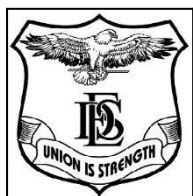


Deccan Education Society's

Kirti M. Doongursee College of Arts, Science and Commerce (AUTONOMOUS)



Affiliated to

UNIVERSITY OF MUMBAI

Syllabus for

Program: Bachelor of Science

Course: S.Y.Bsc

Subject: **Biotechnology**

Choice Based Credit System (CBCS)

with effect from

Academic Year 2024-2025

Semester	Course Code	Course Title	Vertical	Credit
III	24BTMJ311	Cell Biology and Immunology	Major	2
	24BTMJ312	Molecular Biology and cytogenetics -2	Major	2
	24BTMJ31	Practical-3(Cell Biology and Immunology +Molecular Biology and cytogenetics)	Major	2
	24BTMRC321	Chemistry-II	Minor	2
	24BTMRCP321	Practical (Chemistry-II)	Minor	2
	24BTMRM322	Microbiology-II	Minor	2
	24BTMRMP322	Practical (Microbiology-II)	Minor	2
	24BTMRL323	Life Science-II	Minor	2
	24BTMRLP323	Practical (Life Science-II)	Minor	2
	24BTOE331	Sustainable farming	OE	2
	24BTVC341	Bioenzyme	VSC	2

Semester	Course Code	Course Title	Vertical	Credit
IV	24BTMJ411	Medical microbiology	Major	2
	24BTMJ412	Environmental Biotechnology	Major	2
	24BTMJ41	Practical-4 (Medical microbiology + Environmental Biotechnology)	Major	2
	24BTMRC421	Chemistry-III	Minor	2
	24BTMRCP421	Practical (Chemistry-III)	Minor	2
	24BTMRM422	Microbiology-III	Minor	2
	24BTMRMP422	Practical (Microbiology-III)	Minor	2
	24BTMRL423	Life Science-III	Minor	2
	24BTMRLP423	Practical (Life Science-III)	Minor	2
	24BTOE431	Mushroom Cultivation	OE	2
	24BTSE451	Dairy Technology	SEC	2

PROGRAM OUTCOMES

PO	Description
A student completing Bachelor's Degree in Science Program will be able to	
PO1	Understand scope and applications of Biotechnology and its interdisciplinary approach.
PO2	Understand Fundamentals of Biotechnology. Acquire and Demonstrate Comprehensive knowledge and good experimental and Laboratory skills in Biotechnology
PO3	Build strong Knowledge and conceptual learning through systematic thinking and self -study.
PO4	Understand and apply appropriate tools and techniques in Biotechnology Acquire the knowledge of upcoming fields of Biotechnology, make the learner competent to pursue higher studies.
PO5	Acquire an ability to analyze and scientific problems and develop scientific research ability
PO6	Learn appropriate skills in conduction of Biotechnological experiments learn good oral and written communication skills as well as nurturing creativity
PO7	Employee skill and knowledge in environmental management and sustainable development Impart skills and Knowledge in designing entrepreneurial courses in the field of biotechnology.

Semester III			
Course Code	MAJOR-I SEM – III	Credits	Lectures/ Week
24BTMJ311	Paper I- Cell Biology and Immunology	2	2
Course Outcomes: After successful completion of this course, students would be able to - Describe the types, structure, functions, and composition of the motor proteins. - Develop an understanding of the cytoskeleton and cell membrane, role of different types of cells, effector molecules and effector mechanisms in immunology - Implement the knowledge of immunological techniques in medicine - Analyze the regulation of immune system.			
Unit	Topics	No of Lectures	
I Cell biology	Cytoskeleton : Overview of the Major Functions of Cytoskeleton. Microtubules: Structure and Composition. MAPs: Functions- Role in Mitosis, Structural Support and Cytoskeleton Intracellular Motility. Motor Proteins: Kinesins, Dynein; MTOCs. Dynamic Properties of Microtubules. Microtubules in Cilia and Flagella. Microfilaments: Structure, Composition, Assembly and Disassembly. Motor Protein: Myosin. Muscle Contractility: Sliding Filament Model. Actin Binding Proteins : Examples of Non Muscle Motility. Intermediate Filaments :Structure and Composition; Assembly and Disassembly; Types and Functions. Cell Membrane : Uptake of Nutrients by Prokaryotic Cells; Cell Permeability. Principles of Membrane Transport Transporters and Channels; Active Transport, Passive Transport; Types of Transporters; Types of ATP Driven Pumps - Na ⁺ K ⁺ Pump.	15	

