DOMBIVLI SHIKSHAN PRASARAK MANDAL’S,
K.V. PENDHARKAR COLLEGE OF ARTS, SCIENCE AND
COMMERCE, (AUTONOMOUS) DOMBIVLI (EAST), DIST. THANE
(Affiliated to University of Mumbai)

Faculty of Science
DEPARTMENT OF BIOTECHNOLOGY
(Programme: Bachelor of Science, B.Sc.)

SYLLABUS FOR
F. Y. B.Sc. – Biotechnology (Semester I and II)
Choice Based Credit System (CBCS)

(with effect from the Academic Year: 2021-2022)
## Semester – I

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Type</th>
<th>Course Title</th>
<th>Credits</th>
<th>Lectures/Week</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUSBTI21-171</td>
<td>Core Subject</td>
<td>Basic Chemistry-I</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>PUSBTI21-172</td>
<td>Core Subject</td>
<td>Bioorganic Chemistry</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>PUSBTI21-173</td>
<td>Core Subject</td>
<td>Biodiversity and Cell Biology</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>PUSBTI21-174</td>
<td>Core Subject</td>
<td>Microbial Techniques</td>
<td>2</td>
<td>3</td>
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<tr>
<td>PUSBTI21-175</td>
<td>Core Subject</td>
<td>Introduction to Biotechnology</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>PUSBTI21-176</td>
<td>Core Subject</td>
<td>Molecular Biology</td>
<td>2</td>
<td>3</td>
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<tr>
<td>PUAFCI21-141</td>
<td>Ability Enhancement</td>
<td>Foundation Course I</td>
<td>2</td>
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<td>Core Subject</td>
<td>Practicals of PUSBTI21-171 and PUSBTI21-172</td>
<td>6</td>
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<tr>
<td>PUSBTI21-P2</td>
<td>Core Subject</td>
<td>Practicals of PUSBTI21-173 and PUSBTI21-174</td>
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<tr>
<td>PUSBTI21-P3</td>
<td>Core Subject</td>
<td>Practicals of PUSBTI21-175 and PUSBTI21-176</td>
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## Semester – II

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<tbody>
<tr>
<td>PUSBTII21-271</td>
<td>Core Subject</td>
<td>Basic Chemistry-II</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>PUSBTII21-272</td>
<td>Core Subject</td>
<td>Physical Chemistry</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>PUSBTII21-273</td>
<td>Core Subject</td>
<td>Physiology and Ecology</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>PUSBTII21-274</td>
<td>Core Subject</td>
<td>Genetics</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>PUSBTII21-275</td>
<td>Core Subject</td>
<td>Tissue Culture &amp; Dairy Technology</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>PUSBTII21-276</td>
<td>Core Subject</td>
<td>Enzymology, Immunology and Biostatistics</td>
<td>2</td>
<td>3</td>
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<tr>
<td>PUAFCI21-242</td>
<td>Ability Enhancement Course 2 (FC II)</td>
<td>Foundation Course II</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>PUSBTII21-P1</td>
<td>Core Subject Practicals</td>
<td>Practicals of</td>
<td>6</td>
<td>18</td>
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<tr>
<td>PUSBTII21-P2</td>
<td></td>
<td>PUSBTII21-271 and PUSBTII21-272</td>
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<tr>
<td>PUSBTII21-P3</td>
<td></td>
<td>PUSBTII21-273 and PUSBTII21-274</td>
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<tr>
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<td></td>
<td>PUSBTII21-275 and PUSBTII21-276</td>
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SEMESTER – I

THEORY
## SEMESTER I

**Basic chemistry – I**

<table>
<thead>
<tr>
<th>COURSE CODE</th>
<th>TITLE</th>
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</tr>
</thead>
<tbody>
<tr>
<td>PUSBT121-171</td>
<td>Basic Chemistry I</td>
<td>2</td>
</tr>
</tbody>
</table>

**Course Objective:** To acquaint the students with basic concepts of Chemistry.

**Learning Outcome:** By the end of the course the student will be able to:

- Classify and name inorganic and organic compounds based on IUPAC system.
- Understand concepts on various chemical bonds & their role in biological compounds.
- Learn the role of water in biology & preparation of buffers of different pH.

### Unit I
**Nomenclature and Classification**

- Nomenclature and Classification of Inorganic Compounds: Oxides, Salts, Acids, Bases, Ionic, Molecular and Coordination Compounds

15 Lectures

### Unit II
**Chemical Bonds**

- Ionic Bond: Nature and Structure of Ionic Bond, Factors influencing the formation of Ionic Bond.
- Covalent Bond: Nature and Structure of Covalent Bond
- Coordinate Bond: Nature of Coordinate Bond
- Van Der Waals forces: dipole - dipole, dipole-induced dipole, ion-dipole interaction.

15 Lectures
Unit III
Water and Buffers

Chemistry of Water:

Solutions: Normality, Molarity, Molality, Mole fraction, Mole concept, Solubility, Weight ratio, Volume ratio, Weight to Volume ratio, ppb, ppm, millimoles, milliequivalents (Numericals expected).


Buffer solutions – Concept of Buffers, Types of Buffers, Derivation of Henderson equation for Acidic and Basic buffers, Buffer action, Buffer capacity (Numericals expected.)

pH of Buffer Solution.

Learning space

Natural sources of organic compounds, Industrial importance of buffers.

Reference Books

1. Concise Inorganic Chemistry. 5th edition (2008), Author: J. D. Lee, John Wiley & Sons, USA.
4. Inorganic chemistry, Shriver & Atkins

ICT Backup
1. https://youtu.be/1A-M1zA0uL0
2. https://youtu.be/JO8w_BnX-w4
SEMESTER I

Bioorganic Chemistry

<table>
<thead>
<tr>
<th>COURSE CODE</th>
<th>TITLE</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUSBT121-172</td>
<td>Bioorganic Chemistry</td>
<td>2</td>
</tr>
</tbody>
</table>

Course Objectives: To acquaint students with Bioorganic Molecules.

Learning Outcomes: By the end of the course the student will be able to:

- Describe the Classification, Structure and Functions of various Carbohydrates & Lipids.
- Understand Amino acids & their role, Protein structure and conformation.
- Understand the Structure, Properties, Types and importance of nucleic acids.

<table>
<thead>
<tr>
<th>Unit I</th>
<th>Biomolecules: Carbohydrates and Lipids</th>
<th>15 lectures</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Carbohydrates:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>General functions of Carbohydrates</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nomenclature: Classification based on simple sugars (mono, oligo, poly)</td>
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<tr>
<td></td>
<td>Classification based on carbonyl function (aldose, ketose)</td>
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<tr>
<td></td>
<td>Structure, Physical and Chemical properties of Monosaccharides</td>
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<td></td>
<td>Stereoisomers of monosaccharides.</td>
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<tr>
<td></td>
<td>Complex Carbohydrates: Structure and Types of Oligosaccharides and Polysaccharides</td>
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<tr>
<td></td>
<td>Chemical Reactions for Detection of Mono., Di and Polysaccharides</td>
<td></td>
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<tr>
<td></td>
<td>Lipids:</td>
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<tr>
<td></td>
<td>General functions of Lipids, Classification of Lipids</td>
<td></td>
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<td></td>
<td>Structure and Characteristics of Fatty acids</td>
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<tr>
<td></td>
<td>Structure and Functions: Triacylglycerol, Phospholipids, Glycolipids and Lipoproteins</td>
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<tr>
<td></td>
<td>Steroids: Structure and Function of Cholesterol</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Amphipathic lipids</td>
<td></td>
</tr>
</tbody>
</table>
| Unit II | Biomolecules: Proteins and Amino Acids | Amino acids: Properties, Structure, Function and classification  
Chemical tests, Ionization and Titration Curve of Amino Acids.  
Concept of Isoelectric pH, Zwitter ion.  
Proteins: Classification based on Structure and Functions.  
Denaturation of protein. | 15 lectures |
| --- | --- | --- |
| Unit III | Biomolecules: Nucleic Acids | Structure of Nitrogenous Bases, Nucleosides, Nucleotides, Polynucleotides.  
Hydrogen Bonding between Nitrogenous Bases in DNA.  
Properties, Types and Functions of DNA and RNA.  
Differences between DNA and RNA. | 15 lectures |

**Learning space**

Extraction of biomolecules of industrial significance from natural sources.

**Reference Books**


**ICT Backup**

2. [http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000002BI/P000991/M016863/ET/1467781981module21Phospholipids.pdf](http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000002BI/P000991/M016863/ET/1467781981module21Phospholipids.pdf)
acids/a/orders-of-protein-structure

# SEMESTER I

**Biodiversity and Cell Biology**

<table>
<thead>
<tr>
<th>COURSE CODE</th>
<th>TITLE</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUSBTI21-173</td>
<td>Biodiversity and Cell Biology</td>
<td>2</td>
</tr>
</tbody>
</table>

**Course Objectives:** To acquaint students with concept of diversity in Biology, particularly in relation to plant, animal, and microbial diversity & to introduce the various types of experimental models used in Biological Sciences.

**Learning Outcome:** By the end of the course the student will be able to understand:

- The process of origin of life and concept of diversity in biology.
- The basic structure and functions of prokaryotic cells.
- The ultrastructure and functions of sub cellular organelles of eukaryotic cells and cell cycle.
- Some popularly used model organisms and their role in understanding biological processes.

### Unit I

**Origin of Life and Ultrastructure of Prokaryotic Cell**

- Origin of Life (Chemical and Biological Evolution, Origin of Eukaryotic Cell)
- **Ultrastructure of Prokaryotic Cell:** Concept of Cell Shape and Size. Detail Structure of Slime Layer, Capsule, Flagella, Pilli, Cell Wall (Gram Positive and Negative), Cell Membrane, Cytoplasm and Genetic Material Storage Bodies and Spores.

<table>
<thead>
<tr>
<th>Unit II</th>
<th>Ultrastructure of Eukaryotic Cell:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Organelles of the Biosynthetic- Endoplasmic Reticulum &amp; Golgi Apparatus.</td>
</tr>
<tr>
<td></td>
<td>Lysosome, Endocytosis, Phagocytosis, Autophagy, Proteasome.</td>
</tr>
</tbody>
</table>

15 Lectures
External Cell Coverings: Cilia and Flagella.
Comparison of Prokaryotic and Eukaryotic Cells

<table>
<thead>
<tr>
<th>Unit III</th>
<th>Concept of Biodiversity (Taxonomical, Ecological and Genetic Diversity &amp; its Significance)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biodiversity and its conservation</td>
<td>Introduction to Microbial Diversity: Habitats, Examples and Applications of Archaebacteria, Eubacteria, Blue-green Algae, Actinomycetes, Eumycota, Viruses.</td>
</tr>
<tr>
<td>Overview of Plant and Animal diversity</td>
<td>Experimental model organism- <em>Escherichia coli</em>, <em>Arabidopsis thaliana</em>, <em>Drosophila melanogaster</em> and <em>Mus musculus</em>.</td>
</tr>
<tr>
<td></td>
<td>Biotechnology in Biodiversity conservation-Gene banks &amp; its types-Seed banks, pollen banks, DNA banks, Cryobiology</td>
</tr>
<tr>
<td></td>
<td>15 Lectures</td>
</tr>
</tbody>
</table>

**Learning space**

Field visits to understand biodiversity, collaboration with NGOs or enthusiastic naturalists groups, contribution of different model organisms in research.

**Reference Books**

4. iGenetics, A Molecular Approach -3rd edition, Peter J. Russel

**ICT Backup**

2. https://youtu.be/VTolGEpg5Z0
Course Objectives: To acquaint students with basic techniques in Microbial nutrition, Enumeration and Asepsis.

Learning Outcome: By the end of the course the student will be able to:

- To provide a basic understanding of the significance and methods of sterilization.
- To impart skill in handling and culture of Microorganisms.
- To reinforce the use of microscope and study the various types of stains and staining methods to be used for visualization of specimens.

<table>
<thead>
<tr>
<th>Unit I</th>
<th>Microscopy and Stains</th>
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</table>

<table>
<thead>
<tr>
<th>Unit II</th>
<th>Sterilization Techniques</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sterilization and Disinfection Types and Applications: Dry Heat, Moist Heat, Gases, Radiation and Filtration Chemical Agents and their Mode of Action-Aldehydes, Halogens, Quaternary Ammonium Compounds, Phenol and Phenolic Compounds, Heavy Metals, Alcohol, Dyes, and Detergents Characteristics of Ideal Disinfectants and its evaluation</td>
</tr>
</tbody>
</table>
Unit III
Nutrition, Cultivation and Enumeration of Microorganisms

Nutrition and Cultivation of Microorganisms:
- Nutritional Requirements and Classification of Different Nutritional Types of Organisms.
- Design and Types of Culture Media
- Concept of Isolation and its Method
- 15 lectures

Learning space
Development of own microscope using lenses, project on isolation of microorganisms from various sources.

Reference Books
3. Fundamentals of Microbiology by Frobisher, Thomson Learning; 9th edition

ICT Backup
1. https://www.britannica.com/technology/microscope
2. https://nios.ac.in/media/documents/dmlt/Microbiology/Lesson-02.pdf
3. https://nios.ac.in/media/documents/dmlt/Microbiology/Lesson-04.pdf
4. https://nios.ac.in/media/documents/dmlt/Microbiology/Lesson-03.pdf
5. https://www.uwyo.edu/virtual_edge/lab05/nutritional.htm
6. https://www.uwyo.edu/virtual_edge/lab05/enumeration.htm
**SEMESTER I**

**Introduction to Biotechnology**

<table>
<thead>
<tr>
<th>COURSE CODE</th>
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<tbody>
<tr>
<td>PUSBTI21-175</td>
<td>Introduction to Biotechnology</td>
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</table>

**Course Objectives:** To acquaint students with the various fields in Biotechnology, different applications of Biotechnology & an understanding of Agriculture, Food & Fermentation Biotechnology.

**Learning Outcome:** At the end of this course the student would have a good understanding of:

- The field of Biotechnology, its scope and applications.
- Well familiar with a very important aspect of Agriculture biotechnology.
- Basic of Food biotechnology with food processing technology & Fermentation Techniques with industrial application and scope.

<table>
<thead>
<tr>
<th>Unit I</th>
<th>History, Introduction and Scope of Biotechnology</th>
<th>15 lectures</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Branches of Biotechnology</td>
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<tr>
<td></td>
<td>Biotechnology Institutions in India (Public and Private Sector), Biotechnology Research in India, Biotech Success Stories, Biotechnology in context of Developing World, Public Perception of Biotechnology, Ethics in Biotechnology</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Unit II</th>
<th>Genetically Modified Crops</th>
<th>15 lectures</th>
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<tbody>
<tr>
<td></td>
<td>GM Technology for Improved Nutritional quality: GM Tomato, Golden rice</td>
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<tr>
<td></td>
<td>GM Technology for Biotic stress: Pest and Virus resistant plant</td>
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<tr>
<td></td>
<td>GM Technology for Abiotic stress: Salt, cold and drought resistant plant</td>
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<tr>
<td></td>
<td>Molecular Pharming in plants, Plant Based Vaccines</td>
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<tr>
<td>Unit III</td>
<td>Food and Fermentation Biotechnology</td>
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<tr>
<td><strong>Food Biotechnology:</strong></td>
<td>15 lectures</td>
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<tr>
<td>Biotechnological applications in enhancement of Food Quality</td>
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<tr>
<td>Unit Operation in Food Processing</td>
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<tr>
<td>Quality Factors in Pre-processed Food</td>
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<tr>
<td>Food Deterioration and its Control</td>
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<td></td>
</tr>
<tr>
<td>Microbial role in food products</td>
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<tr>
<td>Modern Biotechnological Regulatory Aspects in Food Industries.</td>
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<tr>
<td><strong>Fermentation Technology:</strong> Definition, Applications of Fermentation Technology</td>
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<tr>
<td><strong>Overview of Microbial Fermentations:</strong></td>
<td></td>
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<tr>
<td>Acetic Acid, Citric Acid, Antibiotics, Enzymes and Beverages</td>
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</tr>
</tbody>
</table>

**Learning space**

Collecting information on Biotechnology industries in India and abroad, interviewing an entrepreneur in biotechnology sector, developing model of genetically modified organism.

**Reference Books**

1. Advanced Biotechnology, 1st edition by R.C. Dubey, S Chand publications
2. Biotechnology: Fundamentals and Applications by S. S. Purohit, 1 January 2005, Agrobios (India)
3. Industrial Microbiology- L. E. Casida- John Wiley &Sons

**ICT Backup**

1. https://www.encyclopedia.com/medicine/medical-magazines/biotechnology-ethical-issues


# SEMESTER - I
## Molecular Biology

<table>
<thead>
<tr>
<th>COURSE CODE</th>
<th>TITLE</th>
<th>CREDITS</th>
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<tbody>
<tr>
<td>PUSBTI21-176</td>
<td>Molecular Biology</td>
<td>2</td>
</tr>
</tbody>
</table>

**Course Objectives:** To acquaint students with DNA replication, recombination, mutation and repair & Tools in Genetic Engineering.

**Learning Outcome:** By the end of the course the student will be able to:

- Learn the molecular details of DNA replication.
- Understand the reasons for DNA mutations and mechanism of DNA repair & recombination.
- Understand concepts of cloning vectors & enzymes used in genetic engineering.

<table>
<thead>
<tr>
<th>Unit I</th>
<th><strong>DNA Replication in Prokaryotes and Eukaryotes:</strong> 15 lectures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replication</td>
<td>Semi-conservative DNA replication</td>
</tr>
<tr>
<td></td>
<td>DNA Polymerases and its role</td>
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<tr>
<td></td>
<td>E. coli Chromosome Replication, Bidirectional</td>
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<tr>
<td></td>
<td>Replication of Circular DNA molecules.</td>
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<td></td>
<td>Rolling Circle Replication</td>
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<td></td>
<td>DNA Replication in Eukaryotes</td>
</tr>
<tr>
<td><strong>DNA Recombination:</strong></td>
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<td></td>
<td>Holliday Model for Recombination</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Unit II</th>
<th><strong>Mutation and DNA Repair:</strong> 15 lectures</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Definition and Types of Mutations. Mutagenesis and Mutagens. (Examples of Physical, Chemical and Biological Mutagens)</td>
</tr>
<tr>
<td></td>
<td>Types of Point Mutations, DNA repair</td>
</tr>
<tr>
<td></td>
<td>Photoreversal, Base Excision Repair, Nucleotide Excision Repair, Mismatch Repair, SOS Repair and Recombination Repair.</td>
</tr>
</tbody>
</table>
Unit III
Introduction to Genetic Engineering

<table>
<thead>
<tr>
<th>Basics of Genetic Engineering (Recombinant DNA Technology)</th>
<th>15 lectures</th>
</tr>
</thead>
<tbody>
<tr>
<td>History of Genetic Material.</td>
<td></td>
</tr>
<tr>
<td>Molecular Cloning and Cloning Vectors-Plasmids, Cosmids and Lambda bacteriophage</td>
<td></td>
</tr>
<tr>
<td>Enzymes- DNA Polymerases, Restriction Endonucleases and its types, Ligases, Reverse transcriptases, Nucleases, Terminal Transferases, Phosphatases &amp; Kinases, Topoisomerases.</td>
<td></td>
</tr>
<tr>
<td>Evolution in Enzymology: KLenow Polymerases, Taq DNA polymerases, T7 DNA polymerases</td>
<td></td>
</tr>
</tbody>
</table>

Learning space

Preparing working model of replication, project on effect of mutagens.

