Bioprocess engineering is the subdiscipline within biotechnology that is responsible for translating the discoveries of life science into practical products, processes, or systems that can serve the needs of society. Products developed include: fuels, food, feed, pharmaceuticals, nutraceuticals and a multitude of value-added biomaterials found in and used by all industries. This course provides technical information on fermenter designing and kinetics involved in the fermentation processes. The objective of the course is to apply the principles of biochemical engineering in large scale cultivation of microorganism for production of important products.

### UNIT-1 18 Hours

### UNIT-2 18 Hours
Bioreactor: basic components & design. Types of bioreactors, analysis of batch, fed batch and continuous bioreactors, biotransformation, analysis of mixed microbial populations, specialized bioreactors (pulsed, fluidized, photo bioreactors etc.) Measurement and control of bioprocess parameter.

### UNIT-3 18 Hours
Downstream processing: introduction, removal of microbial cells and solid matters, foam separation, precipitation, filtration, centrifugation, cell disruption, liquid-liquid extraction, chromatography, membrane process, drying and crystallization, effluent treatment.
| UNIT-4 18 Hours | Industrial production of chemicals: alcohols (ethanol and methanol), acids (citric, acetic and gluconic), solvents (glycerol, acetone, butanol), antibiotics (penicillin, streptomycine, tetracycline) amino acids (lysine, glutamic acid), Vitamins (Vitamin B12 and Riboflavin), single cell proteins and vaccines. |
| UNIT-5 18 Hours | Production of alcoholic beverages: wine and beer, microbial production of industrially important enzymes: Extraction of enzymes, preparation of crude enzymes, purification of enzymes, processing of enzymes, applications of enzymes in various sectors. Cell and enzyme immobilization, Biosensors - principle and types. |

<table>
<thead>
<tr>
<th>COURSE CODE: 411 LABORATORY WORK</th>
</tr>
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<tbody>
<tr>
<td>1. Isolation of industrially important microorganisms for microbial Processes.</td>
</tr>
<tr>
<td>2. Production of methane from sewage sludge</td>
</tr>
<tr>
<td>3. Production of ethanol from cellulosic waste</td>
</tr>
<tr>
<td>4. Comparative studies of ethanol production using different substrates</td>
</tr>
<tr>
<td>5. Microbial production of citric acid using <em>Aspergillus niger</em></td>
</tr>
<tr>
<td>6. Microbial production of antibiotics (penicillin)</td>
</tr>
<tr>
<td>7. Production and estimation of Protease</td>
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<tr>
<th>SUGGESTED READINGS</th>
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</table>
Environmental biotechnology is a system of scientific and engineering knowledge related to the use of microorganisms and their products in the prevention of environmental pollution through biotreatment of solid, liquid, and gaseous wastes, bioremediation of polluted environments, and biomonitoring of environment and treatment processes. Environment constitutes one of the most important ingredients because of the global problems. Thus, it is imperative to understand the Bioremediation of different components of the environment. The main objective of this course is to enlighten the masses about the importance of the protection and conservation of our environment through Biotechnological approaches and control of human activities which has an adverse effect on the environment.

UNIT-1 18 Hours

UNIT-2 18 Hours

UNIT-3 18 Hours
<table>
<thead>
<tr>
<th>UNIT-4 18 Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biodegradation of xenobiotics compounds, Organisms involved in degradation of xenobiotics: hydrocarbons, substituted hydrocarbons, surfactants, pesticides.</td>
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<table>
<thead>
<tr>
<th>UNIT-5 18Hours</th>
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</thead>
<tbody>
<tr>
<td>Bioremediation- Biotechnology for clean environment, Biomaterials as substitutes for non-degradable materials, Metal microbe interactions: Heavy Metal Pollution and impact on environment, Microbial Systems for Heavy Metal Accumulation, Biosorption, molecular mechanisms of heavy metal tolerance.</td>
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</table>