II Immunology	Haematopoiesis: Cells of the Immune System; Primary and Secondary Lymphoid Organs. Complement System- Classical, Alternate and Lectin; Regulation and Biological Effects of Complement System; Deficiencies of Complement System T-cell Receptor Complex: Structure and Activation. MHC Classes - General Organization and Inheritance; Structures and Peptide Interactions; Class I and II Diversity and Polymorphism; Antigen Presentation - Endocytic and Exocytic Pathways; MHC Restriction. B-cell Receptor : Structure, Maturation and Activation B-T Cell Interaction (B-T cell Cooperation) ELISA, COMS test	15
Textbooks: • Cell and Molecular Biology – De Robertis- Lippincott Williams& Wilkins • Karp's Cell and Molecular Biology: Concepts and Experiments—Karp – Wiley International • Kuby immunology, Judy Owen , Jenni Punt , Sharon Stranford., 7th edition (2012), Freeman and Co., NY • Textbook of basic and clinical immunology, 1st edition (2013), Sudha Gangal and Shubhangi Sontakke, University Press, India Additional References: • Cell and Molecular Biology 5th edition by Gerald Karp (John Wiley and sons publications) • Immunology, 7th edition (2006), David Male, Jonathan Brostoff, David Roth, Ivan Roitt, Mosby, USA		

Course Code	MAJOR-II SEM – III	Credits	Lectures/ Week
24BTMJ312	Paper II Molecular Biology and Cytogenetics	2	2
Course Outcomes: After successful completion of this course, students would be able to • Recognize the structure of chromosomes. • Develop an understanding the mechanisms associated with gene expression at the level of transcription and translation. Discuss the principles underlying sex determination, linkage and mapping. • Construct chromosomal map and pedigree chart • Do the analysis of various types of chromosomal aberrations.			
Unit	Topics	No of Lectures	
I Molecular Biology	Transcription Process in Prokaryotes: RNA Synthesis; Promoters and Enhancers; Initiation of Transcription at Promoters; Elongation and Termination of an RNA Chain. Transcription in Eukaryotes : Eukaryotic RNA Polymerases; Eukaryotic Promoters; Transcription of Protein Coding Genes by RNA Polymerase; Eukaryotic mRNA's; Transcription of other genes; Spliceosomes; RNA editing. Translation Nature of Genetic Code. Wobble Hypothesis. Translation in Prokaryotes and Eukaryotes: Process of Protein Synthesis (Initiation, Elongation, Translocation, Termination);	15	

II Cytogenetics	Cytogenetics: Structure of Chromosome - Heterochromatin, Euchromatin, Polytene Chromosomes. Variation in Chromosomal Structure and Number : Deletion, Duplication, Inversion, Translocation, Aneuploidy, Euploidy and Polyploidy and Syndromes- Klinefelter, Turner, Cri-du-Chat, Trisomy -21, Trisomy 18 and Trisomy 13. Sex Determination and Sex Linkage : Mechanisms of Sex Determination (XX-XY, ZZ-ZW, XX-XO) Dosage Compensation and Barr Body. Genetic Linkage, Crossing Over and Chromosomal Mapping : Tetrad Analysis; Two-point Cross; Three point Cross; Pedigree Analysis.	15
Textbooks: ● Cell and Molecular Biology – De Robertis- Lippincott Williams& Wilkins ● Genes XI, 11th edition (2012), Benjamin Lewin, Publisher - Jones and Barlett Inc. USA ● iGenetics- Peter Russell -Pearson Education Or 3rd edition ● Cytogenetics, P. K. Gupta Additional References: ● Genetics, (2006) Strickberger MW - (Prentice Hall, India) (recombination repair) ● Cell and Molecular Biology 5th edition by Gerald Karp (John Wiley and sons publications)		

Course Code	Practical of Major	Credits	Lectures/ Week
24BTMJ31	Cell Biology and Immunology and Molecular Biology and Cytogenetics	2	4
Course Outcomes: After successful completion of this course, students would be able to • To acquaint students with various immunotechniques. • To gain proficiency in various cytogenetic techniques, such as karyotyping • To interpret karyotypes and identify chromosomal aberrations, including numerical abnormalities			
Topics 1. Complement Fixation Test (CFT). 2. Passive Agglutination- RA Factor Test. 3. Immunoelectrophoresis. 4. Immunodiffusion technique - Single Radial Immunodiffusion by Mancini Method 5. Immunodiffusion- double immunodiffusion by Ouchterlony Method 6. ELISA (Kit-based) - HEP-ELISA. 7. DOT-ELISA. 8. Coomb's test (Demonstration) 9. Induction of Polyploidy by PDB Treatment using Suitable Plant Material. 10. Study of Polytene Chromosomes. 11. Study of E.coli Diauxic Growth Curve- (Lactose and Glucose). 12. Study of lac Gene Expression using Blue-White Selection. 13. Chloroplast isolation using density gradient centrifugation. 14. Expression of β-galactosidase and Measurement of Activity. 15. Study of Chromosomal Aberrations- Deletion, Duplication, Inversion, Translocation and Syndromes- Trisomy 21 Trisomy 13 Trisomy 18, Klinefelter, Turner and Cri-du-Chat. 16. Mapping based on Tetrad Analysis and Three Point Cross. Pedigree Analysis- Autosomal and Sex-Linked			