Reference Books

1. iGenetics, A Molecular Approach-3rd edition, Peter J. Russell
4. Genetic Engineering: Principles and Practice, Sandhya Mitra (Author)

ICT Backup

1. https://www.youtube.com/watch?v=TNKWgcFPHqw
2. https://www.youtube.com/watch?v=mCaFgwWH61o
## SEMESTER – I

### Practical

<table>
<thead>
<tr>
<th>COURSE CODE</th>
<th>TITLE</th>
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<tbody>
<tr>
<td>PUSBT121-P1</td>
<td>Practicals in PUSBT121-171 and PUSBT121-172</td>
<td>2</td>
</tr>
</tbody>
</table>

1. Pre-practical discussion (Safety measures, Hazards identification, MS-DS data sheet)
2. Safety Measures and Practices in Chemistry Laboratory, Working and use of a Digital Balance, Functioning and Standardization of \( \text{pH} \) Meter, Optical Activity of a Chemical Compounds by Polarimeter
3. Preparation of Standard (Molar, Molal and Normal solutions) and Buffer Solutions. Determination of strength of HCl in commercial sample.
4. Qualitative Analysis of Inorganic Compounds - Three experiments
7. Standardization of Colorimeter and Estimation of Reducing sugar by DNSA method.
8. Estimation of Protein by Biuret method and Lowry method.
9. Saponification of Fats, Saponification Value of Oil or Fat, Iodine value of Oil and determine the rate constant for the saponification reaction between ethyl acetate and NaOH by back titration method.
1. Components and working of Simple, Compound, Dark Field, Fluorescent and Phase Contrast Microscope.
2. Staining of Plant and Animal Tissues using Single and Double Staining Techniques.
5. Study of Photomicrographs of Cell Organelles.
7. Preparation of Media- Nutrient broth and Agar, MacConkey Agar, Sabourauds Agar.
8. Isolation of Organisms: T-streak, Polygon method.
9. Enumeration of microorganisms by Serial Dilution, Pour Plate, Spread Plate Method.
10. Colony Characteristics of Microorganisms, Enumeration by Breed’s count.
<table>
<thead>
<tr>
<th>COURSE CODE</th>
<th>TITLE</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUSBTI21-P3</td>
<td>Practicals in PUSBTI21-175 and PUSBTI21-176</td>
<td>2</td>
</tr>
</tbody>
</table>

1. Assignment- Study of any branch of biotechnology and its applications.
2. Microbial examination of food and detection of Pathogenic Bacteria from Food Samples.
3. Isolation of organisms causing Food Spoilage.
4. Microscopic determination of Microbial flora from Yoghurt and Lactic Acid Determination.
5. Extraction of Casein from Milk.
7. Fermentative production of Alcohol.
8. Determination of Alcohol content.
9. Extraction of genomic DNA from plant material.
## MOOC Details (FY Biotechnology)

### Semester I

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Paper &amp; Unit</th>
<th>Details of the course</th>
<th>Link for reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PUSBTI21-176</td>
<td><strong>Swayam</strong> Genetic engineering: Theory and Applications&lt;br&gt;Duration: 12 weeks&lt;br&gt;Start date: 26 July&lt;br&gt;Free enrolment, Paid certificate</td>
<td><a href="https://onlinecourses.nptel.ac.in/noc19_btt15/preview">https://onlinecourses.nptel.ac.in/noc19_btt15/preview</a></td>
</tr>
<tr>
<td>2</td>
<td>PUSBTI21-176</td>
<td><strong>Alison</strong>&lt;br&gt;Biomolecules: DNA replication and sequencing&lt;br&gt;Duration: 4-5 Hrs.&lt;br&gt;Free enrolment, Self-paced.&lt;br&gt;Publisher: NPTEL</td>
<td><a href="https://alison.com/course/biomolecules-dna-replication-and-sequencing">https://alison.com/course/biomolecules-dna-replication-and-sequencing</a></td>
</tr>
<tr>
<td>3</td>
<td>PUSBTI21-175</td>
<td><strong>Coursera</strong>&lt;br&gt;Industrial Biotechnology&lt;br&gt;Beginner level&lt;br&gt;Manchester Institute of Biotechnology&lt;br&gt;Duration: 6 Weeks&lt;br&gt;Free enrolment, Paid certificate</td>
<td><a href="https://www.coursera.org/learn/industrial-biotech">https://www.coursera.org/learn/industrial-biotech</a></td>
</tr>
<tr>
<td>4</td>
<td>PUSBTI21-172</td>
<td><strong>Coursera</strong>&lt;br&gt;Amino acids to Proteins&lt;br&gt;Princeton University&lt;br&gt;Duration: 8 Weeks&lt;br&gt;Free enrolment, Paid certificate</td>
<td><a href="https://www.coursera.org/lecture/life-on-other-planets/amino-acids-to-proteins-2J7GY">https://www.coursera.org/lecture/life-on-other-planets/amino-acids-to-proteins-2J7GY</a></td>
</tr>
</tbody>
</table>
SEMESTER II

Theory
## SEMESTER II

### Basic chemistry-II

<table>
<thead>
<tr>
<th>COURSE CODE</th>
<th>TITLE</th>
<th>CREDITS</th>
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</thead>
<tbody>
<tr>
<td>PUSBTII21-271</td>
<td>Basic Chemistry II</td>
<td>2</td>
</tr>
</tbody>
</table>

**Course Objective:** To acquaint students with concepts of Stereochemistry, Titrimetry & Gravimetry and Analytical separation techniques.

**Learning Outcome:** By the end of the course the student will be able to:

- Describe the role of isomerism, conformation & configuration of molecules.
- Understand the concepts of Titrimetry & Gravimetry analysis, role of titrations, pH and buffers.
- Separate molecules using the apt techniques relevant to the specific molecule e.g. chromatography & colorimeter.

<table>
<thead>
<tr>
<th><strong>Unit I</strong></th>
<th><strong>Stereochemistry</strong></th>
<th>15 Lectures</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Isomerism – Types of</td>
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<tr>
<td></td>
<td>Isomerism: Constitutional Isomerism</td>
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<td></td>
<td>(Chain, Position and Functional) and Stereoisomerism, Chirality.</td>
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<tr>
<td></td>
<td><strong>Geometric Isomerism and Optical Isomerism:</strong> Enantiomers, Diastereomers, and Racemic mixtures Cis-Trans, Threo, Erythro and Meso isomers. Diastereomerism (Cis-Trans Isomerism) in Alkenes and Cycloalkanes (3 and 4 membered ring)</td>
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<tr>
<td></td>
<td><strong>Conformation:</strong> Conformations of Ethane. Difference between Configuration and Conformation.</td>
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<tr>
<td></td>
<td><strong>Configuration</strong>, Asymmetric Carbon Atom, Stereogenic/Chiral Centers, Chirality, Representation of Configuration by “Flying Wedge Formula”</td>
<td></td>
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<tr>
<td></td>
<td><strong>Projection formulae</strong> – Fischer, Newman and Sawhorse. The Interconversion of the Formulae.</td>
<td></td>
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<tr>
<td></td>
<td><strong>Racemization and Resolution:</strong> Methods of Racemization Resolutions of Racemic mixture</td>
<td></td>
</tr>
<tr>
<td><strong>Unit II</strong> Analytical chemistry: Titrimetry and Gravimetry</td>
<td>Measurement of Mass and Volume: Distinction between mass and weight; Types of analytical balances, Sources of errors in weighing and their elimination. Units of volume, effect of temperature on volume measurement. Apparatus for precise measurement of volume; pipette, burette and volumetric flask. <strong>Titrimetric Analysis:</strong> Titration, Titrant, Titrand, End Point, Equivalence Point, Titration Error, Indicator, Primary and Secondary Standards, Characteristics and examples Types of Titrations – Acid-Base, Redox, Precipitation, Complexometric Titration. Acid-Base Titration, Strong Acid vs Strong Base. Theoretical aspects of Titration Curve and End Point Evaluation. Theory of Acid –Base Indicators, Choice and Suitability of Indicators. <strong>Gravimetric Analysis:</strong> Solubility and Precipitation, Factors affecting Solubility, Nucleation, Particle Size, Crystal Growth, Colloidal State, Ageing/Digestion of Precipitate. Co-Precipitation and Post-Precipitation. Washing, Drying and Ignition of Precipitate. (Numericals Expected).</td>
<td>15 Lectures</td>
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</tbody>
</table>

| **Unit III** Analytical reactions and Techniques | **Scope of analytical reactions:** Scope and applications of analytical chemistry. Chemical equilibria, quantitative reactions and solution chemistry. Coordination, complex formation and chelating. Selectivity, masking. **Methods of Separation** Precipitation, Filtration, Distillation and Solvent Extraction. **Analytical Techniques Chromatography:** Definition, Principles, Types | 15 Lectures |
Introduction to Paper Chromatography, Thin Layer Chromatography, Column Chromatography and its Applications.

**Colorimetry:**

**Learning space**
To explore the relatedness of stereochemistry and analytical techniques in the biology field.

**Reference Books**

2. Physical Chemistry University for biological sciences, 1st edition, Chang R.
6. Fundamentals of Analytical chemistry, Skoog, West, Holler, Crouch
9. Modern Analytical Chemistry, David Harvey

**ICT Backup**

1. [https://www.britannica.com/science/isomerism](https://www.britannica.com/science/isomerism)
3. [https://www.youtube.com/watch?v=obE4YAVJS4](https://www.youtube.com/watch?v=obE4YAVJS4)
6. [https://amrita.olabs.edu.in/?brch=2&cnt=1&sim=96&sub=73](https://amrita.olabs.edu.in/?brch=2&cnt=1&sim=96&sub=73)
7. [https://chemdictionary.org/chromatography/](https://chemdictionary.org/chromatography/)
# SEMESTER II

**Physical chemistry**

<table>
<thead>
<tr>
<th>COURSE CODE</th>
<th>TITLE</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUSBTII21-272</td>
<td>Physical chemistry</td>
<td>2</td>
</tr>
</tbody>
</table>

**Course Objectives:** To acquaint students with concepts in Thermodynamics, Kinetics and Redox Reactions.

**Learning Outcome:** By the end of the course the student will be able to:
- Describe the thermodynamics of chemical reactions.
- Understand the kinetics of chemical reactions.
- Understand the principles of redox reactions.

### Unit I
**Thermodynamics**

Thermodynamics:

15 lectures

### Unit II
**Chemical Kinetics**

**Reaction Kinetics:**
- Rate of Reaction, Rate Constant, Measurement of Reaction Rates Order & Molecularity of Reaction, Integrated Rate Equation of First and Second order reactions (with equal initial concentration of reactants). (Numericals expected)
- Determination of Order of Reaction by
  - a) Integration Method
  - b) Graphical Method
  - c) Ostwald’s Isolation Method
  - d) Half Time Method. (Numericals expected).

15 lectures
Unit III
Oxidation Reduction reactions

| Principles of Oxidation & Reduction Reactions – |
| Oxidizing and Reducing Agents, Oxidation Number, |
| Rules to assign Oxidation Numbers with examples Ions like |
| Oxalate, Permanganate and Dichromate. |
| Balancing Redox Reactions by Ion Electron Method |
| Oxidation, Reduction, Addition, Substitution & |
| Elimination Reactions. |

15 lectures

Learning space
To learn redox reactions in daily life.

Reference Books
1. Physical Chemistry Thermodynamics, SAMUEL GLASSTONE
2. Concise Physical chemistry, DONALD W. ROGERS
4. Physical Chemistry, W. J. MOORE
5. Chemical Kinetics and Reaction Dynamics, Santosh K. Upadhyay
6. Physical Chemistry, SAMUEL GLASSTONE
8. Fundamentals of Analytical chemistry, Skoog, West, Holler, Crouch
9. Inorganic chemistry, Shriver & Atkins

ICT Backup
4. https://www.youtube.com/watch?v=0ZVtMEhY4oM
6. https://www.youtube.com/watch?v=j0hI-a6EWWo
### Course Information

**Course Code**: PUSBTII21-273  
**Title**: Physiology and Ecology  
**Credits**: 2

**Course Objectives**: To acquaint students with physiological processes in plants and animals and knowledge of ecosystem.

**Learning Outcome**: By the end of the course the student will be able to:
- Understand the chemical basis of photosynthesis and mechanism of light reactions.
- Understand the physiology of various systems in animals.
- Understand functioning of ecosystem and interactions.

<table>
<thead>
<tr>
<th>Unit</th>
<th>Title</th>
<th>Lectures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unit I</strong></td>
<td></td>
<td>15</td>
</tr>
<tr>
<td><strong>Unit II</strong></td>
<td></td>
<td>15</td>
</tr>
<tr>
<td>Animal Physiology</td>
<td><strong>Physiology of Digestion</strong>: Movement of Food and Absorption, Secretary functions of Alimentary Canal, Digestion and Absorption, assimilation in Gut of Mammals. <strong>Physiology of Respiration</strong>: Mechanism of Respiration, Principles of Gaseous Exchange in the Blood and Body Fluids. <strong>Physiology of Circulation</strong>: Blood Composition, Structure and Function of its Constituents</td>
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<tr>
<td>Unit III</td>
<td>Ecosystem and Interactions</td>
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<tr>
<td></td>
<td>15 lectures</td>
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</tbody>
</table>

**Learning space**

Preparing working model of plant and animal physiology processes, reading and collecting science articles on environment.

**Reference Books**

5. Applegate anatomy and physiology Learning systems – Guyton

**ICT Backup**

4. [https://www.youtube.com/watch?v=QsSDAXv5BEM&t=7s](https://www.youtube.com/watch?v=QsSDAXv5BEM&t=7s)
5. [https://www.youtube.com/watch?v=PLNEabFZ5Qk](https://www.youtube.com/watch?v=PLNEabFZ5Qk)
6. [https://www.youtube.com/watch?v=qmNCJxpsr0&t=17s](https://www.youtube.com/watch?v=qmNCJxpsr0&t=17s)
8. [https://www.youtube.com/watch?v=nqPhY1-4f_0](https://www.youtube.com/watch?v=nqPhY1-4f_0)
# SEMESTER – II

## Genetics

<table>
<thead>
<tr>
<th>COURSE CODE</th>
<th>TITLE</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUSBII21-274</td>
<td>Genetics</td>
<td>2</td>
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</tbody>
</table>

**Course Objectives:** To acquaint students with concepts in Genetics.

**Learning Outcome:** By the end of the course the student will be able to:

- Understand fundamentals of Mendelian genetics.
- Understand methods of gene exchange in bacteria.
- Understand the concepts of Population Genetics.

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<tr>
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<tbody>
<tr>
<td>Genetics Fundamentals</td>
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</table>

<table>
<thead>
<tr>
<th>Unit II</th>
<th>Genetic analysis in Bacteria- Prototrophs, Auxotrophs. Bacteriophages: Lytic and Lysogenic cycle Mechanism of Genetic Exchange in Bacteria: Conjugation; Transformation; Transduction; (Generalized Transduction, Specialized Transduction) Bacterial Transposable Elements.</th>
<th>15 lectures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microbial Genetics</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Unit III</th>
<th>Introduction to basics of population genetics &amp; terminologies. Genetic Structure of Populations: Genotype Frequencies &amp; Allele Frequencies The Hardy–Weinberg Law: Assumptions, mathematical expression, problems. Genetic Variation in Natural Populations: Measuring Genetic Variation at the Protein Level &amp; Measuring Genetic Variation at the DNA Level</th>
<th>15 lectures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population Genetics</td>
<td></td>
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</tbody>
</table>
Effects of Evolutionary Forces on the Genetic Structure of a Population: Mutation, Migration, Natural selection, Genetic drift & Speciation. Role of Population Genetics in Conservation Biology

Learning space

Data collection of human traits and its inheritance pattern, reading advance reference books and research papers.

Reference Books

1. iGenetics- Mendelian approach by Peter Russell
2. Microbiology by Pelczar (5th edition)
3. Genetics-Mendelian approach by Peter Russell (5th edition)

ICT Backup

2. https://youtu.be/3CQqFPKIDhw
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1392256/
5. https://biologydictionary.net/lytic-cycle/
## SEMESTER II

### Tissue Culture & Dairy Technology

<table>
<thead>
<tr>
<th>COURSE CODE</th>
<th>TITLE</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUSBTII21-275</td>
<td>Tissue Culture &amp; Dairy Technology</td>
<td>2</td>
</tr>
</tbody>
</table>

**Course Objectives:** To acquaint students with Techniques of Plant and Animal Tissue Culture & Dairy microbiology.

**Learning Outcome:** By the end of the course the student will be able to:

- Understand the basic culturing techniques of animal cell culture.
- Understand aseptic techniques involved in plant tissue culturing and perform culturing under sterile conditions.
- Understand the concept of culturing and preservation techniques in dairy technology related to various dairy products.

