AC 25.04.24 ITEM NO: 3.2

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 |
| | 24BTMJP31 | Practical-3( Cell Biology and Immunology +Molecular Biology and cytogenetics) | Major | 2 |
| | 24BTMRC321 | Chemistry | Minor | 2 |
| | 24BTMRCP321 | Practical (Chemistry) | Minor | 2 |
| | 24BTMRM322 | Microbiology | Minor | 2 |
| | 24BTMRMP322 | Practical (Microbiology) | Minor | 2 |
| | 24BTMRL323 | Life Science | Minor | 2 |
| | 24BTMRLP323 | Practical (Life Science) | Minor | 2 |
| | 24BTOE331 | Nanotechnology | OE | 2 |
| | 24BTVC341 | Bioenzyme | VSC | 2 |

| Semester | Course Code | Course Title | Vertical | Credit |
|---|---|---|---|---|
| **IV** | 24BTMJ411 | Medical microbiology | Major | 2 |
| | 24BTMJ412 | Environmental Biotechnology | Major | 2 |
| | 24BTMJP41 | Practical-4 (Medical microbiology + Environmental Biotechnology ) | Major | 2 |
| | 24BTMRC421 | Chemistry | Minor | 2 |
| | 24BTMRCP421 | Practical (Chemistry) | Minor | 2 |
| | 24BTMRM422 | Microbiology | Minor | 2 |
| | 24BTMRMP422 | Practical (Microbiology) | Minor | 2 |
| | 24BTMRL423 | Life Science | Minor | 2 |
| | 24BTMRLP423 | Practical (Life Science) | Minor | 2 |
| | 24BTOE431 | Study of Kingdom fungi | 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.<br>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<br>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<br>learn good oral and written communication skills as well as nurturing creativity |
| PO7 | Employee skill and knowledge in environmental management and sustainable development<br>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**<br><br>**Cell biology** | **Cytoskeleton :**<br>Overview of the Major Functions of Cytoskeleton.<br>Microtubules: Structure and Composition. MAPs: Functions- Role in Mitosis, Structural Support and Cytoskeleton Intracellular Motility.<br>**Motor Proteins:** Kinesins, Dynein; MTOCs.<br>Dynamic Properties of Microtubules.<br>Microtubules in Cilia and Flagella.<br>Microfilaments: Structure, Composition, Assembly and Disassembly.<br><br>**Motor Protein:** Myosin.<br>Muscle Contractility: Sliding Filament Model. Actin Binding Proteins : Examples of Non Muscle Motility.<br>Intermediate Filaments :Structure and Composition; Assembly and Disassembly; Types and Functions.<br><br>**Cell Membrane :**<br>Uptake of Nutrients by Prokaryotic Cells; Cell Permeability.<br>Principles of Membrane Transport Transporters and Channels; Active Transport,<br>Passive Transport; Types of Transporters; Types of ATP Driven Pumps - Na+ K+ Pump. | **15** |

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|---|---|---|
| **II**<br><br>**Immunology** | **Haematopoiesis:**<br><br>Cells of the Immune System;<br>Primary and Secondary Lymphoid Organs.<br>Complement System- Classical, Alternate and Lectin; Regulation and Biological Effects of Complement System; Deficiencies of Complement System<br><br>T-**cell Receptor Complex**:<br>Structure and Activation.<br>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.<br>**B-cell Receptor :**<br>Structure, Maturation and Activation<br>B-T Cell Interaction (B-T cell Cooperation)<br><br>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<br><br>Molecular Biology | **Transcription Process in Prokaryotes:**<br><br>RNA Synthesis; Promoters and Enhancers; Initiation of Transcription at Promoters; Elongation and Termination of an RNA Chain.<br>**Transcription in Eukaryotes :**<br>Eukaryotic RNA Polymerases; Eukaryotic Promoters; Transcription of Protein Coding Genes by RNA Polymerase; Eukaryotic mRNA's; Transcription of other genes; Spliceosomes; RNA editing.<br><br>**Translation**<br><br>Nature of Genetic Code.<br>Wobble Hypothesis.<br>Translation in Prokaryotes and Eukaryotes: Process of Protein Synthesis<br>(Initiation, Elongation, Translocation, Termination); | 15 |