Course Code	Minor SEM III – Chemistry-II	Credits	Lectures/ Week
24BTMRC321	Chemistry-II	2	2
Course Outcome:			
After successful completion of this course, students would be able to - Recall the definitions of system, surrounding, and boundaries in thermodynamics. - Explain the significance of internal energy and enthalpy in thermodynamics. - Understand the biochemical transformations involved in glycolysis, fermentation, citric acid cycle, and other metabolic pathways. - Apply knowledge of metabolic pathways to predict the fate of substrates under different physiological conditions.			
Unit	Topics	No of Lectures	
I Physical chemistry	Thermodynamics: System, Surrounding, Boundaries Sign Conventions, State Functions, Internal Energy and Enthalpy: Significance, examples, (Numericals expected.) Laws of Thermodynamics and its Limitations Reaction Kinetics: Rate of Reaction, Rate Constant, Measurement of Reaction Rates Order & Molecularity of Reaction. Principles of Oxidation & Reduction Reactions Oxidizing and Reducing Agents	15	
II Biochemistry	Carbohydrate metabolism: Glycolytic Pathway and its Regulation, Homolactic Fermentation; Alcoholic Fermentation; Energetics of Fermentation; Citric Acid Cycle and its Regulation; Gluconeogenesis; Pentose Phosphate Pathway; Glyoxalate Pathway; Reductive TCA . (Sequence of Reactions, Regulation, Energy Yield and Metabolic Disorders of the above Pathways) Amino acid breakdown: Deamination Transamination, Urea cycle, Breakdown of amino acid. Lipid metabolism: Beta, alpha and Omega oxidation of saturated fatty acid and oxidation of unsaturated fatty acid	15	

Textbooks:

- A Textbook of Organic Chemistry, 15th edition, Arun Bahl, B S Bahl, S. Chand
- Vogel's Textbook of Quantitative Analysis, Fifth Edition
- Organic Chemistry, by Solomon and Fryhle
- Robert Murray, Daryl G., Peter M., Victor R.; Harper's Illustrated Biochemistry.
- Satyanarayana U. and Chakrapani U. (2007). Biochemistry. 3rd Edition. Books and Allied (P) Ltd.
- Lehninger Principles Of Biochemistry by Nelson and Cox Fifth Edition

Additional References:

- Fundamentals of Biochemistry. 3rd Edition (2008), Donald Voet & Judith Voet, John Wiley and Sons, I. USA

Course Code	Minor SEM – III – Practical	Credits	Lectures/ Week
24BTMRCP321	Chemistry-II	2	4
Course Outcomes: After successful completion of this course, students would be able to ● Explain the factors affecting the enthalpy of dissolution, such as solute-solvent interactions and solution concentration. ● Apply the integrated rate laws to analyze concentration-time data and determine the rate constant for the hydrolysis reaction. ● Analyze experimental data to determine the order of reaction with respect to ester and HCl concentration. ● Analyze the experimental data obtained from the biochemical assays to determine total, LDL, and HDL cholesterol concentrations in serum samples.			
Topics			
1. To determine enthalpy of dissolution of salt like KNO₃ 2. Determine the rate constant for hydrolysis of ester using HCl as a catalyst 3. Study the kinetics of reaction between Thiosulphate ion and HCl 4. Study reaction between potassium Persulphate and Potassium Iodide kinetically and hence to determine order of reaction 5. Determination of Lactate Dehydrogenase (LDH) Activity in Blood Serum. 6. Determination of Total, LDL and HDL Cholesterol in Serum. 7. Disorders caused due to deficiency of different pathways. 8. Isolation of mitochondria and demonstration of ETC using a Marker Enzyme.			