<table>
<thead>
<tr>
<th>Unit</th>
<th>Topic</th>
<th>Lectures</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td><strong>Plant Tissue Culture</strong></td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Concept of Totipotency, Organization of Plant Tissue Culture Laboratory, Equipments and Instruments</td>
<td></td>
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<tr>
<td></td>
<td>Aseptic Techniques: Washing of Glassware, Media Sterilization, Aseptic Workstation, Precautions to maintain Aseptic Conditions</td>
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<tr>
<td></td>
<td>Culture Medium: Nutritional requirements of the explants, PGR’s and their <em>in-vitro</em> roles Media Preparation</td>
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<tr>
<td></td>
<td>Callus Culture Technique: Introduction, Principle and Protocols</td>
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<tr>
<td></td>
<td>Organogenesis, Somatic embryogenesis and synthetic seeds</td>
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<tr>
<td>II</td>
<td><strong>Basics of Animal Tissue Culture</strong></td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Introduction to Animal Tissue culture, Types of Cell Culture Techniques.</td>
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<tr>
<td></td>
<td>Laboratory Organization and Layout for Animal Tissue Culture Laboratory, Equipment, Sterilization Methodology.</td>
<td></td>
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</tbody>
</table>
Introduction to Animal Cell Culture media:
Nutritional and Physiological factors, Growth
Factors and Growth Parameters. Growth
Kinetics
Primary Cell Cultures: Establishment and
Maintenance of Primary Cell Culture, Application
of Cell Cultures

Unit III
Dairy Technology
Milk - Normal flora, changes in raw milk.
Enumeration
Factors affecting bacteriological quality,
Preservation methods, Pasteurization, Starter
cultures,
Fermented products- Production process and
spoilage of cheese: Swiss and Cheddar, Butter,
Yoghurt and Buttermilk.

Learning space

Industry visits, literature survey-based project, experimental project on nutritional and microbiological
quality of milk and milk products.

Reference Books

2. Plant Tissue Culture by Kalyan Kumar De
3. Experiments in Plant tissue culture- Dodds and Roberts- Cambridge University Press
4. Culture of Animal cells- Ian Freshney -- John Wiley &Sons
6. Applied Dairy Microbiology Elmer H Marth and James L Steele, Mercel Dekker Inc New
   York, 2nd edition
7. Microbial Technology Peppler, H.J and Perlman, D 2nd Academic Press Practicals
8. Industrial Microbiology Prescott and Dunn CBS publishers
9. Dairy Technology by Yadav and Grower
ICT Backup

### COURSE CODE | TITLE | CREDITS
--- | --- | ---
PUSBTII21-276 | Enzymology, Immunology and Biostatistics | 2

**Course Objectives:** To acquaint students with concepts in Enzymology, Immunology and Biostatistics.

**Learning Outcome:** By the end of the course the student will be able to:
- Classify enzymes and understand the kinetics of enzyme catalyzed reactions
- Differentiate between innate and acquired immunity, understand the different functional units of immunity in the body.
- Apply statistical tools in data analysis.

| Unit I | Enzymology | Definition, Classification, Nomenclature, Chemical Nature, Properties of Enzymes, Mechanism of Enzyme Action, Active Sites.
Enzyme Specificity, Effect of pH, Temperature, Substrate Concentration on Enzyme Activity, Enzyme Kinetics, Michaelis-Menten Equation, Lineweaver Burk plot
Types of Enzyme Inhibitions-Competitive, Uncompetitive, Non-Competitive Allosteric Modulators Co-Factors, Zymogens.
Industrial applications of enzymes | 15 lectures

| Unit II | Immunology | Overview of Immune Systems:
Cell and Organs involved in immunity: T and B cells.
Innate Immunity, Acquired Immunity, Local and Herd Immunity, Humoral and Cellular Immunity - Factors Influencing and Mechanisms of each.
**Antigens and Antibodies:** Types of Antigens, General Properties of Antigens, Haptens and Superantigens. | 15 lectures
Discovery and Structure of Antibodies: (Framework region) Classes of Immunoglobulins, Antigenic Determinants. Antigen-Antibody Interactions.

<table>
<thead>
<tr>
<th>Unit III</th>
<th>Definition, Importance &amp; applications of Statistics in Biology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biostatistics</td>
<td>Types of Data, Normal and Frequency Distribution</td>
</tr>
<tr>
<td></td>
<td>Representation of Data and Graphs: Bar Diagrams, Pie Charts and Histogram, Polygon and Curve.</td>
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<td></td>
<td>Measures of Central Tendency: (For Raw, Ungroup &amp; Group Data), Mean, Median, Mode.</td>
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<td></td>
<td>15 lectures</td>
</tr>
</tbody>
</table>

Learning space

Extraction of enzymes for industrial use, Data collection and analysis by statistical approach, learning computer software for statistical analysis.

Reference Books

4. Introduction to Immunology- C. V Rao- Narosa Publishing House
ICT Backup

5. https://youtu.be/8PWF5OeB7Ec
6. https://youtu.be/PzunOgYHeyg
7. https://youtu.be/9r0xzlpNjTw
9. https://youtu.be/I64HjpsLnZg
SEMESTER – II

Practical
SEMESTER – II

Practical

<table>
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<tr>
<th>COURSE CODE</th>
<th>TITLE</th>
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<tbody>
<tr>
<td>PUSBTII21-P1</td>
<td>Practicals in PUSBTII21-271 and PUSBTII21-272</td>
<td>2</td>
</tr>
</tbody>
</table>

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. Study the reaction between NaHSO₃ and KMnO₄ and balancing the reaction in acidic, alkaline and neutral medium.
6. Study transfer of electrons (Titration of sodium thiosulphate with potassium dichromate)
7. Determination of the volume strength of hydrogen peroxide solution by titration with standardized potassium permanganate solution.
8. Determination of amount of K oxalate and oxalic acid in the given solution titrimetrically.
9. Standardize commercial samples of NaOH using KHP (Potassium hydrogen phthalate) and sample of HCl using borax.
10. Dissociation Constant of Weak Acids by Incomplete Titration Method using pH Meter and determination of Acetic acid in Vinegar by Titrimetric Method.
11. Determination of the amount of Fe (II) present in the given solution Titrimetrically.
12. Determination of amount of NaHCO₃ + Na₂CO₃ in the given solid mixture Titrimetrically.
13. Determination of the amount of Mg (II) present in the given solution complexometrically.
14. Determination of percent composition of BaSO₄ and NH₄Cl in the given mixture Gravimetrically.
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<tr>
<th>COURSE CODE</th>
<th>TITLE</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUSBTII21-P2</td>
<td>Practicals in PUSBTII21-273 and PUSBTII21-274</td>
<td>2</td>
</tr>
</tbody>
</table>

1. Study of Hill’s reaction.
3. Analysis of Urine.
5. Estimation of Haemoglobin in Mammalian Blood.
8. Study of Mitosis and Meiosis.
10. Study of Interactions- Commensalism, Mutualism, Predation and Antibiosis, Parasitism.
## SEMESTER – II

### Practical

<table>
<thead>
<tr>
<th>COURSE CODE</th>
<th>TITLE</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUSBTI21-P3</td>
<td>Practicals in PUSBTI21-275 and PUSBTI21-276</td>
<td>2</td>
</tr>
</tbody>
</table>

1. Working and use of various Instruments used in Biotechnology Laboratory (Autoclave, Hot air Oven, Centrifuge, Incubator, Rotary Shaker, Filter Assembly, LAF, \(pH\) meter and Colorimeter).

2. Preparation of Stock Solutions and Preparation of Media for PTC.

3. Aseptic Transfer Technique, Surface Sterilization and Inoculation for Callus Culture.

4. Preparation of synthetic seeds.

5. Working and use of various Instruments and glasswares used in ATC Laboratory.


7. Analysis of Milk- Methylene Blue, Resazurin Test, Phosphatase Test.


10. Study of antigen antibody interaction by Ouchterlony method.

11. Biometric Analysis for Mean, Median, Mode and Standard Deviation.

12. Data representation using frequency Polygon, Histogram and Pie Diagram.
# MOOC Details (FY Biotechnology)

## Semester II

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Paper &amp; Unit</th>
<th>Details of the course</th>
<th>Link for reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PUSBTI21-276</td>
<td>Coursera <em>Fundamentals of Immunology</em> specialization</td>
<td><a href="https://www.coursera.org/specializations/immunology">https://www.coursera.org/specializations/immunology</a></td>
</tr>
<tr>
<td></td>
<td>Unit II Immunology</td>
<td>University of Rice Duration: 6 Weeks Free enrolment, Paid certificate</td>
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</tr>
<tr>
<td>2</td>
<td>PUSBTI21-273</td>
<td>Coursera <em>Vital Signs: Understanding what the body is telling us</em></td>
<td><a href="https://www.coursera.org/learn/vital-signs">https://www.coursera.org/learn/vital-signs</a></td>
</tr>
<tr>
<td></td>
<td>Unit II Animal</td>
<td>University of Pennsylvania Duration: 6 Weeks Free enrolment, Paid certificate</td>
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</tr>
<tr>
<td></td>
<td>Physiology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>PUSBTI21-274</td>
<td>Coursera <em>From Disease to Genes and Back</em></td>
<td><a href="https://www.coursera.org/learn/disease-genes">https://www.coursera.org/learn/disease-genes</a></td>
</tr>
<tr>
<td></td>
<td>Unit III Population genetics</td>
<td>Novosibirsk State University Duration: 6 Weeks Free enrolment, Paid certificate</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>PUSBTI21-275</td>
<td>Swayam <em>Food preservation technology</em></td>
<td><a href="https://onlinecourses.swayam2.ac.in/cec20_ag07/preview">https://onlinecourses.swayam2.ac.in/cec20_ag07/preview</a></td>
</tr>
<tr>
<td></td>
<td>Unit III Dairy</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>technology</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
EVALUATION

1. **Core Courses:** The College will conduct all the semester examinations of 100 marks per Theory Paper in the prescribed pattern of 40 marks of internal assessment/Project work and 60 marks for semester end examination. **The student will have to secure a minimum of 40% marks in internal assessment as well as semester end examination per theory paper, for all the above theory papers.**

2. The student will have to secure a minimum of 40% marks in internal assessment as well as semester end examination in the theory paper and practical exam.

3. In each semester, the student will have to submit Project/Assignment/Journal for theory papers in the College before appearing for the Semester End Examination. The last date of submission of the Project will be officially declared by the College.

4. The Project work will be carried out by the student with the guidance of the concerned Faculty Member who will be allotted to the student as the Guide for the Project.

5. The College will conduct all the semester examinations of 100 marks per Practical Paper at the end of each semester. **The student will have to secure a minimum of 40% marks in the examination per practical paper, for all the above practical papers.**
# EVALUATION PATTERN
## FOR F.Y.B.SC. (THEORY)

<table>
<thead>
<tr>
<th>1.</th>
<th>INTERNAL ASSESSMENT</th>
<th>40 Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td><strong>Internal 1:</strong> Assignment/Tutorial/Seminar/Participation in conference, etc</td>
<td>15 Marks</td>
</tr>
<tr>
<td>1.2</td>
<td><strong>Internal 2:</strong> MCQ Test/Project</td>
<td>20 Marks</td>
</tr>
<tr>
<td>1.3</td>
<td>Active Participation, Overall performance</td>
<td>05 Marks</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2.</th>
<th>EXTERNAL ASSESSMENT (Semester End Examination)</th>
<th>60 Marks</th>
</tr>
</thead>
</table>

N.B. 1. All questions are compulsory
2. All questions carry equal marks.

<table>
<thead>
<tr>
<th>Q.1.</th>
<th>Based on Unit-I, II &amp; III</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Multiple choice questions/Fill in the blanks /Match the column/Give one word/Name the following/Give an example/Explain the term/Define</td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Q.2.</th>
<th>Unit-I</th>
<th>12</th>
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<tbody>
<tr>
<td></td>
<td>Long Answer Question</td>
<td>12/08/06</td>
</tr>
<tr>
<td></td>
<td>Short Answer Question</td>
<td>04/02</td>
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</table>

<table>
<thead>
<tr>
<th>Q.3.</th>
<th>Unit-II</th>
<th>12</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Long Answer Question</td>
<td>12/08/06</td>
</tr>
<tr>
<td></td>
<td>Short Answer Question</td>
<td>04/02</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Q.4.</th>
<th>Unit-III</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Long Answer Question</td>
<td>12/08/06</td>
</tr>
<tr>
<td></td>
<td>Short Answer Question</td>
<td>04/02</td>
</tr>
</tbody>
</table>
Q.5. Short Notes based on Unit I, II and III (Solve any three out of six)

EVALUATION PATTERN
F.Y.B.Sc. (PRACTICAL)

<table>
<thead>
<tr>
<th>2.</th>
<th>EXTERNAL ASSESSMENT</th>
<th>100 Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Experiment –1 (Major technique)</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>Experiment –2 (Major technique)</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>Experiment -3 (Minor technique)</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Experiment -4 (Minor technique)</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Viva/Identification/Spots</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Journal</td>
<td>10</td>
</tr>
<tr>
<td>-----</td>
<td>---------------------------------------------</td>
<td>-----------</td>
</tr>
<tr>
<td></td>
<td>TOTAL MARKS</td>
<td>100</td>
</tr>
</tbody>
</table>

Students will have to perform and report experiments in journal.
Semester – I and II

Ability Enhancement Course 1 (FC I)

Ability Enhancement Course 2 (FC I)
DSPM’s K. V. Pendharkar Autonomous College, Dombivli

Revised Syllabus for
F.Y.B.A./B.Sc./F.Y.BCom/FYBAF/FYBMS/FYMAMMC/FYBIOTECH/FYBBI

(Semester I and II)

Course Title: Foundation Course

1. Syllabus as per Credit Based Semester & Grading System.
   i) Name of the Programme - Foundation Course  F.Y.B.A. /B.Sc./B.Com
   ii) Course Code - PUAFCI21-141 and PUAFCII21-242
   iii) Course Title - Foundation Course - I
   iv) Semester wise Course Contents - Enclosed the copy of syllabus
   v) References and additional references – Enclosed in the Syllabus
   vi) Credit structure - 2 Credits per Semester.
   vii) No. of lectures per Unit - 11, 11, 12, 11 and 12, 11, 11, 11 (45 lectures per Semester)
   viii) No. of Lectures per Semester - 45 + 45 (Total 90)
   ix) No. of lectures per week - 03

2. Scheme of Examination - 40 marks for Internal and 60 marks for External Exam
Revised Syllabus for Foundation Course for F.Y.B.A./B. Sc./B. Com

Semester I

Internal marks: 40                               External marks: 60                                   Total Marks: 100

Objectives:

1. To acquaint students with multi-cultural diversity of Indian society.

2. To understand the concept of disparity as arising out of stratification and inequality.

3. To analyze the inequalities and its manifestation in inter-group conflicts.

4. To understand the philosophy and basic features of the Indian Constitution.

5. To develop students’ abilities to think role of youth in promoting tolerance, peace and communal harmony.

6. To acquaint the student with the basic understanding of various growing social problems in India.

Learning Outcome:

1) Learners will acquire a deeper and more inclusive understanding of Indian society, its nature, social problems, role of Indian Constitution and youth in maintaining the social fabric of Indian society.

2) They will know the concept of disparity as arising out of social stratification and inequality

3) They will understand evolution and Salient features of the Indian Constitution
Module 1- Overview of Indian Society

a) Multi-cultural nature of Indian society with its demographic composition: population distribution according to religion, caste, and gender

b) The linguistic diversity in India

c) Regional variations in the context of rural, urban and tribal demography

d) The unity in diversity

Module 2- Concept of Disparity - I  

a) The concept of disparity as arising out of social stratification and inequality

b) The issues faced by the Minorities and elderly population

c) The inequalities faced by persons with disabilities and to know about various welfare schemes available to them

d) Role of NGO’s in addressing the problems of elderly and persons with disabilities

Module 3 - Concept of Disparity - II 

a) The inequalities manifested due to the caste system and inter-group conflicts arising thereof

b) The causes and effects of conflicts arising out of regionalism and linguistic differences

c) Inter-group conflicts arising out of communalism

d) Role of youth in promoting tolerance, peace and communal harmony as crucial values in strengthening the social fabric of Indian society.

Module 4 - The Indian Constitution 

a) Evolution of the Indian Constitution

b) Philosophy of the Constitution as set out in the Preamble
c) Salient features of the Indian Constitution

d) Fundamental Duties of the Indian Citizens

Topics for Assignments - Growing Social Problems in India

1. Substance abuse- impact on youth & challenges for the future
2. HIV/AIDS- awareness, prevention, treatment and services
3. Issue of child labour- magnitude, causes, effects and response
4. Child abuse- effects and ways to prevent
5. Trafficking of women- causes, effects and response
6. Local self-government in urban and rural areas
7. Panchayati Raj and significance of 73rd and 74th Constitutional Amendment and their implications for inclusive politics
8. Participation of women in Indian politics/Organized and Unorganized sectors
9. Social Evils and Remedies: Problems faced by youth community (Addiction to social medias, Ragging, Drug addiction, smoking, Drinking, Depression etc.) and remedial measures to overcome them.
10. References of various organizations and institutes, NGOs providing treatment, support and counseling
11. Information of various social institutes working locally and globally with introduction of some dedicated social workers with the information of the work done by them for better living
12. Disaster Management in natural calamities and in manmade created situations.
13. Concept of Disaster & Types of Disaster
14. Disaster Management: Concept & Significance
15. Educating Masses
16. Role of Youth
Revised Syllabus for F.Y.B.A./B.Sc./F.Y.BCom

Semester II

Internal marks: 40  
External marks: 60  
Total Marks: 100

Objectives:

1. To acquaint students with the concepts of globalization, liberalization and privatization
2. To make students aware of the origin and evolution of the concept of Human Rights
3. To make students understand the importance of the concepts of ecology and environmental and its impact on human life
4. To create awareness about the importance of sustainable development among students
5. To highlight the causes and impact of stress and conflicts arising in the society
6. To equip students with some coping and management techniques to deal with stress and conflicts.

Learning Outcome:

1) Learners will acquire a deeper and more inclusive understanding of the role of globalization, liberalization and privatization in the Indian society along with the understanding of the origin and evolution of Human Rights.

2) An awareness about the environmental problems will be created along with the introduction of the concept of sustainable development.