| | | |
|---|---|---|
| **II**<br><br>**Cytogenetics** | **Cytogenetics:**<br><br>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.<br>Sex Determination and Sex Linkage : Mechanisms of Sex Determination (XX-XY, ZZ-ZW, XX-XO)<br>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 0r 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 |
|---|---|---|---|
| **24BTMJP31** | **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) - HEPELISA.
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 | Credits | Lectures/ Week |
|---|---|---|---|
| **24BTMRC321** | **Chemistry** | **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**<br>**Physical chemistry** | Thermodynamics: System, Surrounding, Boundaries Sign Conventions, State Functions, Internal Energy and Enthalpy: Significance, examples, (Numericals expected.)<br>Laws of Thermodynamics and its Limitations<br>Reaction Kinetics:<br>Rate of Reaction, Rate Constant, Measurement of Reaction Rates Order & Molecularity of Reaction.<br>Principles of Oxidation & Reduction Reactions<br>Oxidizing and Reducing Agents | **15** |
| **II**<br>**Biochemistry** | 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)<br>Electron Transport System :<br>Electron Transport and Oxidative Phosphorylation.<br>Inhibitors of ETS | **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.,VictorR.;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** | **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-** | **Credits** | **Lectures/ Week** |
|---|---|---|---|
| **24BTMRM322** | **Microbiology-** | **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**<br>**General Bacteriology and Bacteria as Human pathogen, Host parasite interactions** | **Host Parasite Relationship:**<br>Normal Flora; Factors Affecting the Course of Infection and Disease; Mechanisms of Infection and Virulence Factors.<br>**Infection:**<br>Patterns of Infection; Types of Infections; Signs and Symptoms; Epidemiology and Epidemiological Markers.<br>**Diseases:**<br>Origin of Pathogens; Vectors; Acquisition of Infection; Koch's Postulates. | **15** |
| **II**<br>**Causative organisms-** | **Skin:**<br>*S. aureus, S. pyogenes.*<br>**Respiratory Tract Infections:**<br>*M. tuberculosis, S. pneumoniae* (Characteristics Transmission, Course of Infection, Lab Diagnosis, Management of TB, Prevention and Control, Immuno and Chemoprophylaxis, DOTS and MDR).<br>**Urinary Tract Infections:**<br>*E.coli* : Characteristics, Virulence, Clinical disease, and *E.coli* 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** | **Credits** | **Lectures/ Week** |
|---|---|---|---|
| **24BTMRMP322** | **Microbiology** | **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 *S.aureus* using selective and differential media
3. Identification of *S.aureus*- Catalase, Coagulase Test.
4. Isolation of *E.coli* using selective and differential media
5. Identification of *E.coli*- Sugar Fermentations, IMViC.
6. Isolation of *Salmonella* using selective and differential media
7. Identification of *Salmonella*- Sugar Fermentations, TSI Slant.
8. Isolation of *Shigella* using selective and differential media
9. Identification of *Shigella*-, Sugar Fermentations, TSI Slant.
10. Isolation of *Pseudomonas* using selective and differential media
11. Identification of *Pseudomonas* - Urease test, Oxidase Test, TSI Slant.

| Course Code | Minor SEM III - Life science | Credits | Lectures/ Week |
|---|---|---|---|
| **24BTMRL323** | **Life science** | **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**<br><br>**Basics of molecular diagnostics** | Introduction to Molecular Diagnostics : Overview of Molecular Diagnostics; History of Molecular Diagnostics; Molecular Diagnostics in Post Genomic Era; Areas used in Molecular Diagnostics; Future Prospects - Commercialising Molecular Diagnostics, Personalized Medicine, Theranostics.<br>Characterisation and analysis of Nucleic – Acids and Proteins :<br>Extraction, Isolation and Detection of DNA, RNA and Proteins; Restriction Endonucleases and Restriction Enzyme Mapping.<br>Hybridisation Techniques :<br>Southern, Northern, Western and FISH; Markers, Probes and its Clinical Applications. | **15** |