Course Code	Minor SEM III - Microbiology-II	Credits	Lectures/ Week
24BTMRM322	Microbiology-II	2	2
Course Outcomes: After successful completion of this course, students would be able to ● Gain insight into disease factors and processes and diseases caused by microorganisms. ● Discuss the various aspects of systemic infections including causative agents, symptoms and prophylaxis. ● Develop skill in the handling, isolation, and identification of diverse bacteria, enhancing technical skills in microbiological techniques. ● Distinguished various causative organisms.			
Unit	Topics	No of Lectures	
I General Bacteriology and Bacteria as Human pathogen, Host parasite interactions	Host Parasite Relationship: Normal Flora; Factors Affecting the Course of Infection and Disease; Mechanisms of Infection and Virulence Factors. Infection: Patterns of Infection; Types of Infections; Signs and Symptoms; Epidemiology and Epidemiological Markers. Diseases: Origin of Pathogens; Vectors; Acquisition of Infection; Koch's Postulates.	15	

II Causative organisms-	Skin: <i>S. aureus, S. pyogenes.</i> Respiratory Tract Infections: <i>M. tuberculosis, S. pneumoniae</i> (Characteristics Transmission, Course of Infection, Lab Diagnosis, Management of TB, Prevention and Control, Immuno and Chemoprophylaxis, DOTS and MDR). Urinary Tract Infections: <i>E.coli</i> : Characteristics, Virulence, Clinical disease, and <i>E.coli</i> Infections.	15
Textbooks: ● Microbiology by Prescott 5th edition ● Microbiology by Pelczar, Reid and Chan 5th Edition ● Textbook of Microbiology by Ananthanarayan ● Textbook of Medical Microbiology- Anantnarayan ● Textbook of Medical Microbiology- Anantnarayan Additional References: ● Fundamental Principles of Bacteriology A J Salle 7th ● Microbiology by Pelczar, Chan and Krieg, 5th Ed		

Course Code	Practical of Minor Microbiology-II	Credits	Lectures/ Week
24BTMRMP322	Microbiology-II	2	4
Course Outcomes: After successful completion of this course, students would be able to • Apply microbiological techniques to isolate and identify pathogenic bacteria from clinical specimens, such as blood, urine, and sputum samples. • Analyze the interactions between pathogenic bacteria and their human hosts, considering factors such as bacterial virulence, host susceptibility, and environmental conditions.			
Topics 1. Study of composition and use of important differential media for identification of bacteria: EMB Agar, McConkey agar, Mannitol salt agar, Deoxycholate citrate agar, TCBS 2. Isolation of <i>S.aureus</i> using selective and differential media 3. Identification of <i>S.aureus</i>- Catalase, Coagulase Test. 4. Isolation of <i>E.coli</i> using selective and differential media 5. Identification of <i>E.coli</i>- Sugar Fermentations, IMViC. 6. Isolation of <i>Salmonella</i> using selective and differential media 7. Identification of <i>Salmonella</i>- Sugar Fermentations, TSI Slant. 8. Isolation of <i>Shigella</i> using selective and differential media 9. Identification of <i>Shigella</i>-, Sugar Fermentations, TSI Slant. 10. Isolation of <i>Pseudomonas</i> using selective and differential media 11. Identification of <i>Pseudomonas</i> - Urease test, Oxidase Test, TSI Slant.			

Course Code	Minor SEM III - Life science-II	Credits	Lectures/ Week
24BTMRL323	Life science-II	2	2
Course Outcomes: After successful completion of this course, students would be able to ● Gain critical thinking and analytical skills of new diagnostic methods ● Understanding molecular techniques and utilizing these techniques in diagnosis. ● Apply molecular biology techniques to perform diagnostic assays, such as PCR amplification of target genes or nucleic acid hybridization assays for pathogen detection. Construct restriction enzyme map. ● Analyze experimental data generated from molecular diagnostic assays, such as gel electrophoresis pattern.			
Unit	Topics	No of Lectures	
I Basics of molecular diagnostics	Characterization and analysis of Nucleic – Acids and Proteins Extraction, Isolation and Detection of DNA, RNA and Proteins; Restriction Endonucleases Hybridization Techniques : Southern, Northern, Western Blotting, Markers, Probes and its Clinical Applications. RFLP and Sickle Cell Anemia -Diagnostic Testing for Cystic Fibrosis; Fragile X	15	
II Plant and Animal Physiology	Plant Hormones Introduction to secondary metabolites Blood circulation Role of kidney in Excretion and Osmoregulation Blood Coagulation Mechanism and working of Heart	15	

Textbooks:

- Molecular Diagnostics: Fundamentals, Methods, and Clinical Applications Third Edition, Lela Buckingham.