3) The course will enable students to understand the different stressors in their life as well as it will equip them with some techniques of coping and management of stress and conflicts.
Module 1 – Globalization and Indian Society

a) Understanding the concepts of liberalization, privatization and globalization

b) Growth of Information technology and communication and its impact on everyday life

c) Impact of globalization on industry; changes in employment and increasing migration

d) Changes in agrarian sector due to globalization; rise in corporate farming and increase in farmers’ suicides

Module 2 – Human Rights

a) Concept of Human Rights – Its origin and evolution

b) The Universal Declaration of Human Rights

c) Human Rights constituents with special reference to Fundamental Rights and stated in the Indian constitution

d) Directive Principles of the State Policy enshrined in Indian Constitution

Module 3 – Ecology

a) Concept of Ecology and Environment

b) Environmental degradation – Its causes and impact on human life

c) Sustainable development – concept and components

d) Role of an Indian individuals and organizations in environment protection movements

Module 4 – Understanding stress and conflicts – Its management

a) Agents of socialization and their role in development of the individual

b) Stress: Causes, impact and coping Mechanism

c) Conflict: Meaning, Types and Ways of Resolutions
d) Abraham Maslow’s Theory of Self-Actualization

Topics for Assignments – Contemporary Societal changes

1. Impact of Globalization on marginalized groups
2. Increasing urbanization, problems of housing, health and sanitation
3. Changing lifestyle and its impact on culture
4. Impact of consumerism and materialism in today’s society
5. Farmers’ Suicide and agrarian distress
6. Land acquisition and change of land use
7. Debate regarding genetically modified crops
8. Development projects and human rights violations
9. Increasing crime among youth and impact on society
10. Increasing suicides among youth and impact on society
11. Impact of social media on stress and leading to conflict
12. Significance of values, ethics, prejudices in development of individual
13. Stereotypes and prejudices as cause of conflict in society.
14. Aggression and violence: causes, impact and remedial measures
15. Self-Actualization
16. From Unsustainable to Sustainable development
17. Water conservation, rain water harvesting, watershed management.
18. Climate change, global warming, ozone layer depletion,
19. Environment protection Act
20. Wildlife Protection Act
21. Forest Conservation Act
22. Population explosion, impact on environment
23. Women and Child Welfare Value Education
24. Role of Information Technology in Environment and human health

References:

1. Asthana, D. K., and Asthana, Meera, Environmental Problems and Solutions, S. Chand, New Delhi, 2012.

2. Bakshi, P.M., Indian Constitution,


**Learners Space**

In addition to the assigned curriculum, there will be innovative ways for students with a special interest in social, economic, constitutional or political aspects. The subject foundation course is very wide and its scope is enlarged. The students can do various things along-with the prescribed things in curriculum. In addition to the syllabus presented, they will be informed about various references to develop this attitude the use of following things are recommended.

1) Watch a television programme based on subject matter of foundation course and mark out its different perspectives

2) Prepare a survey based report on the primary sources available in your village or town and throw light on social and economic challenges faced by the people.

3) Work with NGO or any serving organization to help challenged and destitute section in the society.

**Recommended ITC BACK UP**

It is commended to orient the students about social discourse in India with the help of teaching-aid and photos, documentaries, movies, charts, PPT and other available ICT tools along with YouTube channels offering history information.

**Referred other Autonomous colleges**

1) Ramnarain Ruia Autonomous College, Matunga

2) B. K. Birla College of arts, science and commerce (Autonomous), Kalyan

3) St. Xavier's College (Autonomous), Mumbai
Foundation Course- Pedagogy

The Foundation course subject students of FYBA, FYBCOM and FYBSC class will study Overview of Indian Society, Concept of Disparity and Indian Constitution. Learners will also acquire a deeper and more inclusive understanding of the role of globalization, liberalization and privatization in the Indian society along with the understanding of the origin and evolution of Human Rights. As this paper is largely associated with current events and problem the reading of newspapers, magazines and watching news is recommended for the students.

The students need to develop association with the society or the social components and first-hand experience of reality. There are various topics for the projects regarding the characteristics of the Indian society, issues and challenges and the economic, ecological transformation. The Students are expected to participate in project work to find the real glimpse of the society and to develop humanitarian perspectives to all the communities in India. It has been suggested to break up the group of students in the class and distribute the topics to them and organize singing discussions in it so that the skills of expressing ideas will be developed in the students.

Multi-perspective attitude will be more useful and will makes teaching more dynamic, challenging, and motivating for students and has the long-term consequence of educating generations for peace, tolerance, and democracy. Along with classroom teachings. It is commended to orient the students about social discourse with the help of teaching-aid and photos, documentaries, movies, charts, PPT and other available ICT tools. This will enhance their grasping abilities ns understanding of the subject and make it more interesting.

Mr. P. B. Kusmude

Convenor
Assessment:

Workload: 3 lectures per week.

Marks: For 60 marks 4 questions of 15 marks with options are allotted for external assessment.

40 marks out of 100 will be allotted to internal assessment. A minimum of 16 out of 40 (Internal) 24 out of 60 (external/term end) marks must be scored by the student. The student should get an aggregate 40 marks out of 100 per semester to pass in the course.

Internal Assessment – 40 marks (Semester I & II)

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Particulars</th>
<th>Marks</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>One periodical class tests including two shorts notes (10), Fill in the blanks (5), and Answer in one line (5)</td>
<td>20</td>
<td>30 Minutes</td>
</tr>
<tr>
<td>2</td>
<td>One assignment based on curriculum (10), Group/individual discussion and Active participation in class (10)</td>
<td>20</td>
<td>-</td>
</tr>
</tbody>
</table>

Projects / Assignments (for Internal Assessment)

i. Projects/Assignments topics can be taken from any of the four modules.

ii. Students should be given a list of possible topics - at least 3 from each Module at the beginning of the semester.

iii. The Project/Assignment can be done in form of Street-Plays/Power-Point Presentations/Poster Exhibitions and any other similar mode appropriate to the topic.
iv. Students can work in groups (not more than 6 students in a group).

v. Students must submit a hard/soft copy of the Project/Assignment before appearing for the semester end examination.
F.Y.B.A./B.Sc. – Foundation Course - I

Question Paper Pattern for Semester I & II

Time - 2 hours                                                                                                                Total Marks - 60

NB: Answer the following questions (15 Marks Each)

Q.1. Based on Module I
       OR
Q.1. Based on Module I

Q.2. Based on Module II
       OR
Q.2. Based on Module II

Q.3. Based on Module III
       OR
Q.3. Based on Module III

Q.4. Based on Module IV
       OR
Q.4. Based on Module IV
Pedagogy

Biotechnology – key technology of 21st century- refers to applications or manipulations of techniques on living things to produce goods and services. Due to ever expanding scope of biotechnology, the role of teachers is becoming challenging. The syllabus of First Year Biotechnology is designed to impart fundamental concepts of basic chemistry, life science, genetics, molecular biology, applications of biotechnology, etc. The student will gradually be directed further towards specific knowledge related to the field of biotechnology. The teacher must be competent enough to not only impart knowledge but to develop a student as a keen observer, hard worker, goal setter and independent thinker.

The teaching and learning process underlying this course is student centric to create an environment which interests, challenges and develops confidence among students. Although the primary method of teaching would be interactive lectures and practical sessions to facilitate learning, various pedagogical approaches to be followed to enhance effective learning process. It may include various methods as below:

- Co-curricular activities like poster making, model making, presentations, etc.
- Audio- video based lectures, animated presentations, science fiction movies, cartoon programmes, etc. will help in cognitive learning of important concepts.
- Laboratory based learning; experimental teaching learning has to be major component of teaching to help students acquire practical skills in the area.
- Use of models, charts, simulations, virtual labs will help students understand basic subject concepts.
- Collaborative approaches like Seminars, Group discussions, Role plays, Field work and Group projects will facilitate overall personality development of students.
- The evaluation process may involve formative and summative assessment approach involving assignment, objective tests, presentations, seminars, projects, quizzes, etc.
- Through industrial visits and excursions students can understand practical utility and scope of the subject.

Above all students should be inculcated with positive attitude, preparedness, creativity and compassionate learning with personal touch in the subject.
DOMBIVLI SHIKSHAN PRASARAK MANDAL’S,
K.V. PENDHARKAR COLLEGE OF ARTS, SCIENCE AND
COMMERCE, (AUTONOMOUS) DOMBIVLI (EAST), DIST. THANE
(Affiliated to University of Mumbai)

Faculty of Science
DEPARTMENT OF BIOTECHNOLOGY
(Programme: Bachelor of Science, B.Sc.)

SYLLABUS FOR
S. Y. B.Sc. – Biotechnology (Semester III and IV)
Choice Based Credit System (CBCS)

(With effect from the Academic Year: 2022-2023)
### SEMESTER- III

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course type</th>
<th>Course Title</th>
<th>Credits</th>
<th>Lectures/ Week</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUSBTIII22-371</td>
<td>Core Subject</td>
<td>Biophysics</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>PUSBTIII22-372</td>
<td>Core subject</td>
<td>Applied Chemistry- I</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>PUSBTIII22-373</td>
<td>Core Subject</td>
<td>Immunology</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>PUSBTIII22-374</td>
<td>Core Subject</td>
<td>Cell Biology and Cytogenetics</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>PUSBTIII22-375</td>
<td>Core Subject</td>
<td>Molecular Biology</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>PUSBTIII22-376</td>
<td>Skill enhancement elective</td>
<td>Bioprocess Technology</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>PUSBTIII22-377</td>
<td>General Elective</td>
<td>Entrepreneurship development</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>PUSBTIII22-P1</td>
<td>Core subject Practical</td>
<td>Practical of PUSBTIII22-371 and PUSBTIII22-372</td>
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<td>6</td>
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<tr>
<td>PUSBTIII22-P2</td>
<td>Core subject Practical</td>
<td>Practical of PUSBTIII22-373 and PUSBTIII22-374</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>PUSBTIII22-P3</td>
<td>Core Subject and Skill enhancement elective Practical</td>
<td>Practical of PUSBTIII22-375 and PUSBTIII22-376</td>
<td>2</td>
<td>6</td>
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### SEMESTER- IV

<table>
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<th>Course code</th>
<th>Course type</th>
<th>Course Title</th>
<th>Credits</th>
<th>Lectures/ Week</th>
</tr>
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<tbody>
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<td>PUSBTIV22-471</td>
<td>Core Subject</td>
<td>Biochemistry</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>PUSBTIV22-472</td>
<td>Core subject</td>
<td>Applied Chemistry- II</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>PUSBTIV22-473</td>
<td>Core Subject</td>
<td>Medical Microbiology</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>PUSBTIV22-474</td>
<td>Skill enhancement</td>
<td>Molecular Diagnostics</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Code</td>
<td>Type</td>
<td>Subject</td>
<td>Credits</td>
<td>Total</td>
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<tr>
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<td>---------</td>
<td>-------</td>
</tr>
<tr>
<td>PUSBTIV22-475</td>
<td>Core Subject</td>
<td>Biostatistics and Bioinformatics</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>PUSBTIV22-476</td>
<td>Core Subject</td>
<td>Environmental Biotechnology</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>PUSBTIV22-477</td>
<td>General Elective</td>
<td>Research methodology</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>PUSBTIV22-P1</td>
<td>Core subject Practical</td>
<td>Practical of PUSBTIV22-471 and PUSBTIV22-472</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>PUSBTIV22-P2</td>
<td>Core Subject and Skill enhancement elective Practical</td>
<td>Practical of PUSBTIV22-473 and PUSBTIV22-474</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>PUSBTIV22-P3</td>
<td>Core subject Practical</td>
<td>Practical of PUSBTIV22-475 and PUSBTIV22-476</td>
<td>2</td>
<td>6</td>
</tr>
</tbody>
</table>
Course Code | Title | Credits | No. of Lectures
---|---|---|---
PUSBTIII22-371 | BIOPHYSICS | 2 | 15

**Course objectives:**
The objective of this course is to have a firm foundation in the fundamentals and applications of current biophysical theories.

**Learning outcomes:** By the end of the course the student will:
- Develop an understanding of the different aspects of classical physics.
- Be able to relate principles of physics to applications and techniques in the field of biology such as microscopy, spectroscopy and electrophoresis.

**UNIT I**
*Optics and Electromagnetic Radiations*

**Introduction to Optics and Lasers:**

*Optics:*
Properties of Light - Reflection, Refraction, Dispersion, Interference.

*Lasers:*

*Electromagnetic Radiations:*
Introduction to Electromagnetic Radiation.

*Spectroscopy:*
Types and Properties of Spectra; Basic Laws of Light Absorption.
Spectrophotometer:- Principle, Instrumentation and Applications; UV-Vis Spectrophotometer, Single and Dual Beam Spectrophotometer.

*Microscopy:*
Types of Microscopy; Electron Optics; Electron Microscopy- Preparation of Specimen, SEM, TEM and Immuno-Electron Microscopy.
Fluorescence Microscopy.
## UNIT II
### Heat, Sound, Magnetism and Fluid Dynamics

**Heat:** Concept of Temperature; Modes of Heat Transfer; Measuring Temperature; Platinum Resistance Thermometer; Thermocouple and Thermistors.

**Sound:** Types of Sound Waves - Audible, Ultrasonic and Infrasonic Waves; Doppler Effect; Applications of Ultrasonic Waves.

**Magnetism:** Magnetic Field; Magnetism of Earth; Paramagnetism, Diamagnetism, Ferromagnetism.

Nuclear Magnetism and Biomagnetism.

**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.

## UNIT III
### Electrophoretic Techniques

**Electrophoresis:**
Introduction, Principle of Electrophoresis
Migration of Ions in an applied electric field; Factors affecting Electrophoretic Mobility;

**Types & Techniques of electrophoresis:**
Free Electrophoresis: Moving Boundary Electrophoresis;
Zone Electrophoresis: Supporting Matrix Paper electrophoresis; AGE; Native and SDS PAGE (reducing and non-reducing, continuous and discontinuous);

**Specialized Electrophoretic techniques:**
Discontinuous Gel Electrophoresis, Isoelectric focusing and 2D PAGE. Staining and Detection methods; Gel-Documentation.

Applications in Biology.
Learner’s space:
Applications of Optics in Medical field/Space Science, etc. Use of Electrophoresis in Advance Molecular Biological techniques like PCR/RAPD/RFLP/AFLP etc.

MOOC:

Pedagogy: Group discussion, Models, Animated YouTube Videos, Online worksheets, Virtual Labs.

Reference books:
1. Essential Biophysics, Narayanan, New Age Publications
2. Handbook of Molecular Biophysics (Methods & Application), 2009, HG Bohr, Wiley

ICT backup:
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Credits</th>
<th>No. of Lectures</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUSBTHI22-372</td>
<td>APPLIED CHEMISTRY – I</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

**Course objectives:**
The objective of this course is to have a firm foundation in the fundamentals and applications of organic and green chemistry.

**Learning outcomes:** By the end of the course the student will be able to:
- Develop an understanding of the different aspects of organic and green chemistry.
- Discuss the role of organic compounds in biology and synthesis of organic compounds.
- Discuss the role of green chemistry and its application in industry.

<table>
<thead>
<tr>
<th>UNIT I</th>
<th>Introduction to Types of Organic Reactions:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Organic Chemistry</td>
<td>Addition, Elimination and Substitution Reactions. Rearrangement reactions</td>
<td>15</td>
</tr>
<tr>
<td>Metal Coordination in Biological Systems: Essential and Non-essential Elements in Biological Systems. Role of Metal Ions in Biological Systems Enzymes, Apoenzymes and Coenzymes. Biological Role of Metalloenzymes with respect to Myoglobin, Haemoglobin. Biological Role of Carboxypeptidases, Catalases and Peroxidases. Structure and Function: Dioxygen Binding, Transfer and Utilization; Metal Complexes in Medicines.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>UNIT II</th>
<th>Synthesis of Organic Compounds :</th>
<th></th>
</tr>
</thead>
</table>
UNIT III
Green Chemistry and Synthesis

Introduction to Green Chemistry; Need and Relevance of Green Chemistry; Goals of Green Chemistry. Limitations/Obstacles in the pursuit of the goals of Green Chemistry.

Principles of Green Chemistry.

Future Trends in Green Chemistry:
Green chemistry in sustainable development.

Learner’s space:
Biological role of different enzymes, isoenzymes and coenzymes, organic synthesis of active pharmaceutical compounds and the significance of green chemistry for sustainable development can be studied.

MOOC:
Enzymology - https://onlinecourses.swayam2.ac.in/cec20_bt20/preview Swayam, Credit point - 4, Duration - 12 weeks, UG level

Pedagogy: Animated Videos, Group discussion, Models, Google classrooms.

Reference books:

ICT backup:
1. https://www.rgpv.ac.in/campus/PY/enzymes_ppt.pdf
3. https://www2.chemistry.msu.edu/faculty/reusch/virttxtjml/synth2.htm
5. https://www.epa.gov/greenchemistry/basics-green-chemistry
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Credits</th>
<th>No. of lectures</th>
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</thead>
<tbody>
<tr>
<td>PUSBTIII22-373</td>
<td>IMMUNOLOGY</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

**Course objectives:**
The objective of this course is to familiarize students with the immune effector mechanisms and various immunotechniques.

**Learning outcomes:** By the end of the course the student will be able to:
- Understand the role of complements in immune response and different immune cell receptors involved in immune reaction.
- Understand the principles underlying various immunotechniques.

### UNIT I
**Effectors of Immune Response**

<table>
<thead>
<tr>
<th>Complement System</th>
<th>Classical, Alternate and Lectin pathways; Regulation and Biological Effects of Complement System; Deficiencies of Complement System</th>
</tr>
</thead>
<tbody>
<tr>
<td>MHC Classes</td>
<td>General Organization and Inheritance; Structures and Peptide Interactions; Class I and II Diversity and Polymorphism; Antigen Presentation through Endocytic and Exocytic Pathways; MHC Restriction.</td>
</tr>
</tbody>
</table>

### UNIT II
**Cell Receptors**

<table>
<thead>
<tr>
<th>T-cell Receptor Complex</th>
<th>Structure and Activation.</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-cell Receptor</td>
<td>Structure, Maturation and Activation</td>
</tr>
<tr>
<td>Toll like receptors</td>
<td></td>
</tr>
<tr>
<td>B-T cell interaction (B-T cell cooperation)</td>
<td></td>
</tr>
<tr>
<td>Cell cytotoxic responses as the effector mechanism.</td>
<td></td>
</tr>
</tbody>
</table>

### UNIT III
**Immuno Techniques**

<table>
<thead>
<tr>
<th>Precipitation Reactions</th>
<th>Immunoprecipitation, Immunoelectrophoresis, CIEP, Rocket Electrophoresis and 2-D Immunoelectrophoresis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agglutination Reactions</td>
<td>Passive, Reverse Passive, Agglutination Inhibition. Coomb’s Test; Complement Fixation Tests, RIA, ELISA, ELISPOT,</td>
</tr>
</tbody>
</table>
Chemiluminescence, Western Blot, Immunofluorescence, Flow Cytometry.
Alternatives to Antigen-Antibody Reactions.