| | | |
|---|---|---|
| **II**<br>**Molecular biology based diagnostics** | DNA Polymorphism and Identification: RFLP and Parentage Testing;<br>RFLP and Sickle -Cell Anaemia.<br>Genetic Counseling and Molecular Diagnosis<br>Genetic Testing<br>- Need and Uses; genetic Counseling.<br>Case Studies<br>- Diagnostic Testing for Cystic Fibrosis; Fragile X Diagnostic and Carrier Testing.<br>Ethical, Social and Legal Issues to Molecular Genetic Testing | **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 | Credits | Lectures/ Week |
|---|---|---|---|
| **24BTMRLP323** | **Life Science** | **2** | **4** |

**Course Outcomes:**

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

- 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

# Semester III

| Course Code | OE SEM – III | Credits | Lectures/Week |
|---|---|---|---|
| **24BTOE331** | **Nanotechnology** | **2** | **2** |

**Course Outcomes:**

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

- Recall the definition of nanotechnology, its fundamental principles, anomaterials and their unique properties at the nanoscale.
- Explain the impact of nanotechnology on fields such as materials science, medicine, electronics, and energy.
- Apply principles of nanotechnology to propose innovative solutions to real-world challenges.
- Analyze the ethical, social, and environmental implications of nanotechnology advancements.

| Unit | Topics | No of Lectures |
|---|---|---|
| **I**<br>**Introduction to Nanotechnology** | Introduction to Nanotechnology<br>Principal and implication of Nanotechnology<br>Nanoscience, Nanoscales<br>History of Nanotechnology<br>Fundamental Nanoeffect<br>Nanoscience in nature | **15** |
| **II**<br>**Importance Nanotechnology** | Introduction of Nanomaterial<br>Forms of Nanomaterial: Nanoparticles, Nanoflims, Nanotubes<br>Synthesis and Characterization of Nanomaterial<br>Applications of Nanomaterial | **15** |

**Textbooks:**

- Introduction to Nanoscience and Nanotechnology by Alain Nouailhat Vol 10
- Nanotechnologies: Principles, Applications, Implications and Hands-on Activities By Union européenne.

- **Additional References:**

- Nanotechnology: Principles and Practices by Sulabha K. Kulkarni and Sunil B. Karanjkar -

| Course Code | VSC-2– Practicals Sem-III | Credits | Lectures/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**<br><br>**Viral and fungal diseases** | Pathogenesis, clinical symptoms, laboratory diagnosis, epidemiology, prophylaxis and treatment of Viral diseases<br>Air borne viral diseases:<br>Influenza ,measles, COVID<br>Vector Borne viral diseases:<br>(Dengue, AIDS, Rabies).<br>Fungal diseases- transmission, symptoms and prevention of cutaneous mycoses (Athlete's foot),<br>systemic mycoses (Histoplasmosis) and opportunistic mycoses (Candidiasis) | **15** |

