO4:	Apply the principles of statistics for designing microbiological experiment, statistical analysis, and interpretation of results
CO5:	Operate and solve exercise using computation statistics

TEXT BOOKS

1.	Pagano M and Gauvreau K (2000). Principles of Biostatistics. Duxbury Thomas learnings.
2.	Ramakrishnan P (2017). Biostatistics. Fourth edition, Saras Publications
3.	Pranab Kumar Banerjee (2011). Introduction to Biostatistics. Fourth edition, S.Chand & Company ltd.

4.	Bremer M and Doerge RW (2010). Statistics at the Bench: A Step-by-Step Handbook for Biologists. Cold Spring Harbor Laboratory Press (New York).
REFERENCES	
1.	Whitlock M and Schluter D (2009). Analysis of Biological Data. Roberts and company publishers.
2.	Daniel WW (2009). Biostatistics: A Foundation for Analysis in the Health Sciences. Ninth edition, John Wiley and Sons Inc.

CO'S-PO'S & PSO'S MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1:	3	3	2	1	2	1	3	3	3	1	3
CO2:	3	3	2	1	2	1	3	3	3	1	3
CO3:	3	3	2	1	2	1	3	3	3	1	3
CO4:	3	3	2	1	2	1	3	3	3	1	3
CO5:	3	3	2	1	2	1	3	3	3	1	3
CO	3	3	2	1	2	1	3	3	3	1	3

1 - LOW, 2 - MEDIUM, 3 - HIGH

24MBU431	MUSHROOM CULTIVATION	L	T	P	C	TOTAL MARKS
		2	0	0	2	100

PREREQUISITES:

COURSE OBJECTIVES:

The main objectives of this course are to:

1	To provide knowledge to the students on Types of Mushrooms and to identify edible and poisonous mushroom
2	To provide knowledge to the students on cultivation and production of edible mushrooms
3	To understand the life cycles of various mushrooms
4	Students will gain knowledge about industrial production, harvesting and marketing of mushrooms
5	To provide an insight knowledge on post-harvest technology and disease management

UNIT 1:	INTRODUCTION	3

Introduction: Morphology, Types of Mushroom, identification of edible and poisonous mushroom, Nutritive values, life cycle of common edible mushrooms.

UNIT 2:	CULTIVATION	3

Mushroom cultivation, prospects and scope of Mushroom cultivation in small scale Industry.

UNIT 3:	LIFE CYCLE	3

Life cycle of *Pleurotus* spp and *Agaricus* spp.

UNIT 4:	PRODUCTION	3

Spawn production, growth media, spawn running and harvesting of mushrooms and marketing.

UNIT 5:	DISEASE MANAGEMENT	3

Diseases and post-harvest technology, Insect pests, nematodes, mites, viruses, fungal competitors and other important diseases.

15 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students will be able to:

CO1:	Describe the structure and types of edible mushrooms
CO2:	Illustrate the methods to cultivate edible mushrooms
CO3:	Explain the life cycle of edible mushrooms
CO4:	Illustrate the methods of spawn production and mushroom harvest
CO5:	Explain the disease management and control in mushroom cultivation

TEXT BOOKS

1.	Marimuthu T, Krishnamoorthy AS, Sivaprakasam K and Jayarajan R (1991). Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University,
2.	Nita Bahl (2002). Handbook on Mushroom. Fourth edition. Oxford & IBH publishing Co., Pvt., Ltd., New Delhi.
3.	Suman (2005). Mushroom Cultivation Processing and Uses. IBD Publishers and Distributors.

REFERENCES

1.	Sing (2005). Modern Mushroom Cultivation, International Book Distributors, Dehradun.
2.	Sharma VP (2006). Diseases and Pests of Mushrooms, M/s. IBD Publishers and Distributors, New Delhi.
3.	Tewari P and Kapoor SC (1988). Mushroom cultivation, Mittal Publications New Delhi.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1:	2	3	3	2	2	3	2	2	3	1	3
CO2:	2	3	3	2	2	3	2	2	3	1	3
CO3:	2	3	3	2	2	3	2	2	3	1	3
CO4:	2	3	3	2	2	3	2	2	3	1	3
CO5:	2	3	3	2	2	3	2	2	3	1	3
CO	2	3	3	2	2	3	2	2	3	1	3

1 - LOW, 2 - MEDIUM, 3 - HIGH