**Learner’s space:**
Application of immunology concepts and techniques in commercial kits used to diagnose the infections.

**MOOC:**
1. Fundamentals of Immunology: Innate Immunity and B-Cell Function
   https://www.coursera.org/learn/immunologyfundamentalsimmunitybcells?specialization=immunology, Coursera, Duration - 12 weeks, UG level
2. Immunology - Course (swayam2.ac.in) Swayam, Credit point – 4, Duration - 12 weeks, UG level.

**Pedagogy:** YouTube videos, PPT, Group discussion, Models, Practical techniques, Animated videos, Virtual labs.

**Reference books:**
1. Immunology, Richard Goldsby, Thomas Kindt, Barbara Osborne, JenisKuby; 5th edition.
2. Textbook of basic and clinical immunology, 1st edition (2013), Sudha Gangal and ShubhangiSontakke, University Press, India
3. Immunology, 7th edition (2006), David Male, Jonathan Brostoff, David Roth, Ivan Roitt, Mosby, USA.
4. Introduction to Immunology- C V Rao- Narosa Publishing House

**ICT backup:**
1. https://www.physio-pedia.com/Complement_System
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Credits</th>
<th>No. of lectures</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUSBTIII22-374</td>
<td>CELL BIOLOGY AND CYTOGENETICS</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

**Course objectives:-**
The objective of this course is to have a firm foundation in the fundamentals of cell biology and cytogenetics.

**Learning outcomes:-** By the end of the course the student will be able to:
- Develop an understanding of the cytoskeleton and transport mechanism across cell membranes.
- Discuss the structure of chromosomes and types of chromosomal aberrations, linkage and mapping.

<table>
<thead>
<tr>
<th>UNIT I Cytoskeleton</th>
<th>Overview of the Major Functions of Cytoskeleton.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Microtubules:</strong> Structure and Composition, MAPs, Functions of Microtubules.</td>
</tr>
<tr>
<td></td>
<td>Motor Proteins: Kinesin, Dynein</td>
</tr>
<tr>
<td></td>
<td>MTOCs, Dynamic Properties of Microtubules</td>
</tr>
<tr>
<td></td>
<td>Microtubules in Cilia and Flagella</td>
</tr>
<tr>
<td></td>
<td><strong>Intermediate Filaments:</strong> Structure and Composition Assembly and Disassembly Types and Functions</td>
</tr>
<tr>
<td></td>
<td><strong>Microfilaments:</strong> Structure and Composition, Assembly and Disassembly</td>
</tr>
<tr>
<td></td>
<td>Motor Protein: Myosin</td>
</tr>
<tr>
<td></td>
<td>Role of Microfilaments in Muscle Contractility</td>
</tr>
<tr>
<td></td>
<td>Actin Binding Proteins</td>
</tr>
<tr>
<td></td>
<td>Examples of Nonmuscle Motility and Contractility</td>
</tr>
</tbody>
</table>

15
### UNIT II

**Cellular Transport and Cellular Interactions**

- Concept of Cell Permeability
- Uptake of Nutrients by cells

**Principles of Membrane Transport**
- Transporters and Channels
- Active Transport, Passive Transport

**Types of Transporters:**
- ATP Driven Pumps - Na+ K+ Pump, Ca2+ pump
- **Cell Junctions and its Classification,** Microvilli
- **Cell Adhesion:** Role of cadherins and integrins
- **Extracellular Matrix**
- Cell Coat and Cell Recognition.
- Cellular Interactions.

### UNIT III

**Cytogenetics**

- **Genome organization in Viruses, Prokaryotes and Eukaryotes**
- **Extrachromosomal Inheritance**
  - Mitochondrial DNA, Chloroplast DNA
  - Kappa particles in Paramoecium
- **Structural organization and Significance**
  - of Polytene chromosome, Lampbrush Chromosome
- **Variation in Chromosomal Structure and Number:**
  - Deletion, Duplication, Inversion, Translocation, Aneuploidy, Euploidy and Polyploidy and Syndromes
  - Karyotyping and its importance
- **Genetic Linkage, Crossing Over and Chromosomal Mapping:**
  - Two-point Cross; Three point Cross
- **Pedigree Analysis.**

---

**Learner’s space:**

Insight into Cytoskeletal Abnormalities, cellular processes like Endocytosis and Literature search of human genetic disorders through OMIM.
MOOC:


Pedagogy: Posters, PowerPoint presentation, animated videos, Models, Case study (Genetic counselling), Preparing pedigree charts for inheritance of some human traits, Flipped classroom.

Reference books:

3. Cell and Molecular Biology – De Robertis- Lippincott Williams & Wilkins

ICT backup:

7. https://www2.kumc.edu/genetics/lab/
# Course Code

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Credits</th>
<th>No. of Lectures</th>
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</thead>
<tbody>
<tr>
<td>PUSBTEI22-375</td>
<td>MOLECULAR BIOLOGY</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

**Course objectives:**
The objective of this course is to have an insight into the mechanism of gene expression and regulation.

**Learning outcomes:** By the end of the course the student will be able to:
- Examine the steps involved in the transcription of Prokaryotes & Eukaryotes.
- Discuss the mechanisms associated with gene expression at the level of translation.
- Discuss the mechanisms associated with regulation of gene expression in prokaryotes and eukaryotes.

## UNIT I
### Gene Expression - Transcription

**Gene Expression- an Overview.**
**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

## UNIT II
### Gene Expression - Translation

**Nature of Genetic Code** (Deciphering the genetic code, Characteristics, Wobble Hypothesis)

**Translation in Prokaryotes and Eukaryotes**
- Charging of t-RNA, Process of Protein Synthesis (Initiation, Elongation, Translocation, Termination)

**Post Translational Modifications.**
- Glycosylation, Acetylation, Methylation
- **Protein sorting**
UNIT III  
Regulation of Gene Expression

In Prokaryotes:

In Bacteria: **lac** Operon of *E.coli*; **trp** Operon of *E.coli*.

In Eukaryotes:

Operons in Eukaryotes; Control of Transcriptional Initiation; Gene Silencing and Genomic Imprinting; Post-Transcriptional Control; RNA Interference.

Learner’s space:
Role of Antibiotics in Bacterial Transcription & Translation Inhibition. Use of Gene Silencing in Therapeutics & its challenges.

MOOC:


Reference books:-
1. iGenetics(Molecular Approach), 3rd edition- Peter Russell -Pearson Education
2. Microbial Genetics- Freifelder –Narosa Publishing House
3. Genes XI, 11th edition (2012), Benjamin Lewin, Publisher - Jones and Barlett

ICT backup:
1. https://www.youtube.com/watch?v=nXj2Hmd51l4
2. https://www.youtube.com/watch?v=CxxQ5i97YB0
3. https://www.youtube.com/watch?v=G8RYhV569xg
<table>
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<th>Credits</th>
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</tr>
</thead>
<tbody>
<tr>
<td>PUSBTII22-376</td>
<td>BIOPROCESS TECHNOLOGY</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

**Course objectives:**
The objective of this course is to understand the basic skills applied in fermentation technology and build a foundation for more advanced studies in bioprocess technology.

**Learning outcomes:** By the end of the course the student will be able to:
- Develop an understanding of the various aspects of bioprocess technology.
- Develop skills associated with screening of industrially important strains.
- Understand principles underlying design of fermenter and fermentation process.

**UNIT I**
**Microorganisms in Industrial Processes**

| Types of Microorganisms used in Industrial Processes: |
| Bacteria, Actinomycetes, Fungi and Algae. |

**Screening and maintenance of strains:**
- Primary Screening and Secondary Screening.
- Culture Collection centres.
- Strain improvement of microorganisms

**Preservation of Industrially Important Microbial Strains** - Stab culture, Soil stock method, Lyophilisation & Cryopreservation

**UNIT II**
**Fermenter and Fermentation Processes**

| Design of a fermenter: Stirred Tank Fermenter- Basic Design; Parts of a Typical Industrial Fermenter. |
| Fermentation Media: Components; Design and Optimization. |
| Sterilization: Sterilization of Fermenter and Fermentation Media. |
| Process Parameters: pH, Temperature, Aeration, Agitation, Foam, etc. |
| Types of Fermentation: Surface and Submerged; Batch and Continuous, Aerobic and Anaerobic. |
| Product Isolation and Purification. |
| Study of representative fermentation processes: Outline of Penicillin and Ethanol Production by fermentation along with a flow-diagram. |
UNIT III

In-vivo and In-vitro Assay of Industrial Products

Assay of Industrial Products:
- In vivo Animal assays - Pyrogen and Endotoxin testing
- Chemical and Biological; Types and Subtypes; Kinetics.
- Advantages and Disadvantages.
- Bioavailability and Bioequivalence Studies

Learner’s space:
To explore manufacturing details of various industrial products produced by microorganisms.

MOOC:
1. Phase- I Online Certificate Course on Fermentation Technology - Atal Bihari Vajpayee Vishwavidyalaya (e-atalgyansangum.ac.in).
2. Microbial fermentation processes and bioreactor design - Biochemical and Bioprocess Engineering | Coursera

Pedagogy: Google classroom & making crossword puzzle & group discussions, Production flow-sheet preparation, Industrial visits.

Reference books:
1. Food Microbiology- Frazier
2. Industrial Microbiology- A. H. Patel
3. Industrial Microbiology- L. E. Casida- John Wiley & Sons

ICT backup:
2. Screening of Microorganisms: Primary and Secondary Techniques | Industrial Biotechnology (biotechnologynotes.com)
Course Code | Title | Credits | No. of Lectures
--- | --- | --- | ---
PUSBTIII22-377 | ENTREPRENEURSHIP DEVELOPMENT | 2 | 

Course objectives:
To develop and systematically apply an entrepreneurial way of thinking that will allow identification and creation of business opportunities.

**Learning outcomes:** - By the end of the course the student will be able to:
- Develop an understanding of the systematic process and to select and screen a business idea.
- Design strategies for successful implementation of ideas.
- Learn potential opportunities and ideas and career choices available to the entrepreneur.

| UNIT I | Introduction to Entrepreneurship Development | | 
|---|---|---|---
| Concept of Entrepreneur & Entrepreneurship; Need and Importance; Factors Influencing Entrepreneurship; Essentials of a Successful Entrepreneur. Ethics & Social Responsibility of Entrepreneurs, Opportunities & Scope of Entrepreneurs, Entrepreneurs in India & Abroad; Woman as an Entrepreneur. | | 15 | 

| UNIT II | Setting-up of an Enterprise and Planning | | 
|---|---|---|---
| Location of Enterprise; Real Estate and Human Resource Planning, Financial Planning; Role of Government and Financial Institutions in Entrepreneurship Development; Raising Money from Venture Capitalists, Government Grants, Product Selection and Ideas; Project Planning and Formulation; Project Feasibility Assessment; Regulatory Affairs, Corporate Laws, Innovation, IPR generation and Protection, Preparation of a Business Plan, Characteristics and Importance of Planning | | 15 | 

| UNIT III | Marketing, Research and Opportunities in Biotechnology | | 
|---|---|---|---
| Marketing Plan for an Entrepreneur; Strategic Alliances, Marketing strategy, Advertising and Sales Promotion Market Assessment and Market Research, Need for International Market Research, Domestic vs. International Market Research, Cost and Methodology of Market Research, Desk and Field Research Entrepreneurship Opportunities in Biotechnology | | 15 |
Learner’s space:
Learn mentorship programs in collaboration with government organizations, incubation centres, educational institutions and private organizations.

MOOC:

2. The Science and Business of Biotechnology: Duration: 16 weeks (10–12 hours per week), Self-paced, Free (Optional upgrade available)

Pedagogy: YouTube videos, Case studies, Group Discussion, Seminars, Case studies, Flipped Classroom.

Reference books:
1. Entrepreneurship - Kurup
2. Handbook of Entrepreneurship development - Basotia and Sharma

ICT backup:
2. https://youtu.be/oI_VZfjgkME
3. https://youtu.be/YxjPCXHAAwA
### PRACTICAL

#### SEMESTER III

<table>
<thead>
<tr>
<th>Course code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
</table>
| **PUBSTIII22-P1** (PRACTICAL based on PUBSTIII22-371 and PUBSTIII22-372) | 1. Verification of Beer-Lambert’s Law.  
2. Study of Absorption Spectra of any one coloured compound (CuSO₄/CoCl₂/KMnO₄).  
3. Plasmid Biology  
   a) Extraction of Plasmid DNA and quantification using UV Spectrophotometry.  
   b) Separation of plasmid DNA by Agarose Gel Electrophoresis.  
4. Electrophoresis of Proteins by native PAGE and SDS-PAGE.  
5. Electron Microscope, Fluorescence Microscope (Lab Visit).  
8. Organic Preparations:  
   a) Acetylation of Primary Amine (Preparation of Acetanilide) | 2 |
| **PUBSTIII22-P2** (PRACTICAL based on PUBSTIII22-373 and PUBSTIII22-374) | 1. Passive Agglutination- RA Factor Test.  
2. Immunoelectrophoresis  
3. ELISA (Kit-based) - HEPALISA.  
4. DOT-ELISA.  
5. Western Blotting - Demonstration.  
7. Study of Human chromosomal disorders - Trisomy 21 Trisomy 13 Trisomy 18, Klinefelter and Turner, Cri-du-Chat.(Preferably using online software)  
10. Mapping based on Three Point Cross.(Problems)  
11. Pedigree Analysis- Autosomal and Sex-Linked. (Problems)  
12. Karyotyping: Video demonstration | 2 |
<table>
<thead>
<tr>
<th>Course code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
</table>
| PUSBTIII22-P3   | 1. Study of *E.coli* Diauxic Growth Curve- (Lactose and Glucose).  
2. Study of *lac* Gene Expression using Blue-White Selection.  
4. Screening for an Antibiotic Producing Strain of Microorganism.  
5. Lab Scale Production of Penicillin (Static and shaker).  
6. Purification of Penicillin from Broth Culture of *Penicillium spp.* by Solvent Extraction.  
8. Estimation of Penicillin from Recovered Broth by Biological (Bioassay) Method. | 2       |
### Course objectives:-
The objective of this course is to gain an insight into the metabolic processes associated with catabolism of carbohydrates, amino acids, lipids and nucleotides.

#### Learning outcomes:-
By the end of the course the student will be able to
- Understand the catabolic pathways of carbohydrates, amino acids, lipids and nucleotides.
- Explain the role of energy rich molecules in metabolism.

### UNIT I

**Carbohydrate Metabolism, ETS and Energy Rich Compounds**

#### Carbohydrate Metabolism:
- Glycolytic Pathway (Homolactic Fermentation; Alcoholic Fermentation)
- Citric Acid Cycle and its Regulation; Gluconeogenesis; Pentose Phosphate Pathway; Glyoxylate Pathway; Reductive TCA.
  - (Sequence of Reactions, Regulation, Energy Yield and Metabolic Disorders of the above pathways)

#### Electron Transport System:
- Electron Transport and Oxidative Phosphorylation, Inhibitors of ETS.

#### Energy Rich Compounds:
- ATP as Energy Currency, Structure of ATP, Hydrolysis, Other Energy Rich Compounds other than ATP like PEP, Creatine Phosphate, etc.

### UNIT II

**Amino Acid Metabolism**

#### Protein digestion and absorption
- Overview of Amino acid biosynthesis

#### Amino Acid Catabolism:
- Transamination, Deamination, Fate of Ammonia, Urea Cycle
- **Metabolic fate of carbon chain of amino acids:** Breakdown of Glucogenic and Ketogenic Amino Acids.

#### Amino Acids as Biosynthetic Precursors:
- Biosynthesis of Epinephrine, Dopamine, Serotonin, GABA, Histamine, Glutathione, Creatine, Indoleacetic acid and Cinnamate
UNIT III
Lipid and Nucleotide Metabolism

<table>
<thead>
<tr>
<th>Lipid Metabolism:</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digestion, Mobilization &amp; Transport of Fatty Acids.</td>
<td></td>
</tr>
<tr>
<td>Beta oxidation of Saturated Fatty Acids; Oxidation of Unsaturated Fatty Acids; Oxidation of Odd Chain Fatty Acids.</td>
<td></td>
</tr>
<tr>
<td>Alpha and Omega Oxidation of Fatty acids.</td>
<td></td>
</tr>
<tr>
<td>Ketone Body synthesis and breakdown.</td>
<td></td>
</tr>
<tr>
<td>(Sequence of Reactions, Regulation, Energy Yield and Metabolic Disorders of the above pathways)</td>
<td></td>
</tr>
</tbody>
</table>

Nucleotide Metabolism:
Degradation of Purines and Pyrimidines.

Learner’s space:
Anabolic pathways and Human genetic disorders affecting carbohydrates, amino acid, lipids and nucleotide metabolism can be studied.


Pedagogy: Flow-sheet preparation, metabolic pathway poster preparation, animated videos, Flipped classroom, Case study, Google classroom for E-notes.

Reference books:

ICT backup:
2. https://www.youtube.com/watch?v=ppqpUVaasNc
5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6331359/
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Credits</th>
<th>No. of Lectures</th>
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</thead>
<tbody>
<tr>
<td>PUSBTIV22-472</td>
<td>APPLIED CHEMISTRY –II</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

Course objectives: -
The objective of this course is to have a firm foundation in the fundamentals and applications of current chemical theories for the physical world.

Learning outcomes: - By the end of the course the student will:
- Develop an understanding of the different aspects of analytical chemistry.
- Gain knowledge of natural product chemistry and related acquired skills.
- Gain an understanding of basic concepts in polymer chemistry and Nanomaterials.

### UNIT I

#### Sampling and Separation Techniques

**Sampling:**
- Importance of Sampling and Sampling Techniques
- Types of Sampling - Random and Non-Random Sampling of Solids, Liquids and Gases.

**Separation Techniques:**
- Types of Separation Techniques - Filtration, Zone refining, Distillation, Vacuum Distillation.
- Solvent Extraction - Partition Coefficient and Distribution Ratio, Extraction Efficiency, Separation Factor, Role of Complexing Agents, Chelation, Ion pair Formation, Solvation, and Soxhlation.
- Centrifugation - Basic principles of sedimentation.