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|---|---|---|
| **II**<br>**Chemotherapeutic agents** | Discovery and Design of antimicrobial agents; Classification of Antibacterial agents, Selective toxicity, MIC, MLC<br>Inhibition of cell wall synthesis (Mode of action for): Beta lactam antibiotics: Penicillin, Cephalosporins; Glycopeptides: Vancomycin; Polypeptides: Bacitracin<br>Injury to Plasma membrane: Polymyxin;<br>Inhibition of protein synthesis Aminoglycosides,<br>Tetracyclines Chloramphenicol, Macrolides Erythromycin;<br>Inhibition of Nucleic acid synthesis: Quinolones, Rifampicin, Metronidazole ;<br>Antimetabolites: Sulphonamides, Trimethoprim<br>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**<br><br>**Environmental Pollution, Global Environmental Problems and Issues** | **Air Pollution and Water Pollution :**<br>Types; Sources; Classification of Air Pollutants; Air Pollution Monitoring and Control.<br>**Soil and Solid Waste Pollution :**<br>Characteristics of Wastes, Impacts of Solid Waste on Health, Occupational Hazards and Control.<br>**Green House Effect :**<br>Factors Responsible for Green House Effect; Green House Gases.<br>Global Warming; Ozone Depletion; Kyoto Protocol; UV Radiation; Acid Rain | **15** |
| **II**<br><br>**Bioremediation** | Concept of Bioremediation.<br>Microorganisms in Bioremediation, Mycoremediation and Phytoremediation.<br>Bioremediation Technologies.<br>Measuring Bioremediation in the Field.<br>Bioaugmentation and Biostimulation.<br>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 | Lectures/Week |
|---|---|---|---|
| 24BTMJP41 | 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 | Credits | Lectures/ Week |
|---|---|---|---|
| **24BTMRC421** | **Chemistry** | **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**<br><br>**Applied Chemistry** | Introduction to Types of Organic Reactions : Addition, Elimination and Substitution Reactions.<br>Essential and Non-essential Elements in Biological Systems.<br>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**<br><br>**Biophysics** | **Chromatography**<br>Paper Chromatography, Ion exchange chromatography; size exclusion chromatography; affinity chromatography;<br>**Fluid Dynamics :**<br>Viscosity:<br>Definition Flow of Liquids through<br>Capillaries; Stokes' Law; Terminal Velocity. Determination of<br>'η' by Falling Sphere<br>Method; Viscosity Estimation by Oswald's Viscometer.<br>Surface Tension:<br>Definition –<br>Surface Tension and Surface Energy; Capillary<br>Action; Angle of Contact;<br>Wettability; Temperature Dependence of Surface Tension.<br>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.,VictorR.;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 | 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 | Credits | Lectures/ Week |
|---|---|---|---|

| | | | |
|---|---|---|---|
| **24BTMRM422** | **Microbiology** | **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**<br><br>**Fermentor design , media and sterilization** | **Fermentor designs:**<br>Air lift fermentor, Tower fermentor,Acetator and cavitator, deep jet, packed Tower<br>Fermentation Media:<br>Media components :<br>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<br>Antifoam agents- Types , Properties of Antifoam agent<br>Medium properties: Fast metabolism,Rheology<br>Concept of Inoculum and Production Media<br>Sterilization :<br>Sterilization of Fermentor and Fermentation Media.<br>Sterilization of Media -Batch and Continuous<br>Concept of Del factor<br>Sterilization of Fermentor, feeds, liquid wastes<br>Sterilization of Air Supply, Exhaust gases<br>Filter sterilization | **15** |

| | | |
|---|---|---|
| **II**<br><br>**Fermentation processes-1** | . Types of fermentations and fermentation process<br>Significance and applications of<br>Batch and continuous,<br>surface and submerged,<br>aerobic and anaerobic,<br>Solid state fermentation.<br>● Industrial products from MicroorganismsPenicillin,semisynthetic penicillin, Streptomycin,<br>Vaccines, hormones<br>● Enzymes and Organic acids from<br>Microorganisms:<br>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** | **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** | **Credits** | **Lectures/ Week** |
|---|---|---|---|
| **24BTMRL423** | **Life science** | **2** | **2** |

**Course Outcomes:**

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

- Recall the principles of reverse transcriptase PCR
- Understand the applications and advantages of RT-PCR and real-time PCR in gene expression analysis, viral detection, and molecular diagnostics.
- Apply statistical methods to analyze experimental data and assess the strength and direction of relationships between variables.
- Analyze hypothesis test results to make decisions about accepting or rejecting hypotheses based on calculated test statistics and significance levels.

| **Unit** | **Topics** | **No of Lectures** |
|---|---|---|

| | | |
|---|---|---|
| **I**<br><br>**Nucleic acid amplification methods** | Target amplification :<br>PCR - General Principle; Components of a Typical PCR Reaction; Experimental Design; Primer Designing; Control of PCR Contamination and Mispriming; PCR Product Clean-up and Detection.<br>PCR Types :<br>Reverse Transcriptase and Real Time PCR.<br>Probe amplification :<br>Ligase Chain Reaction | **15** |
| **II**<br><br>**Biostatistics** | Theory and Problems based on- Coefficient of Correlation and Regression Analysis; Steps in Testing Statistical Hypothesis; Parametric Tests:- z Test – Single Mean and Two Means, t-Test – Single Man, Paired and Unpaired; Chi Square Test. | **15** |