Additional References:

- Karp's Cell and Molecular Biology: Concepts and Experiments—Karp – Wiley International

Course Code	Practical of Minor Life Science-II	Credits	Lectures/ Week
24BTMRLP323	Life Science-II	2	4
Course Outcomes: After successful completion of this course, students would be able to • Explain the methodology and reagents used in the estimation of hemoglobin levels and effect of PGR on plant • Apply molecular biology techniques to perform diagnostic assays • Analyze experimental data obtained from molecular diagnostic assays, such as band patterns on agarose gels.			
Topics 1. Visualization DNA Amplification – PCR. 2. Genetic Counseling and Molecular Diagnosis Genetic Testing 3. Case Studies- for Cystic Fibrosis; Fragile X Diagnostic and Carrier 4. Isolation and Detection of RNA from Bacteria. 5. Isolation and Detection of RNA from Yeast 6. Restriction site analysis of lambda phage DNA. 7. Preparation of Restriction map			

Course Code	Open Elective SEM – III	Credits	Lectures/Week
24BTOE331	Sustainable farming	2	2
Course Outcomes: After successful completion of this course, students would be able to • Describe the concept of sustainable farming system • Understand the sources of nutrients and role of soil in sustainable farming • Explain the cropping methods and crop rotation. • Apply the important manures, compost and pesticides • Analyze the different aspects of crop harvesting			
Unit	Topics	No of Lectures	
I Introduction of sustainable farming	Introduction: Concept of sustainable farming system History and development Definition and Principle Advantages and limitations. Need of organic farming in present Context and future prospects - Barrier. Sources of nutrients for organic farming. Organic Manure. Green Manure Liquid Manure Role of soil in sustainable farming texture and composition of soil, soil types, soil structure, soil profile, Humus Soil pH. Soil factors affecting plant growth	15	
II Organic Farm management and Crop management	Land preparation - Tools and Techniques Introduction to Composting Preparation of seed bed, Manuring Sowing Watering and raising of seedling Pest control Crop rotation: Need and Benefits Harvesting and post harvesting management	15	
References : Principles of organic farming by P.L.Maliwal A Text book of modern organic farming by Vikas Singh Sengar Sharma, Arun k 2002, A Handbook of Organic Farming Organic Farming: The ecological system-Agronomy Monograph 54			

Course Code	Vocational Skill Course – Sem-III Practical	Credits	Lecture s/Week
24BTVC341	Bioenzymes	2	4
Course Outcomes: After successful completion of this course, students would be able to • To impart the knowledge of Bioenzyme. • To learn about different analytical techniques and apply that knowledge to different concepts. • To understand various antimicrobial activity and uses of Bioenzyme			
Topics			
1. Proteases Test 2. Lipases Test 3. Amylase Test 4. Cellulose Test 5. Preparation of Bioenzyme with help of fruit and vegetable waste 6. Characterization of bioenzymes 7. Use of Bioenzyme as fertilizers 8. Applications of bioenzymes 9. Preliminary tests for qualitative analysis of bioenzymes. 10. Identification of carbohydrates from bioenzymes. 11. Anti-microbial test for bioenzymes			

Semester IV

Course Code	MAJOR I SEM – IV	Credits	Lectures/Week
24BTMJ411	Paper I- Medical Biotechnology	2	2
Course Outcomes: After successful completion of this course, students would be able to • Comprehend pathogenesis and diagnosis process • Understand mechanism of drug action and mode of drug resistance, the inhibition of protein and nucleic acid synthesis. • Apply medical biotechnology techniques to solve practical problems • Illustrate the discovery and design of antimicrobial agents.			
Unit	Topics	No of Lectures	
I Viral and fungal diseases	Pathogenesis, clinical symptoms, laboratory diagnosis, epidemiology, prophylaxis and treatment of Viral diseases Air borne viral diseases: Influenza ,measles, COVID Vector Borne viral diseases: (Dengue, AIDS, Rabies). Fungal diseases- transmission, symptoms and prevention of cutaneous mycoses (Athlete's foot), systemic mycoses (Histoplasmosis) and opportunistic mycoses (Candidiasis)	15	

II Chemotherapeutic agents	Discovery and Design of antimicrobial agents; Classification of Antibacterial agents, Selective toxicity, MIC, MLC Inhibition of cell wall synthesis (Mode of action for): Beta lactam antibiotics: Penicillin, Cephalosporins; Glycopeptides: Vancomycin; Polypeptides: Bacitracin Injury to Plasma membrane: Polymyxin; Inhibition of protein synthesis Aminoglycosides, Tetracyclines Chloramphenicol, Macrolides Erythromycin; Inhibition of Nucleic acid synthesis: Quinolones, Rifampicin, Metronidazole ; Antimetabolites: Sulphonamides, Trimethoprim Antimicrobial susceptibility tests	15
Textbooks: • Mim's Medical Microbiology 5th edition • Prescott's Microbiology, 9th edition, Joanne M. Willey, Linda M. Sherwood, Christopher J. Woolverton, McGraw-Hill, USA Additional References: • Industrial Microbiology, A. H. Patel • Biotechnology Fundamentals by Dr. FirdosAlam Khan • Medical Biotechnology Glick 1st edition		