<table>
<thead>
<tr>
<th>UNIT II</th>
<th>Natural Product Chemistry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Product Chemistry:</td>
<td></td>
</tr>
<tr>
<td>Primary and Secondary Metabolites.</td>
<td></td>
</tr>
<tr>
<td>Distribution and biogenetic origin of natural products</td>
<td></td>
</tr>
</tbody>
</table>

**Natural products from Microorganisms and Fungi:** Antibiotics, non-antibiotic drugs from fungal and other microbial sources, microbial phytotoxins

**Natural products from plants:** Glycosides & Saponins, Alkaloids, Steroids & triterpenoids, Flavonoids, Coumarins & Lignans, Essential oils

15
| Chromatographic Separation of Natural Products: |
| Separation Techniques: |
| Planar chromatography: HPTLC |
| Column chromatography: HPLC, GC |

| UNIT III Polymers and Nanomaterials | Polymers: |
| Introduction to Polymers. |
| Types of Polymers - Monomer, Polymer, Homopolymer, Copolymer, Thermoplastics and Thermosets, Addition and Condensation Polymers (Examples and Uses) Stereochemistry of Polymers. Biodegradable Polymers. Nanomaterials: |
| Introduction to Nanomaterials. |
| Forms of Nanomaterials: Nanoparticles, Nanofilms and Nanotubes |
| Synthesis and Characterization of Nanomaterials. |
| Applications of Nanomaterials. |

Learners’ space:
Industrial applications of Sampling and Separation techniques, Structure elucidation of Natural products, Examples of nanomaterial products.

Pedagogy: PPTs, Preparation of charts, Video based lectures

References books:
1. Chemistry of Natural Products, O. P. Agarwal, Goel Publishing House
2. Trease and Evans Pharmacognosy, William C. Evans, 16th edition
10. Textbook of T.Y.B.Sc Analytical Chemistry Revised syllabus
11. Unit Operation of Chemical Engineering, 6th edition by Warren McCabe
12. S.Y.B.Sc Analytical Chemistry Textbook- Sheth Publishers
13. Basic Concepts of Analytical Chemistry- S.M. Khopkar
16. Polymer Science- V.R. Gowariker, Viswanathan
17. Nanomaterials: B. Viswanathan

ICT backup:
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Credits</th>
<th>No. of lectures</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUSBTIV22-473</td>
<td>MEDICAL MICROBIOLOGY</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

**Course objectives:**
The objective of this course is to gain insight into disease factors and processes and diseases caused by microorganisms.

**Learning outcomes:** By the end of the course the student will be able to:

- List the factors playing a role in causing a disease gain.
- Discuss the various aspects of systemic infections including causative agents, symptoms and prophylaxis.
- Gain the technical capability of handling, isolating and identifying various bacteria.

---

**UNIT I**

**Infectious Diseases**

**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.

---

**UNIT II**

**Medical microbiology - Causative Organisms - I**

**Skin:**
*S. aureus, S. pyogenes.*

**Respiratory Tract Infections:**

**Urinary Tract Infections:**
*E.coli:* Characteristics, Virulence, Clinical disease, and *E.coli* Infections. *Proteus.*

---

**UNIT III**

**Medical microbiology - Causative Organisms - II**

**GI Tract Infections:**
*Salmonella* and *Shigella spp.* (Characteristics, Virulence- Pathogenesis and Immunity, Clinical Disease, Carriers Lab Diagnosis, Phage Typing Prophylaxis)
| and Treatment).  
**Sexually Transmitted Diseases:**  
Syphilis and Gonorrhoea.  
**Nosocomial Infections:**  
*Pseudomonas aeruginosa*  
**Collection & processing of Clinical samples** |

**Learner’s space:**  
To learn biochemical identification of other microorganisms of related infections using Bergey’s Manual.

**MOOC:**  
1. [https://www.coursera.org/learn/epidemics#about](https://www.coursera.org/learn/epidemics#about)  
3. Bacteria and Chronic Infections | Coursera

**Pedagogy:** Google classroom & making crossword puzzle & group discussions on examples, Practical techniques, PowerPoint presentation with pictures, E- journals, Virtual labs.

**Reference Books:**  
2. N.Y Prescott’s Microbiology, 8th edition (2010), Joanne M Willey, Joanne Willey, Linda  
4. Text book of Medical Microbiology, Anantnarayan 7th Edition  
5. Microbiology- Frobisher, 9th Edition  

**ICT backup:**  
2. [https://www.healthline.com/health/klebsiella-oxytoca#symptoms](https://www.healthline.com/health/klebsiella-oxytoca#symptoms)  
3. [https://www.medicalnewstoday.com/articles/161858#medical-signs](https://www.medicalnewstoday.com/articles/161858#medical-signs)  
4. Lesson-10.pmd (nios.ac.in) Isolation & identification of Organisms  
5. [https://youtu.be/3T7TpyCOpCo](https://youtu.be/3T7TpyCOpCo)  
6. Bacterial Infections of the Respiratory Tract | Microbiology: Health and Disease (lumenlearning.com)
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Credits</th>
<th>No. of Lectures</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUSBTIV22-474</td>
<td>MOLECULAR DIAGNOSTICS</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

Course objectives:-
The objective of this course is learning and understanding molecular techniques and utilizing these techniques in diagnosis.

Learning outcomes:- By the end of the course the student will be able to:
- Gain an understanding of the basic principles used in molecular diagnosis.
- Gain critical thinking and analytical skills to understand new diagnostic methods.
- Apply the knowledge and skills gained in the course to be able to use in developing new diagnostic kits.

UNIT I  
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.

**Characterisation and analysis of Nucleic acids and Proteins:**
Extraction, Isolation and Detection of DNA, RNA and Proteins; Restriction Endonucleases and restriction enzyme mapping, RFLP.

**Hybridisation techniques:**
Southern, Northern, Western and FISH; Markers, probes and its Clinical applications.

UNIT II  
Nucleic acid amplification Method

**Target amplification:**
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.

**PCR Types:**
Reverse Transcriptase PCR, Real Time PCR, Multiplex PCR, Nested PCR Applications of PCR
| UNIT III Molecular Biology based Diagnostics | Disease identification and Genetic tests for following disorders: Thalassemia, Sickle Cell anaemia, Alzheimer’s disease. Molecular Diagnostics for infectious diseases: Molecular testing for Neisseria, Molecular diagnosis for HIV-1; Genetic Counselling and Molecular Diagnosis Genetic testing- Need and uses; genetic counselling. Case studies- Diagnostic testing for Cystic fibrosis; Fragile X diagnostic and Carrier testing. Ethical, Social and legal issues to molecular genetic testing | 15 |

**Learner’s space:**
Collect information about molecular therapeutics. Applications of PCR other than medical field.

**MOOC:**

**Pedagogy:** Activity, Videos, Virtual labs.

**Reference books:**
3. Molecular diagnostics for the clinical laboratorian by Coleman and Tsongalis, Humana Press publication

**ICT backup:**
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3768498/

29
Course Code | Title | Credits | No. of Lectures
---|---|---|---
PUSBTIV22-475 | BIOINFORMATICS and BIOSTATISTICS | 2 | 15

**Course objectives:**
The objective of this course is learning and understanding basic concepts of Bioinformatics and Biostatistics.

**Learning outcomes:** By the end of the course the student will be able to:
- Gain an understanding of the basic concepts of Bioinformatics and Biostatistics.
- Understand the tools used in bioinformatics.
- Apply the various statistical tools for analysis of biological data.

<table>
<thead>
<tr>
<th>UNIT I</th>
<th>Introduction to Computers and Biological Databases</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Computer Basics:</strong></td>
<td>Organization of a Computer; I/O Units; Computer Memory; Processor; Operating System. MS Word, Power point, Excel</td>
</tr>
<tr>
<td><strong>Internet Basics:</strong></td>
<td>Connecting to the Internet, E-mail, FTP, www, Difference between www and Internet.</td>
</tr>
<tr>
<td><strong>Biological Databases:</strong></td>
<td>Classification of Databases – General Introduction of Biological Databases; Nucleic acid databases (NCBI, DDBJ, and EMBL). Protein databases (Primary, Composite (KEGG), and Secondary (PIR). Structure databases (CATH &amp; SCOP)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>UNIT II</th>
<th>Sequence Alignments &amp;Visualization</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Local alignment and Global alignment</strong></td>
<td>Pairwise alignment (BLAST and FASTA Algorithm) <strong>BLAST and Sequence Alignment:</strong> BLAST and its Types; Retrieving Sequence using BLAST. <strong>Multiple Sequence Alignment:</strong> Progressive Alignment Algorithm (ClustalW), Application of multiple sequence alignment. <strong>Protein Structure Visualization Software</strong> (RasMol). <strong>Phylogenetic analysis:</strong> Definition and description of phylogenetic trees, comparison</td>
</tr>
</tbody>
</table>

15
of genetic sequences of organisms, Phylogenetic analysis tools.

| UNIT III 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 Mean, Paired and Unpaired; Chi square Test. | 15 |

Learner’s space:

MOOC:
2. https://www.coursera.org/learn/bioinformatics-methods-1

Pedagogy: Google classroom, online bioinformatics software, YouTube videos, Online Worksheets.

Reference books:-
2. Introduction to Bioinformatics by Attwood & Parry-Smith
3. Biostatistics by Malhan & Arora
5. Biostatistics by Veer Bala Rastogi

ICT backup:
2. https://www.ebi.ac.uk/
3. https://www.rcsb.org/
5. https://scope-international.online/biostatistics/
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Credits</th>
<th>No. of Lectures</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUSBTV22-476</td>
<td>ENVIRONMENTAL BIOTECHNOLOGY</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

**Course objectives:**
The course is an introduction to environmental biotechnology and focuses on the utilization of microbial processes in waste and water treatment.

**Learning outcomes:** By the end of the course the student will be able to:
- Understand the application of available energy sources.
- Understand the current applications of biotechnology to environmental quality evaluation, monitoring and remediation of contaminated environments.

<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Unit II</th>
<th>Biological processes for industrial effluent treatment - Aerobic biological treatment, Activated sludge process, CASP, Advanced activated sludge processes (any two) Biological filters, RBC, FBR Anaerobic biological treatment- Contact digesters, Packed bed reactors, Anaerobic baffled digesters, UASB. Solid waste treatment Pollution indicators &amp; biosensors - Biodegradation of xenobiotics— persistent compounds, chemical properties influencing biodegradability, microorganisms in biodegradation. Use of immobilized enzymes or microbial cells for treatment.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Unit III</td>
<td>Wastewater treatment: Introduction, Biological treatment, impact of pollutants on bio treatment, use of packaged organisms and genetically engineered organisms in waste treatment. Heavy metal pollution: Sources, microbial systems for heavy metal accumulation, techniques used for heavy metal removal. Bioremediation: Biosorption by bacteria, fungi and algae, factors affecting biosorption limitations of biosorption.</td>
</tr>
</tbody>
</table>

**Learner’s space:**
Learn production of zero carbon (or carbon negative) renewable fuels; Artificial Photosynthesis. Commercial application of use of consortia of microorganisms in Bioremediation.

**MOOC:**
1. Wastewater Treatment and Recycling - Course (nptel.ac.in), Duration - 12 weeks, Credit points - 3.
2. Environmental Biotechnology - Course (nptel.ac.in)

**Pedagogy:** Animated videos, Google classroom for E- Notes, Presentations, Group Discussion, YouTube videos, Case study of examples, E- Journals.

**Reference books:**
1. Environmental Biotechnology Allan Scragg Oxford University press
2. Environmental Biotechnology Indu Shekhar Thakur IK International (Basic concepts and applications).
3. Environmental Biotechnology by M. H. Fulekar
5. Environmental Chemistry – A. K. De

**ICT backup:**
1. https://www.youtube.com/watch?v=3UafRz3QeO8
2. https://www.csrir.res.in/achivement/csir-pride/energy
3. https://youtu.be/QERmaMtEtY8
5. https://youtu.be/uAyVcR17COs
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Credits</th>
<th>No. of Lectures</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUSBTIV22-477</td>
<td>RESEARCH METHODOLOGY</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

Course objectives:-
The objective of this course is to develop research aptitude, logical thinking and reasoning.

Learning outcomes:- By the end of the course the student will be able to:
- Understand basic principles of research methodology and identify a research problem.
- Understand a general definition of research design.
- Identify the overall process of designing a research study from its inception to its report.

<table>
<thead>
<tr>
<th>UNIT I Introduction to Research Methodology and Research Problem</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Meaning of Research; Objectives of Research; Motivation in Research; Types of Research; Research Approaches; Significance of Research; Research Methods versus Methodology; Research Process; Criteria of Good Research; Problems Encountered by Researchers in India; What is a Research Problem? Selecting the Problem; Necessity of Defining the Problem; Technique Involved in Defining a Problem</td>
<td>15</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>UNIT II Research Design and Data Collection</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Meaning of Research Design; Need for Research Design; Features of a Good Design; Important Concepts Relating to Research Design; Different Research Designs; Basic Principles of Experimental Designs; Developing a Research Plan-Collection of Primary Data; Observation Method; Interview Method; Collection of Data through Questionnaires; Collection of Data through Schedules; Other Methods of Data Collection, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method</td>
<td>15</td>
</tr>
</tbody>
</table>
UNIT III
Interpretation and Report Writing


Learner’s space:
Use of data collection methods in Semester VI projects, conducting survey-based research project, Exploring online software’s for statistical analysis of data

MOOC:
1. https://www.coursera.org/learn/research-methods,

Pedagogy: Google classroom, E-journals, Discussion, PPTs

Reference books:
1. Research Methodology: Methods and Techniques, C. R. Kothari, New Age International Publishers

ICT backup:
1. https://gradcoach.com/what-is-research-methodology/
3. https://eduvoice.in/types-research-methodology/
5. https://eduvoice.in/types-research-report-writing/
6. https://www.ox.ac.uk/students/academic/guidance/skills/plagiarism#:~:text=Plagiarism

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# PRACTICAL
## SEMESTER IV

<table>
<thead>
<tr>
<th>Course code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUSBTIV22-P1</td>
<td>Determination of Lactate Dehydrogenase (LDH) Activity in Blood Serum.</td>
<td>2</td>
</tr>
<tr>
<td>(PRACTICAL</td>
<td>2. Organ Function Tests: Liver (SGPT, SGOT); Kidney (Urea from Serum).</td>
<td></td>
</tr>
<tr>
<td>based on PUSBTIV22-471 and PUSBTIV22-472)</td>
<td>3. Estimation of Uric acid and Creatinine in Urine.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Qualitative Detection of Ketone Body in Urine.</td>
<td></td>
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<tr>
<td></td>
<td>5. Isolation of Mitochondria and Demonstration of ETC using a Marker Enzyme.</td>
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<tr>
<td></td>
<td>7. Identification of Organic Compounds of Known Chemical Type (Min 4 Compounds).</td>
<td></td>
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<tr>
<td></td>
<td>8. Instrumentation - GC, HPLC, HPTLC analysis (Lab visit)</td>
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<tr>
<td></td>
<td>9. Qualitative detection of Secondary metabolites</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10. Separation of any one secondary metabolite by TLC</td>
<td></td>
</tr>
<tr>
<td></td>
<td>11. Chemical and Biological Synthesis of Silver Nanoparticles and its characterisation by UV- Vis Spectrophotometer.</td>
<td></td>
</tr>
<tr>
<td>PUSBTIV22-P2</td>
<td>Identification of S. aureus-Isolation, Catalase, Coagulase Test.</td>
<td>2</td>
</tr>
<tr>
<td>(PRACTICAL based on PUSBTIV22-473 and PUSBTIV22-474)</td>
<td>2. Identification of E. coli-Isolation, Sugar Fermentations, IMViC.</td>
<td></td>
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<tr>
<td></td>
<td>3. Identification of Salmonella- Isolation, Sugar Fermentations, TSI Slant.</td>
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<tr>
<td></td>
<td>4. Identification of Pseudomonas - Isolation, Urease test, Oxidase Test, TSI Slant.</td>
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</tr>
<tr>
<td></td>
<td>5. RPR Test (Kit Based).</td>
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<tr>
<td></td>
<td>7. Isolation, Quantitative Analysis and AGE of Genomic DNA from Yeast.</td>
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<td></td>
<td>8. Isolation and Quantification of RNA from Yeast.</td>
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<tr>
<td></td>
<td>10. RFLP- Kit Based.</td>
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</tr>
<tr>
<td></td>
<td>11. DNA Amplification – PCR.</td>
<td></td>
</tr>
<tr>
<td>Course code</td>
<td>Title</td>
<td>Credits</td>
</tr>
<tr>
<td>--------------</td>
<td>----------------------------------------------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>PUSBTIV22-P3</td>
<td>1. MS Power point, MS Excel</td>
<td>2</td>
</tr>
<tr>
<td>(PRACTICAL</td>
<td>2. Familiarization with NCBI, EMBL, DDBJ, PIR, KEGG</td>
<td></td>
</tr>
<tr>
<td>based on</td>
<td>Databases.</td>
<td></td>
</tr>
<tr>
<td>PUSBTIV22-475</td>
<td>3. Use of NCBI BLAST Tool.</td>
<td></td>
</tr>
<tr>
<td>and</td>
<td>4. Pairwise and Multiple Sequence Alignment and Phylogeny.</td>
<td></td>
</tr>
<tr>
<td>PUSBTIV22-476</td>
<td>5. Classification of Proteins using CATH/SCOP.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7. Determination of Total solids from an effluent sample.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8. Study of physico-chemical parameters (pH, colour,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>turbidity, BOD, COD) of an industrial effluent sample.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>9. Most Probable Number (MPN) – Presumptive, Confirmed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>and Completed tests.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>11. Visit to STP / CETP</td>
<td></td>
</tr>
</tbody>
</table>

**Summer Training:**

1. This should be taken up in the summer over a period of one month preferably in an immunology / veterinary / virology institute or a laboratory using recombinant DNA methods.
2. The students could also be assigned to assist a clinic (in a hospital), a fermentation plant, brewery or bakery and watch the various stages in brewing and baking and post-fermentation processing. Prior arrangement must be made on the mode of interaction of the educational institute with the clinic and the industry.
Evaluation pattern S.Y Biotechnology (Autonomous) 2022 -2023

1. Core Courses: The College will conduct all the Semester examinations of 100 marks per Theory Paper in the prescribed pattern of 40 marks of internal assessment/Project work and 60 marks for Semester end examination. The student will have to secure a minimum of 40% marks in Internal assessment as well as Semester end examination per theory paper.

2. In each semester, the student will have to submit a Project/Assignment/Journal for theory papers in the College before appearing for the Semester End Examination.

3. The Project work will be carried out by the student with the guidance of the concerned Faculty Member who will be allotted to the student as the Guide for the Project.