**Textbooks:**

- Molecular Diagnostics: Fundamentals, Methods, and Clinical Applications Third Edition, Lela Buckingham.
- Methods in Biostatistics- B. K. Mahajan –Jaypee Brothers

**Additional References:**

- Introductory Biostatistics. 1st edition. (2003), Chap T. Le. John Wiley, USA
- Methods in Biostatistics- B. K. Mahajan –Jaypee Brothers
- Introductory Biostatistics. 1st edition. (2003), Chap T. Le. John Wiley, USA

| **Course Code** | **Practical of Minor** | **Credits** | **Lectures/ Week** |
|---|---|---|---|
| **24BTMRLP423** | **Life science** | **2** | **4** |

**Course Outcomes:**

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

- Apply PCR techniques to amplify DNA inserts for cloning into plasmid vectors.
- Analyze z test and t-test results to determine whether differences between sample means are statistically significant based on calculated test statistics and critical values.
- Analyze the results of PCR amplification to confirm the successful amplification of the target DNA sequence.

**Topics**

1. Amplify a specific DNA sequence using PCR.(Demonstration)
2. PCR for Cloning and Plasmid Screening:
3. Detection of Transgenic DNA by PCR
4. Reverse Transcriptase and Real Time PCR.
5. Problems based on correlation
6. Problems based on t test,
7. Problems based on z-test
8. Problems based on Chi Square Test
9. Problems based on Regression

# Semester IV

| Course Code | OE SEM – IV | Credits | Lectures/Week |
|---|---|---|---|
| **24BTOE431** | **Study of Kingdom Fungi** | **2** | **2** |

**Course Outcomes:**

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

- Recall the basic characteristics of fungi, including their cellular structure, reproduction methods, and ecological roles.
- Explain the significance of fungi in various ecosystems, including their roles as decomposers, pathogens, and symbiotic partners.
- Apply knowledge of fungal morphology and ecology to identify common fungi.
- Compare the composition and diversity of fungal communities in different habitats

| Unit | Topics | No of Lectures |
|---|---|---|
| **I**<br>**Introduction to Fungi** | History of Mycology,<br>Introduction to Kingdom Fungi and fungal-like organisms,<br>Diversity of fungi and fungus-like organisms<br>Ecological roles of fungi<br>The fungal body and cells | **15** |
| **II**<br>**Importance of Fungi** | Modes of nutrition in Fungi.<br>Fungi as symbionts: Lichens<br>Fungi as symbionts: Mycorrhizae<br>Applications of Fungi<br>Economic importance of Fungi | **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
- Introduction to Mycology in India" by K.C. Mehta

- **Additional References:**

- "The Kingdom Fungi: The Biology of Mushrooms, Molds, and Lichens" by Steven L. Stephenson:

| Course Code | SEC-2 – Practical Sem-IV | Credits | Lectures/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.

## Evaluation Scheme for Second Year (UG) under NEP (2 credits)

### I. Internal Evaluation for Theory Courses – 20 Marks

**1) Continuous Internal Assessment(CIA) Assignment** - Tutorial/ Project / Presentations/ Group Discussion / Ind. Visit. – 10 marks

**2) Continuous Internal Assessment(CIA)** ONLINE Unit Test – 10 marks

### II. External Examination for Theory Courses – 30 Marks

Duration: 1 Hour

Theory question paper pattern: All questions are compulsory.

| Question | Based on | Marks |
|---|---|---|
| Q.1 | Unit I | 15 |
| Q.2 | Unit II | 15 |

- All questions shall be compulsory with internal choice within the questions.
- Each Question may be sub-divided into sub questions as a, b, c, d, etc. & the allocation of Marks depends on the weight age of the topic.

### III. Practical Examination

- Each core subject carries 50 Marks.( 30 marks external+20 marks internal)
- Duration: 2 Hours for each practical course.
- Certified Journal is compulsory for appearing at the time of Practical Exam

**NOTE: To pass the examination, attendance is compulsory in both Internal & External (Theory + Practical) Examinations.**