Course Code	MAJOR II SEM – IV	Credits	Lectures/Week
24BTMJ412	Paper II- Environmental Biotechnology 1	2	2
Course Outcomes: After successful completion of this course, students would be able to • Gain awareness about understanding of the causes, types and control methods for Environmental Pollution and Related Issues. • Summarize the environmental impacts of human activities and the role of biotechnology in reducing pollution. • To analyze the causes, types and control methods for Environmental Pollution and Related Issues. • Application of different life forms in Environmental Remediation.			
Unit	Topics	No of Lectures	
I Environmental Pollution, Global Environmental Problems and Issues	Air Pollution and Water Pollution : Types; Sources; Classification of Air Pollutants; Air Pollution Monitoring and Control. Soil and Solid Waste Pollution : Characteristics of Wastes, Impacts of Solid Waste on Health, Occupational Hazards and Control. Green House Effect : Factors Responsible for Green House Effect; Green House Gases. Global Warming; Ozone Depletion; Kyoto Protocol; UV Radiation; Acid Rain	15	
II Bioremediation	Concept of Bioremediation. Microorganisms in Bioremediation, Mycoremediation and Phytoremediation. Bioremediation Technologies. Measuring Bioremediation in the Field. Bioaugmentation and Biostimulation. Monitoring the Efficacy of Bioremediation	15	

Textbooks:

- Environmental Biotechnology Allan Scragg Oxford University press

Additional References:

- Environmental Biotechnology Indu shekar Thakur IK International (Basic concepts and applications)

Course Code	MAJOR SEM – IV – Practical	Credits	Lecture s/Week
24BTMJ41	Medical Biotechnology And Environmental Biotechnology 1	2	4

Course Outcomes:

After successful completion of this course, students would be able to

- Impart the knowledge of medicinal Techniques.
- Learn about different analytical techniques and apply that knowledge to different concepts.
- Understand various separation techniques such as environmental issues.

Topics

1. Screening for an Antibiotic Producing Strain of Microorganism by Crowded plate Technique.
2. Screening for an Antibiotic Producing Strain of Microorganism by Wilkin Overlay plate Technique
3. MIC of any one antibiotic
4. MLC of any one antibiotic
5. Antibiotic sensitivity test using agar cup method
6. Antibiotic sensitivity test using paper disc method
7. Antibiotic sensitivity test using ditch method.
8. To study synergistic action of drugs
9. Biological Oxygen Demand (BOD).
10. Chemical Oxygen Demand (COD).
11. Isolation of Bacteria from Air by Gravity Sedimentation Method.
12. Most Probable Number (MPN) – Presumptive, Confirmed and Completed Tests.
13. Bioremediation of Metal.

Course Code	Minor SEM IV – Chemistry-III	Credits	Lectures/ Week
24BTMRC421	Chemistry-III	2	2
Course Outcome: After successful completion of this course, students would be able to ● Recall the basic definitions of addition, elimination, and substitution reactions in organic chemistry. ● Understand the roles of essential elements in biological processes, including their functions as structural components, cofactors, and signaling molecules. ● Apply chromatographic techniques to separate and analyze complex mixtures of biological molecules, such as proteins, nucleic acids, and metabolites. ● Analyze experimental data on fluid viscosity, surface tension, and capillary action to determine relationships between variables.			
Unit	Topics	No of Lectures	
I Applied Chemistry	Introduction to Types of Organic Reactions : Addition, Elimination and Substitution Reactions. Essential and Non-essential Elements in Biological Systems. Role of Metal Ions in Biological Systems. Metal Coordination in Biological Systems : Enzymes, Apoenzymes and Coenzymes. Biological Role of Metalloenzymes wrt Myoglobins, Haemoglobin. Biological Role of Carboxypeptidases, Catalases and Peroxidases.	15	

II Biophysics	Chromatography Paper Chromatography, Ion exchange chromatography; size exclusion chromatography; affinity chromatography; Fluid Dynamics : Viscosity: Definition Flow of Liquids through Capillaries; Stokes' Law; Terminal Velocity. Determination of 'η' by Falling Sphere Method; Viscosity Estimation by Oswald's Viscometer. Surface Tension: Definition – Surface Tension and Surface Energy; Capillary Action; Angle of Contact; Wettability; Temperature Dependence of Surface Tension. Applications in Biology.	15
Textbooks: ● A Textbook of Organic Chemistry, 15th edition, Arun Bahl, B S Bahl, S. Chand ● Vogel's Textbook of Quantitative Analysis, Fifth Edition ● Organic Chemistry, by Solomon and Fryhle ● Robert Murray, Daryl G., Peter M., Victor R.; Harper's Illustrated Biochemistry. ● Satyanarayana U. and Chakrapani U. (2007). Biochemistry. 3rd Edition. Books and Allied (P) Ltd. ● Lehninger PRINCIPLES OF BIOCHEMISTRY by Nelson and Cox Fifth Edition Additional References: ● Fundamentals of Biochemistry. 3rd Edition (2008), Donald Voet & Judith Voet, John Wiley and Sons, I. USA		