4. The College will conduct all the Semester examinations of 100 marks per Practical Paper at the end of each semester. The student will have to secure a minimum of 40% marks in the examination per practical paper.

Evaluation Pattern
For S.Y.B.Sc. Biotechnology (Theory)

<table>
<thead>
<tr>
<th>1.</th>
<th>INTERNAL ASSESSMENT</th>
<th>40 Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>One class test (Objectives/ Multiple Choice)</td>
<td>20 Marks</td>
</tr>
<tr>
<td>1.2</td>
<td>Assignment/ Project/ Presentation/Book or Research paper review report/Business proposal presentation/Case-study</td>
<td>15 Marks</td>
</tr>
<tr>
<td>1.3</td>
<td>Active Participation, Overall performance</td>
<td>05 Marks</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2.</th>
<th>EXTERNAL ASSESSMENT (Semester End Examination)</th>
<th>60 Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>N.B. 1. All questions are compulsory</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. All questions carry equal marks.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Q.1. Based on Unit-I, II & III
Multiple choice questions/Fill in the blanks /Match the column/Give one word/Name the following/Give an example/Explain the term/Define/Give significance/State the role of

| 12 |

Q.2. Unit-I
Long Answer Question
Short Answer Question

| 12 |

Q.3. Unit-II
Long Answer Question
Short Answer Question

<p>| 12 |</p>
<table>
<thead>
<tr>
<th>Q.4.</th>
<th>Unit-III</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Long Answer Question</td>
<td>12/08/06</td>
</tr>
<tr>
<td></td>
<td>Short Answer Question</td>
<td>04/02</td>
</tr>
<tr>
<td>Q.5.</td>
<td>Short Notes based on Unit I, II and III (Solve any three out of six)</td>
<td>12</td>
</tr>
</tbody>
</table>

**Practical**

<table>
<thead>
<tr>
<th>EXTERNAL ASSESSMENT (Practical)</th>
<th>100 Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experiment - 1 (Major technique)</td>
<td>25</td>
</tr>
<tr>
<td>Experiment - 2 (Major technique)</td>
<td>25</td>
</tr>
<tr>
<td>Experiment - 3 (Minor technique)</td>
<td>15</td>
</tr>
<tr>
<td>Experiment - 4 (Minor technique)</td>
<td>15</td>
</tr>
<tr>
<td>Viva/Identification/Spots</td>
<td>10</td>
</tr>
<tr>
<td>Journal</td>
<td>10</td>
</tr>
<tr>
<td><strong>TOTAL MARKS</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>
Revised Syllabus for T.Y.B.Sc.
Programme- B.Sc.
Course- Biotechnology (USBT)
(Third Year – Sem. V & VI)

(Credit Based Semester and Grading System with effect from the academic year 2018-2019)
# TYBSC Biotechnology Course Structure

## Semester V

<table>
<thead>
<tr>
<th>Course code USBT</th>
<th>Title</th>
<th>Theory /Practical</th>
<th>Marks</th>
<th>Credits</th>
<th>Nos of Lectures &amp; Practical</th>
</tr>
</thead>
<tbody>
<tr>
<td>501</td>
<td>Cell biology</td>
<td>Theory</td>
<td>100</td>
<td>2.5</td>
<td>60</td>
</tr>
<tr>
<td>502</td>
<td>Medical Microbiology &amp; Instrumentation</td>
<td>Theory</td>
<td>100</td>
<td>2.5</td>
<td>60</td>
</tr>
<tr>
<td>503</td>
<td>Genomes and Molecular Biology</td>
<td>Theory</td>
<td>100</td>
<td>2.5</td>
<td>60</td>
</tr>
<tr>
<td>504</td>
<td>Marine Biotechnology</td>
<td>Theory</td>
<td>100</td>
<td>2.5</td>
<td>60</td>
</tr>
<tr>
<td>P501+502</td>
<td>Cell biology + Medical Microbiology &amp; Instrumentation</td>
<td>Practical</td>
<td>100</td>
<td>3.0</td>
<td>72</td>
</tr>
<tr>
<td>P503+504</td>
<td>Genomes and Molecular Biology + Marine Biotechnology</td>
<td>Practical</td>
<td>100</td>
<td>3.0</td>
<td>72</td>
</tr>
<tr>
<td>Applied Component</td>
<td>Biosafety</td>
<td>Theory</td>
<td>100</td>
<td>2.0</td>
<td>48</td>
</tr>
<tr>
<td></td>
<td>Biosafety</td>
<td>Practical</td>
<td>100</td>
<td>2.0</td>
<td>48</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td>800</td>
<td>20</td>
<td>480</td>
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</tbody>
</table>
### Semester VI

<table>
<thead>
<tr>
<th>Course code USBT</th>
<th>Title</th>
<th>Theory/Practical</th>
<th>Marks</th>
<th>Credits</th>
<th>Nos of Lectures &amp; Practical</th>
</tr>
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<tbody>
<tr>
<td>601</td>
<td>Biochemistry</td>
<td>Theory</td>
<td>100</td>
<td>2.5</td>
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<tr>
<td>602</td>
<td>Industrial Microbiology</td>
<td>Theory</td>
<td>100</td>
<td>2.5</td>
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<tr>
<td>603</td>
<td>Pharmacology and Neurochemistry</td>
<td>Theory</td>
<td>100</td>
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<td>604</td>
<td>Environmental Biotechnology</td>
<td>Theory</td>
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<td>2.5</td>
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<td>P 601-P 602</td>
<td>Biochemistry &amp; Industrial Microbiology</td>
<td>Practical</td>
<td>100</td>
<td>3</td>
<td>72</td>
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<tr>
<td>P 603-P 604</td>
<td>Pharmacology - Neurochemistry and Environmental Biotechnology (50M)+ Project work (50M)</td>
<td>Practical</td>
<td>100</td>
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<tr>
<td>Applied component</td>
<td>Agribiotechnology</td>
<td>Theory</td>
<td>100</td>
<td>2.0</td>
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<tr>
<td>Applied component</td>
<td>Agribiotechnology</td>
<td>Practical</td>
<td>100</td>
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<td>800</td>
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</table>

**Teaching pattern:**

One (01) Credit would be of thirty- forty (30-40) learning hours; of this more than fifty percent of the time will be spent on class room instructions including practical as prescribed by the University. Rest of the time spent invested for assignments, projects, journal writing, case studies, library work, industrial visits, attending seminars / workshops, preparations for examinations etc. would be considered as notional hours. The present syllabus considers (60L as class room teaching and 15 lectures as Notional hours/ paper). Each lecture duration would be for 48 min.

The names of the reference books provided in the syllabus are for guidance purpose only. Students and faculty are encouraged to explore additional reference books, online lectures, videos, science journals for latest/ additional information.
Examination pattern for:

Theory:

- The question paper for the Term End Exam would be of **100 marks** consisting of 5 Questions (20M each), of which one question would be common for all units in the syllabus.
- The question paper would be set for 150 marks including internal options.
- There shall be no internal exam for any paper.

Practical:

- Would be conducted over a period of 3 days; 50M each paper.
- Each student to perform 2 major and 2 minor practical for Sem V and 2 major and project presentation for Sem VI ,
- Viva would be conducted during the practical during Sem V; Sem VI would have ONLY project presentation
- Journals would be uniform throughout all the centres; matter would be communicated to all the centres by the syllabus committee.
- Distribution of marks for the experiments carried out during the examination:
  
  **Sem V (50M/paper)**: Major: 20M; Minor: 10M; Viva: 10M; Journal 10M.  
  **Sem VI (50M/paper)**: Major (x2): 40M; Journal: 10M; Project 50M

  The report could be around 25-30 pages with appropriate referencing and formatting. Marks distribution for the project would be as follows: 25M documentation, 15M presentation, 10 M viva and interactions;
- Students would undertake a project for 1-2 months during the last semester for 50 M. The project **should** include **either** of the following:
  1. One/ more major instrumentation OR
  2. One / more major technique/s required in the field of interest OR
  3. Bioinformatics OR
  4. Biostatistics
<table>
<thead>
<tr>
<th>Course code</th>
<th>Title</th>
<th>Unit</th>
<th>Topics</th>
<th>Credit</th>
<th>No of Lectures</th>
</tr>
</thead>
<tbody>
<tr>
<td>501 Cell Biology</td>
<td>I: Cell cycle</td>
<td></td>
<td>Cell cycle Introduction: Prokaryotic and Eukaryotic- (3 \text{ Lectures;}) The Early Embryonic Cell Cycle and the Role of MPF- (4 \text{ Lectures;}) Yeasts and the Molecular Genetics of Cell-Cycle Control – (4 \text{ Lectures;}) Apoptosis, Cell-Division Controls in Multicellular Animals- (4 \text{ Lectures;})</td>
<td>2.5</td>
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</tr>
<tr>
<td></td>
<td>II: Cell Signallning</td>
<td></td>
<td>Cell signalling and signal transduction:Introduction General Principles of Cell Signaling - (3 \text{ Lectures;}) Signaling via G-Protein-linked Cell-Surface Receptors - (3 \text{ Lectures;}) Signaling via Enzyme-linked Cell-Surface Receptors - (3 \text{ Lectures;}) Target-Cell Adaptation, The Logic of Intracellular - (3 \text{ Lectures;}) Signaling: Lessons from Computer-based &quot;Neural Networks&quot;- (3 \text{ Lectures;})</td>
<td>2.5</td>
<td>15</td>
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<tr>
<td></td>
<td>III: Developmental Biology</td>
<td></td>
<td>Overview of how the modern era of developmental biology emerged through multidisciplinary approaches - (5 \text{ Lectures;}) Stages of development- zygote, blastula, gastrula, neurula cell fate &amp; commitment – potency- concept of embryonic stem cells, differential gene expression, terminal differentiation ,lineages of three germ layers, fate map - (6 \text{ Lectures;}) Mechanisms of differentiation- cytoplasmic determinants, embryonic induction, concept of morphogen, mosaic and regulative development Pattern formation-- axis specification, positional identification (regional specification), Morphogenetic movements, Model organisms in Developmental biology - (4 \text{ Lectures;})</td>
<td>2.5</td>
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</tr>
<tr>
<td></td>
<td>IV: Cancer Biology</td>
<td></td>
<td>Cancer: Introduction, Cancer as a Microevolutionary Process - (4 \text{ Lectures;}) The Molecular Genetics of Cancer - (6 \text{ Lectures;}) Cancer and Virus Cancer diagnosis and chemotherapy - (5 \text{ Lectures;})</td>
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<td>Total</td>
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References:

5. Developmental Biology; Scott Gilbert; 9th Edition
<table>
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<th>Course code</th>
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<th>Unit</th>
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<th>No of Lectures</th>
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<tr>
<td>USBT</td>
<td></td>
<td></td>
<td>I: Virology</td>
<td>15</td>
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<tr>
<td>502</td>
<td>Medical Microbiology and Instrumentation</td>
<td>502</td>
<td>Introduction to viruses-Position in biological spectrum; Virus properties - <strong>2 Lectures</strong>; General structure of viruses Baltimore Classification and Taxonomy(ICTV) - <strong>2 Lectures</strong>; Cultivation of viruses - <strong>2 Lectures</strong>; Reproduction of ds DNA phages Hepatitis /ss RNA (influenza), animal viruses and plant (TMV) virus - <strong>4 Lectures</strong>; Virus purification and assays - <strong>2 Lectures</strong>; Cytocidal infections and cell damage - <strong>2 Lectures</strong>; Viroids and Prions - <strong>1 Lecture</strong></td>
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<tr>
<td>502</td>
<td></td>
<td></td>
<td>II: Chemotherapeutic drugs</td>
<td>15</td>
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<tr>
<td>502</td>
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<td></td>
<td>Discovery and Design of antimicrobial agents - <strong>1 Lecture</strong>; Classification of Antibacterial agents, Selective toxicity, MIC, MLC - <strong>2 Lectures</strong></td>
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<td>502</td>
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<td>Inhibition of cell wall synthesis (Mode of action for): Beta lactam antibiotics: Penicillin, Cephalosporins; Glycopeptides: Vancomycin; Polypeptides: Bacitracin - <strong>2 Lectures</strong></td>
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<tr>
<td>502</td>
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<td></td>
<td>Injury to Plasma membrane: Polymyxin – <strong>1 Lecture</strong>; Inhibition of protein synthesis Aminoglycosides, Tetracyclines Chloramphenicol, Macrolides- Erythromycin- <strong>2 Lectures</strong>; Inhibition of Nucleic acid synthesis: Quinolones, Rifampicin, Metronidazole - <strong>2 lectures</strong>; Antimetabolites: Sulphonamides, Trimethoprim - <strong>1 lecture</strong>; Drug Resistance: Mechanism, Origin and transmission of drug resistance - <strong>1 lecture</strong>; Use and misuse of antimicrobial agents - <strong>1 lecture</strong>; Antifungal drugs, Antiviral drugs - <strong>2 lectures</strong></td>
<td></td>
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</tr>
</tbody>
</table>
III: Spectroscopy

Principle, instrumentation, working
and applications of:
Fluorescence Spectroscopy - \(3\) Lectures
Luminometry - \(3\) Lectures
Light scattering spectroscopy - \(3\) Lectures
Infrared Spectroscopy - \(3\) Lectures
Atomic absorption Spectroscopy - \(3\) Lectures

IV: Bio-analytical techniques

Principle, working and applications of:
Affinity chromatography - \(2\) Lectures
Ion-exchange chromatography - \(2\) Lectures
Molecular (size) exclusion chromatography - \(2\) Lectures;
HPLC - Method development and
validation- \(3\) Lectures;
Isotopes in Biology: Nature of
radioactivity - \(1\) Lecture;
Detection Techniques using GM
counter, Scintillation counter,
autoradiography - \(4\) Lectures;
Applications of Tracer techniques in
Biology - \(1\) Lecture

Total 60

References:
1. Principles and techniques in biochemistry and molecular biology (2010), Keith
   Sheehan , John Wiley & Sons Ltd
4. HPLC method validation for pharmaceuticals: a review (2013), Harshad V.
   Paithankar, International Journal of Universal Pharmacy and Bio Sciences 2(4): July-
   August.
5. Mim’s Medical Microbiology 5th edition
7. Medical Microbiology Jawetz,E., Brooks,G.E, Melnick,J.L., Butel,J.S Adelberg E. A
   18th edition
8. Medical Microbiology by Patrick Murray 5th edition
10. Understanding Viruses by Teri Shors
PRACTICALS

USBT P 501-502 3 credits 72hrs

1. Separation of components from a mixture using Affinity chromatography  
   (Kit may be used)
2. Separation of components from a mixture using ion exchange chromatography  
   (Kit may be used)
3. Separation of components from a mixture using Size exclusion chromatography  
   (Kit may be used)
4. HPLC method validation.
5. MIC and MLC of any one antibiotic
6. Antibiotic sensitivity test using agar cup method
7. Antibiotic sensitivity test using paper disc method
9. Cancer Biology: (Field visit and 2 page report in the journal)
10. Chick embryo candling and inoculation methods Demonstration experiment
11. Book review (Emperor of all Maladies)
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Unit</th>
<th>Topics</th>
<th>Credit</th>
<th>No of Lectures</th>
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<tbody>
<tr>
<td>USBT 503</td>
<td>Genomics and Molecular Biology</td>
<td>I: Genetic engineering of plants</td>
<td>Genetic engineering of plants; Methodology. Plant transformation with the Ti plasmid of <em>A. tumefaciens</em>, Ti plasmid derived vector system - <strong>4 Lectures</strong>; Transgenic plants: Physical methods of transferring genes to plants: electroporation, microprojectile bombardment, liposome mediated, protoplast fusion - <strong>5 Lectures</strong>; Vectors for plant cells - <strong>4 Lectures</strong>; Improvement of seed quality protein - <strong>2 Lectures</strong></td>
<td>2.5</td>
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<td>II: Transgenic Animals</td>
<td>Transgenic mice- methodology-retroviral method, DNA microinjection, ES method - <strong>5 Lectures</strong>; genetic manipulation with cre-loxP - <strong>2 Lectures</strong>; Vectors for animal cells - <strong>2 Lectures</strong>; Transgenic animals recombination system - <strong>2 Lectures</strong>; Cloning live stock by nuclear transfer - <strong>2 Lectures</strong>; Green Fluorescent Protein - <strong>1 Lectures</strong></td>
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<tr>
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<td></td>
<td>III: Tools in Molecular Biology</td>
<td>Cloning vectors-Plasmids (pUC series), Cosmids, phagemids M13, shuttle vectors, YAC vectors, expression vectors pET - <strong>4 Lectures</strong>; Gene cloning-Isolation and purification of DNA; Isolation of gene of interest: Restriction digestion, electrophoresis, blotting, cutting, and joining DNA, methods of gene transfer in prokaryotes and eukaryotes - <strong>3 Lectures</strong>; Recombinant selection and screening methods: genetic, immunochemical, Southern and Western analysis, nucleic acid hybridization, HART, HRT- <strong>2 Lectures</strong>; Expression of cloned DNA molecules and maximization of expression - <strong>2 Lectures</strong>; Cloning strategies-genomic DNA libraries, cDNA libraries, chromosome walking and jumping - <strong>4 Lectures</strong></td>
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<td>IV: Gene sequencing and editing</td>
<td>Maxam Gilbert’s method, Sanger’s dideoxy method, Automated DNA sequencing, Pyrosequencing - <strong>6 Lectures</strong>; Human genome mapping and it’s implications in health and disease - <strong>3 Lectures</strong>; RNAi, ZNF(Zinc finger nuclease), TALENS(Transcription Activator Like Effector Nuclease), CRISPER/Cas system(Clustered Regularly Interspersed Repeats) - <strong>6 Lectures</strong></td>
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<th>Topics</th>
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<th>No. of Lectures</th>
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<tr>
<td>USBT 504</td>
<td>Marine Biotechnology</td>
<td>I:</td>
<td>Introduction to Marine Biotechnology- 1 lecture; The marine ecosystem and its functioning: intertidal, estuarine, salt marsh, mangrove, coral reef, coastal &amp; deep sea ecosystems. Hydrothermal vents- 4 lectures; Bioprospecting, Marine Microbial Habitats and Their Biotechnologically relevant Microorganisms- 2 lectures; Methods for Microbial Bioprospecting in Marine Environments - 2 lectures; Biotechnological Potential of Marine Microbes - 1 lecture; Bioactive compounds from other Marine Organisms: fungi, Microalgae, Seaweeds, Actinomycetes, sponges - 5 lectures</td>
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<td>II:</td>
<td>Drugs from Marine organisms: Pharmaceutical compounds from marine flora and fauna - marine toxins, antiviral and antimicrobial agents - 4 lectures; Approved Marine Drugs as Pharmaceuticals - 2 lectures; Marine Natural products and its Challenges - 2 lectures; Marine Microbial Enzymes- Marine Extremozymes and Their Significance, Current Use of Marine Microbial Enzymes - 7 lectures.</td>
<td>2.5</td>
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<td>III:</td>
<td>Marine Functional Foods: Marine Sources as Healthy Foods or Reservoirs of Functional Ingredients - 3 lectures; Marine-Derived Ingredients with Biological Properties- 3 lectures; Functional Foods Incorporating Marine-Derived Ingredients - 2 lectures; Marine Nutraceuticals: Marine Bioactives as Potential Nutraceuticals, Functional Carbohydrates, Polyunsaturated Fatty Acids- 3 lectures; Carotenoids, Soluble Calcium, Fish Collagen and Gelatin, Marine Probiotics - 4 lectures.</td>
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<tr>
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<td>IV:</td>
<td>Marine Bioresources, Marine Secondary Metabolites, Marine Proteins, Marine Lipids- 4 lectures; Cosmetics from Marine Sources: Scenario of Marine Sources in the Cosmetic Industry, Cosmetics: Definition and Regulations,</td>
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</table>
Cosmetics | Cosmeceuticals, Target Organs and Cosmetics Delivery Systems, Components of Cosmetics, Major Functions of Some Marine Components in Cosmetics and Cosmeceuticals, Treatments Based on Marine Resources, Products Based on Marine Resources - **11 lectures.**
---|---
Total | 60