Course Code	MINOR SEM – IV – Practical	Credits	Lectures/ Week
24BTMRCP421	Chemistry-III	2	4
Course Outcomes: After successful completion of this course, students would be able to • Understand the principle of the quantitative assay for catalase and peroxidase activity. • Optimize chromatographic conditions, such as solvent composition and development time, for efficient separation. • Analyze the experimental data obtained from the capillary rise method to calculate the surface tension of the sample and Viscosity.			
Topics			
1. Quantitative test – catalase activity 2. Quantitative test – peroxidase activity 3. Separation of amino acids with the help of paper chromatography. 4. Separation of components from a mixture using Size exclusion chromatography (Kit may be used for demonstration) 5. Separation of components from a mixture using ion exchange chromatography (Kit may be used for demonstration) 6. Separation of components from a mixture using Affinity chromatography (Kit may be used for demonstration) 7. Determine the surface tension of sample by capillary rise method 8. Determine the viscosity of the sample with the help of viscometer			

Course Code	Minor SEM IV - Microbiology-III	Credits	Lectures/ Week
24BTMRM422	Microbiology-III	2	2
Course Outcomes: After successful completion of this course, students would be able to ● Acquired knowledge about various industrial products produced by microorganisms by using fermentation processes. ● Understand various types of fermentation processes and Describe different fermentor designs ● Apply fermentation techniques to produce a variety of alcoholic beverages. ● Evaluate the environmental and economic impacts of fermentation processes.			
Unit	Topics	No of Lectures	
I Fermentor design , media and sterilization	Fermentor designs: Air lift fermentor, Tower fermentor, Acetator and cavitator, deep jet, packed Tower Fermentation Media: Media components : Carbon source-factors affecting choice of Carbon source with examples, Nitrogen source factors affecting choice of Carbon source with examples, Growth factors, Minerals, buffers, minerals, Inducers, precursors Antifoam agents- Types , Properties of Antifoam agent Medium properties: Fast metabolism, Rheology Concept of Inoculum and Production Media Sterilization : Sterilization of Fermentor and Fermentation Media. Sterilization of Media -Batch and Continuous Concept of Del factor Sterilization of Fermentor, feeds, liquid wastes Sterilization of Air Supply, Exhaust gases Filter sterilization	15	

II Fermentation processes-1	. Types of fermentations and fermentation process Significance and applications of Batch and continuous, surface and submerged, aerobic and anaerobic, Solid state fermentation. ● Industrial products from Microorganisms Penicillin, semisynthetic penicillin, Streptomycin, Vaccines, hormones ● Enzymes and Organic acids from Microorganisms: Ethanol, Citric acid, acetic acid, Lysine, Glutamic acid, Amylases, protease	15
Textbooks: ● Microbiology by Prescott 5th edition ● Fermentation technology by Stanbury and Whittkar ● Microbiology by Pelczar, Reid and Chan 5th Edition ● Textbook of Microbiology by Ananthanarayan Additional References: ● Fundamental Principles of Bacteriology A J Salle 7th ● Microbiology by Pelczar, Chan and Krieg, 5th Ed		

Course Code	Practical of Minor	Credits	Lectures/ Week
24BTMRMP422	Microbiology-III	2	4
Course Outcomes: After successful completion of this course, students would be able to • Apply aseptic techniques to prepare and handle microbial cultures for fermentation experiments.. • Utilize analytical techniques to monitor microbial growth and metabolite production during fermentation.			
Topics 1. Lab Scale Production of Penicillin (Static and Shaker). 2. Purification of Penicillin from Broth Culture of Penicillium pp. by Solvent extraction. 3. Estimation of Penicillin from Recovered Broth by Chemical (Iodometric) Method. 4. Estimation of Penicillin from Recovered Broth by Biological (Bioassay) Method. 5. RPR Test (Kit Based). 6. Permanent Slide- Mycobacterium 7. Field visit To winery or fermentation unit			