**References:**
PRACTICALS

USBT P 503-504  3 credits  72hrs

1. Transformation in \textit{E.coli}.
3. Restriction enzyme digestion and ligation (Kit may be used).
4. Phage titration: \textit{Demonstration}
5. Polymerase chain reaction. \textit{Demonstration}
6. Gradient plate technique
7. Bacterial gene expression (Kit may be used).
8. Study of any 5 marine bacteria and algae (Macro and micro)
9. DPPH assay for antioxidant extracted from marine algae
10. Extraction of carotenoids from marine algae/Bacteria/Fungi
12. Extraction of alkaloids from marine organisms and their separation by TLC.
<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
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<th>Topics</th>
<th>Credits</th>
<th>Lectures</th>
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<tbody>
<tr>
<td>I: Introducti on to biosafety</td>
<td>Introduction</td>
<td>Medical - 1 lecture</td>
<td>Biological Risk Assessment, Hazardous Characteristics of an Agent - 2 lectures; Genetically modified agent hazards - 1 lecture; Cell cultures - 1 lecture; Hazardous Characteristics of Laboratory Procedures - 1 lecture; Potential Hazards Associated with Work Practices - 2 lectures; Safety Equipment and Facility Safeguards - 2 lectures; Pathogenic risk and management - 2 lectures.</td>
<td>15</td>
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<tr>
<td>II: GLP</td>
<td>Concept of GLP- 1 lecture</td>
<td>Practicing GLP- 1 lecture</td>
<td>Guidelines to GLP - 2 lectures; Documentation of Laboratory work - 1 lectures; Preparation of SOPs - 2 lectures; Calibration records - 1 lectures; Validation of methods - 1 lecture; Documentation of results - 1 lecture; Audits &amp; Audit reports - 1 lecture.</td>
<td>12</td>
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<tr>
<td>III: Detection and testing of contaminants</td>
<td>Microbial Contamination in food and pharma product - 3 lectures; Some common microbial contaminants - 3 lectures; Microbiological Assays for pharmaceutical products - 4 lectures; Regulatory Microbiological testing in pharmaceuticals - 3 lectures.</td>
<td>12</td>
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<tr>
<td>IV: Biosafety in Biotechnology</td>
<td>Concepts on biosafety in Biotechnology - 2 lectures; Regulating rDNA technology - 2 lectures; Regulating food and food ingredients - 3 lectures; Genetically engineered crops, livestock Bioethics - 3 lectures; Contemporary issues in Bioethics - 2 lectures.</td>
<td>12</td>
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</table>
References:

PRACTICALS

Applied Component- Biosafety 2 Credits 48hours

1. Validation of micropipette, measuring cylinders, colorimeters
2. Calibration of pH meter and weighing balance
3. Vitamin B12 bioassay
4. Testing for adulterants in food; ex. Starch in milk
5. Making SOP for any 2 major laboratory instruments
6. Sterility of injectables
## Semester VI

<table>
<thead>
<tr>
<th>Course Code USBT</th>
<th>Title</th>
<th>Unit</th>
<th>Topics</th>
<th>Credits</th>
<th>Lectures</th>
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<tr>
<td>601</td>
<td>Biochemistry</td>
<td>I: Protein Biochemistry</td>
<td>Protein structure: Protein Tertiary and Quaternary Structures - <strong>2 Lectures</strong>; Protein Denaturation and Folding – <strong>3 Lectures</strong>; Protein Function: Reversible Binding of a Protein to a Ligand: Oxygen-Binding Proteins – <strong>2 Lectures</strong>; Complementary Interactions between Proteins and Ligands: Immunoglobulins – <strong>1 Lecture</strong>; Protein Interactions Modulated by Chemical Energy: Actin, Myosin, and Molecular Motors - <strong>3 Lectures</strong>; Protein purification – <strong>4 Lectures</strong>.</td>
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<td>II: Metabolism</td>
<td>Carbohydrate biosynthesis and its regulation: Peptidoglycan in Bacteria - <strong>2 Lectures</strong>; Starch and sucrose in Plants - <strong>4 Lectures</strong>; Glycogen in Animals - <strong>4 Lectures</strong>; Biosynthesis and regulation of Cholesterol, Atherosclerosis – <strong>5 Lectures</strong>.</td>
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<tr>
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<td></td>
<td>III: Endocrinology</td>
<td>Mechanism of action of group I and II hormones- <strong>1 Lecture</strong>; Structure, storage, release, transport, biochemical functions and disorders associated with hormones secreted by Hypothalamus - <strong>1 Lecture</strong>; Anterior Pituitary gland - GH, stimulating hormones) - <strong>1 Lecture</strong>; Posterior Pituitary gland – oxytocin and vasopressin - <strong>1 Lecture</strong>; Thyroid gland – Thyroxine, calcitonin - <strong>2 Lectures</strong>; Parathyroid gland – PTH - <strong>1 Lecture</strong>; Adrenal medulla – epinephrine and norepinephrine - <strong>1 Lecture</strong>; Adrenal cortex – Glucocorticoids - <strong>1 Lecture</strong>; Pancreas – insulin and glucagon - <strong>2 Lectures</strong>; Female Gonads – estrogen and progesterone - <strong>2 Lectures</strong>; Male gonads – testosterone- <strong>1 Lecture</strong>; Placenta – hCG - <strong>1 Lecture</strong>.</td>
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<td>IV:</td>
<td>Minerals and Vitamins;</td>
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</table>
Nutrition
Dietary sources, bioactive form, functions and disorders associated with fat soluble (A, D, E, K) and water soluble vitamins-
7 Lectures;
Minerals - physiological and biochemical functions of principal and trace elements. - 7 Lectures;
Malnutrition – Over nutrition (obesity) and PEM (Kwashiorkor and Marasmus)- 1 Lecture.

| Total | 60 |

References:

2. Biochemistry, 4th edition (2010), Voet and Voet, John Wiley and sons, USA
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Unit</th>
<th>Topics</th>
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<th>No. of Lectures</th>
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<tr>
<td>USBT 602</td>
<td>Industrial Microbiology</td>
<td>I: Dairy technology</td>
<td>Milk: Normal flora, changes in raw milk - 2 lectures; Enumeration - 1 lecture; Factors affecting bacteriological quality - 1 lecture; Dairy technology Preservation methods - 2 lectures; Pasteurization - 1 lecture; Starter Cultures - 2 lectures; Fermented products: Production process and spoilage of Cheese: Swiss and Cheddar - 2 lectures; Butter - 2 lectures; Yogurt - 1 lectures and Buttermilk - 1 lecture.</td>
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<td>II: Down-stream Processing (DSP)</td>
<td>Introduction of DSP - 2 lectures; Foam separation - 1 lecture; Types of Precipitation - 1 lecture; Filtration 2 lectures, Centrifugation - 1 lecture; Chromatography in DSP - 2 lectures; Cell disruption - physical and chemical methods - 2 lectures; Solvent recovery, Membrane processes - 1 lecture; Drying - 1 lecture; Crystallization and Whole broth processing - 2 lectures.</td>
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<tr>
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<td>III: Fermentation process</td>
<td>Introduction to Inoculum development - 2 lectures; Bacterial and fungal inoculum development with one example each - 3 lectures, scale up, scale down - 2 lectures; Production of: Streptomycin - 1 lecture; Protease - 1 lecture; Mushroom - 1 lecture; Glutamic acid - 1 lecture; Lysine - 1 lecture, ethanol production 1 lecture; Semi-synthetic Penicillin 1 lecture, Biotransformation - 1 lecture.</td>
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<td>IV: QA-QC</td>
<td>Concept of GMP - 1 Lectures; Requirements of GMP implementation - 2 Lectures; Documentation of GMP practices - 2 Lectures; Regulatory certification of GMP - 2 Lectures; Quality Control (QC): Concept of QC - 2 Lectures; Requirements for implementing QC -</td>
<td></td>
<td>15</td>
</tr>
</tbody>
</table>
References:

3. Industrial Microbiology Prescott and Dunn CBS publishers
4. Dairy technology by Yadav and Grower
5. Fermentation technology by Stanbury and Whittkar
6. Pharmaceutical Microbiology by Russel and Hugo
PRACTICALS

USBT P 601-602  3 credits  72hrs

1. Estimation of Milk protein-Pynes method
2. Microbial analysis of Milk by MBRT and RRT
3. Phosphatase test in Milk
4. DMC of milk sample
5. Isolation of Normal flora from Milk and curd
6. Determination of blood glucose levels for detection of diabetes mellitus.
7. Determination of serum cholesterol (total, HDL and LDL ratio)
8. Estimation vitamin C by DCPIP method from food samples.
<table>
<thead>
<tr>
<th>Course Code USBT</th>
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<tbody>
<tr>
<td>603</td>
<td>Basic pharmacology and Neurochemistry</td>
<td>I: General principles of Pharmacology</td>
<td>Mechanism of drug action - 2 Lectures; drug receptors and biological responses - 2 Lectures; second-messenger systems, the chemistry of drug–receptor binding - 2 Lectures; dose–response relationship: therapeutic index - 3 Lectures; ED, LD, - 2 Lectures; Potency and Intrinsic Activity - 2 Lectures; Drug antagonism - 2 Lectures.</td>
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<td>II: Drug Absorption and Distribution</td>
<td>Absorption of drugs from the alimentary tract - 2 Lectures; factors affecting rate of gastrointestinal absorption - 2 Lectures; absorption of drugs from lungs - 1 Lecture; skin - 1 Lecture; absorption of drugs after parenteral administration factors influencing drug distribution - 2 Lectures; binding of drugs to plasma proteins - 2 Lectures; Physiological barriers to drug distribution - 3 Lectures.</td>
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<td>III: Basic Toxicology and Regulatory Toxicology</td>
<td>Background Definitions - 1 Lectures; Causation: degrees of certainty Classification - 1 Lectures; Causes Allergy in response to drugs Effects of prolonged administration: chronic organ toxicity - 2 Lectures; Adverse effects on reproduction - 1 Lecture; Poisons: Deliberate and accidental self-poisoning Principles of treatment Poison-specific measures General measures - 2 Lectures; Specific poisonings: cyanide, methanol, ethylene glycol, hydrocarbons, volatile solvents, heavy metals, - 3 Lectures; herbicides and pesticides, - 2 Lectures; biological substances (overdose of medicinal drugs is dealt with under individual agents) - 1 Lecture; Incapacitating agents: drugs used for torture - 1 Lecture; Nonmedical use of drugs - 1 Lecture.</td>
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<td>IV: Neurochemistry</td>
<td>Anatomy and functioning of the brain - 2 Lectures; Neuronal pathways - 2 Lectures;</td>
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## References:

4. Biochemistry Metzler, D.E Elsevier

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<td>Propogation of nerve impulses</td>
<td><strong>2 Lectures</strong></td>
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<td>Neuronal excitation and inhibition</td>
<td><strong>3 Lectures</strong></td>
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<td>Synapses and gap junctions</td>
<td><strong>3 Lectures</strong></td>
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<td>Action of Neuro toxins and neurotransmitters</td>
<td><strong>3 Lectures</strong></td>
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**Notes:**
- **Lectures** indicate the number of lectures dedicated to each topic.
- Credits are based on the number of lectures.
- Total credits sum up to 60.

**Course Code:** USBT

**Title:** Environmental Biotechnology

**Unit I:** Renewable sources of energy

- Energy sources renewable – solar energy, wind power, geothermal energy and hydropower, biomass energy - **5 Lectures**;
- Biogas technology- biogas plant & types, biodigester. Biogas- composition, production and factors affecting production, uses - **5 Lectures**;
- Biofuels – ethanol production. Microbial hydrogen production Biodiesel, Petrocrops - **5 Lectures**;

**Unit II:** Industrial effluent treatment

- Biological processes for industrial effluent treatment, aerobic biological treatment- activated sludge process, CASP, advanced activated sludge processes (any two) Biological filters, RBC, FBR - **5 Lectures**;
- Anaerobic biological treatment- contact digesters, packed bed reactors, anaerobic baffled digesters, UASB - **3 Lectures**;
- Solid waste treatment - **2 Lectures**; pollution indicators & biosensors - **2 Lectures**; biodegradation of xenobiotics- persistent compounds, chemical properties influencing biodegradability, microorganisms in biodegradation - **2 Lectures**;
- Use of immobilized enzymes or microbial cells for treatment - **1 Lecture**.

**Unit III:** Wastewater treatment

- Wastewater treatment - introduction, biological treatment, impact of pollutants on biotreatment, use of packaged organisms and genetically engineered organisms in waste treatment - **5 Lectures**;
- Heavy metal pollution – sources, microbial systems for heavy metal accumulation, techniques used for heavy metal removal - **5 Lectures**; biosorption by bacteria, fungi and algae, factors affecting biosorption limitations of biosorption - **5 Lectures**.

**Unit IV:** Hazardous waste management

- Biodegradation of waste from tanning industry - **2 Lectures**; petroleum industry - **2 Lectures**; paper & pulp industry - **2 Lectures**; Dairy - **2 Lectures**; Distillery - **2 Lectures**; Dye - **1 Lecture**; Antibiotic industry - **2 Lectures**; Removal of oil spillage & grease deposits - **2 Lectures**.

**Total Credits:** 60
References:

1. Environmental Biotechnology Allan Scragg Oxford University press
2. Environmental Biotechnology (Basic concepts and applications) Indu Shekar Thakur  
   IK International
3. Environmental Biotechnology (Industrial pollution management) S.D. Jogdand  
   Himalaya Publishing House
1. LD 50, ED 50 evaluation using suitable models e.x daphnia
2. Study the effect of heavy metals on the growth of bacteria.
3. Determination of Total Solids from an effluent sample.
4. Study of physico-chemical (pH, color, turbidity, BOD, COD) parameters of any one industrial effluent sample
5. Estimation of chromium from Effluents (Demonstration)
6. Visit to ETP/ CETP
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<th>Course</th>
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<tr>
<td>Applied</td>
<td>Component Agri Biotechnology</td>
<td>I:</td>
<td>Introduction to Agriculture and Agriculture systems- <strong>1 Lecture</strong>; Green house Technology-- Types of green house, importance, functions and features of green house, Design criteria and calculation <strong>-2 Lectures</strong>; Construction material, covering material and its characteristics, growing media, green house irrigation system, nutrient management <strong>-3 Lectures</strong>; Greenhouse heating, cooling and shedding and ventilation system, Computer controlled environment <strong>- 3 Lectures</strong>; Phytotrons, fertigation and roof system <strong>-1 Lecture</strong>; Precision Cultivation- tools, sensors for information acquisition <strong>-2 Lectures.</strong></td>
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<td>III:</td>
<td>Genetic markers in plant breeding--Classical markers, DNA markers (RFLP, RAPD, AFLP, SSR, SNP)- <strong>4 Lectures</strong>; Application of Molecular Markers to Plant Breeding [quantitative trait locus (QTL) mapping] <strong>- 4 Lectures</strong>; Plant DNA Barcoding- Barcoding Markers (matK, rbcl, ITS, tmH-psbA), steps, recent advances, Benefits, Limitations <strong>- 4 Lectures.</strong></td>
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<td>IV: Biofertilizers and Biopesticides</td>
<td>Biofertilizer: Nitrogen-fixing Rhizobacteria - Symbiotic Nitrogen Fixers - 2 Lectures; Nonsymbiotic Nitrogen Fixers Plant Growth Promoting Microorganisms-Phosphate-Solubilizing Microbes (PSM), Phytohormones and Cytokinins, Induced Systemic Resistance - 2 Lectures; Plant Growth Promotion by Fungi--Mycorrhizae Arbuscular Mycorrhizae Ectomycorrhizae - 2 Lectures; Microbial Inoculants -- Inocula, Carriers, and Applications, Monoculture and Co-culture Inoculant Formulations Biocontrol, Polymicrobial Inoculant Formulations-3 Lectures; Biopesticides – types, Bacillus thuringiensis, insect viruses and entomopathogenic fungi (characteristics, physiology, mechanism of action and application) -3 Lectures.</td>
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References:
2. P. Parvatha Reddy (auth.) - Sustainable Crop Protection under Protected Cultivation- Springer Singapore (2016)
5. Travis R. Glare, Maria E. Moran-Diez - Microbial-Based Biopesticides_ Methods and Protocols (2016, Humana Press)
1. RAPD analysis demonstration experiment  
2. Isolation of Rhizobium  
3. Isolation of Azotobacter  
4. Isolation of Phosphate solubilising bacteria  
5. Study of effect of abiotic stress on plants.  
6. Rapid screening tests for abiotic stress tolerance (drought, - PEG, Mannitol & salinity NaCl)  
7. Estimation of antioxidants and antioxidant enzymes - Ascorbate, Catalase, and Peroxidase  
8. Visit to greenhouse facility and submission of field visit report.