Course Code	Minor SEM IV - Life science-III	Credits	Lectures/ Week
24BTMRL423	Life science-III	2	2
Course Outcomes:			
After successful completion of this course, students would be able to			
- Recall the principles of reverse transcriptase PCR - Understand the concept of Concept of Morphogen and developmental biology - Identify biotic and abiotic factors influencing specific ecosystems and their inhabitants. Analyze the impact of disruptions or changes in one part of a food web on other organisms within the ecosystem..			
Unit	Topics	No of Lectures	
I Nucleic acid amplification n methods and Developme ntal biology	Target amplification : PCR - General Principle; Components of a Typical Control of PCR Contamination Reverse Transcriptase and Real Time PCR. Ligase Chain Reaction Mechanism of Differentiation Concept of Morphogen Developmental Biology: stages of development- Zygote, Blastula, gastrula	15	
II Ecosystem and interactions	Food Chain and Food Web Ecological Pyramid Ecosystems, Biotic and Abiotic Factors Trophic Levels Ecological pyramids Biogeochemical cycles	15	
Textbooks:			
- Molecular Diagnostics: Fundamentals, Methods, and Clinical Applications Third Edition, Lela Buckingham. - Developmental Biology" by Scott F. Gilbert - Text book on Environment Studies- Erach Bharucha for University Grants Commission			
Additional References:			
Developmental Biology" by Scott F. Gilbert and Michael J. F. Barresi:			

Course Code	Practical of Minor	Credits	Lectures/ Week
24BTMRLP423	Life science-III	2	4
Course Outcomes: After successful completion of this course, students would be able to • Understand PCR techniques to amplify DNA inserts for cloning into plasmid vectors. • Analyze the concept of developmental biology.			
Topics 1. Construction of Different Types of Food web 2. Study of DNA amplification by PCR 3. Checking of PCR product of AGE 4. Calibration and handling of Micropipette 5. Study of polytene chromosome 6. Review reports of 5 scientific papers related to Developmental Biology 7. Study of interactions commensalism, mutualism 8. Isolation of microorganisms from Air by gravity sedimentation method			

Course Code	Open Elective SEM – IV	Credits	Lectures/Week
24BTOE431	Mushroom cultivation	2	2
Course Outcomes:			
After successful completion of this course, students would be able to			
- Recall different types of mushrooms commonly cultivated. - Understand the process of mushroom spawn production and its importance in cultivation - Apply knowledge of environmental requirements to create an optimal growing environment for mushroom - Analyze the potential risk and benefits associated with scaling up mushroom cultivation operations.			
Unit	Topics	No of Lectures	
I Introduction of Mushroom	Introduction of Mushroom, Identification of Poisonous and Edible mushroom, Commonly cultivated mushrooms, Nutritional value of mushroom, Health benefits of mushroom Ecological and economical role of mushroom.	15	
II Cultivation of mushroom	Cultivation system, Composting , Spawn preparation, casting Cultivation of button mushroom, oyster mushroom, Packaging and processing of Mushroom	15	
Textbooks:			
- The Kingdom Fungi: The Biology of Mushrooms, Molds, and Lichens" by Steven L. Stephenson: - Webster J, Weber R.W.S. 2007. Introduction to Fungi. Cambridge University Press - Mushroom Cultivation, Tripathi, D.P.(2005) Oxford & IBH Publishing Co. PVT.LTD, New Delhi. - Mushroom Production and Processing Technology, Pathak Yadav Gour (2010) Published by Agrobios (India). - A hand book of edible mushroom, S.Kannaiyan& K.Ramasamy (1980). Today & Tomorrows printers & publishers, New Delhi			
Additional References:			
- The Kingdom Fungi: The Biology of Mushrooms, Molds, and Lichenss by Steven L. Stephenson - Handbook on Mushrooms, Nita Bahl, oxford & IBH Publishing Co.			

Course Code	Skill Enhancement Course – Sem-IV Practical	Credits	Lecture s/Week
24BTSE451	Dairy Technology	2	4
Course Outcomes: After successful completion of this course, students would be able to • To impart the knowledge of Milk flora and different test to check quality of milk . • To learn about different analytical techniques and apply that knowledge to different concepts. • To understand various techniques related to milk processing			
Topics			
1. Basic hygiene and facilities related milk industry 2. Pyne’s method for protein determination from the Milk sample. 3. MBRT and RRT for assessing the raw milk quality. 4. Phosphotase test for the given milk sample. 5. Optimize the microbial flora with the milk sample 6. Direct microscopic count of raw milk. 7. Determine the amount of casein present in the milk sample. 8. Preparation of paneer from the milk sample. 9. Preparation of yogurt from the milk sample. 10. Preparation of cheese from the milk sample. 11. Testing of adulterants from the milk sample. 12. To check the milk purity with the help of lactometer.			