<table>
<thead>
<tr>
<th>COURSE CODE: BTC 412 LABORATORY WORK</th>
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</thead>
<tbody>
<tr>
<td>1. Determination of Total Dissolved Solids (TDS)</td>
</tr>
<tr>
<td>2. Determination of Most Probable number (MPN) from water</td>
</tr>
<tr>
<td>3. Chemical Analysis of Sewage / effluent sample</td>
</tr>
<tr>
<td>4. Determination of Dissolved oxygen content</td>
</tr>
<tr>
<td>5. Determination of BOD from Marine Drive Pond Water.</td>
</tr>
<tr>
<td>7. Determination of Nitrogen (NH4-N, NO3-N, NO2-N, Total Organic N).</td>
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<th>SUGGESTED READINGS</th>
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The Applied Biotechnology course gives the opportunity to study science on the edge of innovation, technology and even science itself. The main objective of this course is to impart theoretical knowledge on Agricultural Biotechnology, Medical and Pharmaceutical Biotechnology, Bioengineering and Law.

<table>
<thead>
<tr>
<th>UNIT</th>
<th>Hours</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNIT-3</td>
<td>20</td>
<td>Medical application of r-DNA technology, human disorders associated with defects in protein/enzyme biosynthesis. DNA probes and their application in diagnostics of genetic and other disorders. Detection of HIV, hepatitis virus in human. Quantitative assay of viral DNA by branched DNA and PCR methods. Introduction to basic concepts of Nanobiotechnology.</td>
</tr>
<tr>
<td>UNIT-4</td>
<td>18</td>
<td>Environmental Pollution - types of pollution methods for management of the pollution, Environmental management, waste water treatment, degradation of xenobiotics in Environment, Bioremediation of xenobiotics and heavy metals, Ozone depletion, greenhouse effect and acid rains and their impact and biotechnological approaches of management. Use of microbes: Mineral beneficiation and oil recovery.</td>
</tr>
</tbody>
</table>
**UNIT-5**  
**18 Hours**  

<table>
<thead>
<tr>
<th>COURSE CODE: BTC 413</th>
<th>LABORATORY WORK</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>Comparative studies of ethanol production using different substrates</td>
</tr>
<tr>
<td>2.</td>
<td>Microbial production of citric acid using <em>Aspergillus niger</em></td>
</tr>
<tr>
<td>3.</td>
<td>Microbial production of antibiotics</td>
</tr>
<tr>
<td>4.</td>
<td>Determination of chemical oxygen demand (COD) of sewage sample</td>
</tr>
<tr>
<td>5.</td>
<td>Study of Mitosis and Meiosis</td>
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<tr>
<td>6.</td>
<td>Disease diagnosis</td>
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<td>7.</td>
<td>Molecular marker assay</td>
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<tr>
<td>8.</td>
<td>Isolation of xenobiotic degrading bacteria by selective enrichment technique</td>
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<tr>
<td>9.</td>
<td>Isolation of antibiotic resistant bacteria from waste / sewage water</td>
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<tr>
<td>10.</td>
<td>Assay of antibiotics by disc diffusion method.</td>
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<th>SUGGESTED READINGS</th>
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</table>
# M.Sc. BIOTECHNOLOGY

**IV SEMESTER**

<table>
<thead>
<tr>
<th>COURSE CODE: BTC 421</th>
<th>COURSE TYPE: SSC/PRJ</th>
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<thead>
<tr>
<th>COURSE TITLE: DISSERTATION</th>
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<tr>
<th>CREDIT: 06</th>
<th>HOURS: 90</th>
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<tbody>
<tr>
<td>THEORY: 06</td>
<td>THEORY: 90</td>
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<table>
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<tr>
<th>MARKS: 100</th>
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<tbody>
<tr>
<td>THEORY: 70</td>
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<tr>
<td>CCA: 30</td>
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**Note for Students:**

1. During the 4th semester, all students will have to carry out the project /dissertation work under the supervision of Professor/ Associate Professor/ Assistant Professor of Dept. of Biotechnology, Sarguja University, Ambikapur, Chhattisgarh.

2. The Project/dissertation report will be evaluated by the external examiner and Head, Dept. of Biotechnology, Sarguja University, Ambikapur, at the Dept. of Biotechnology Sarguja University, Ambikapur.

3. The Project/dissertation work should be carried out in the field of Biotechnology/course studied as proposed for semester system.

4. During the project study constant repetition of experimental procedures, information, and facts among sections should be avoided.

5. Strictly the average length of the Project/dissertation report should not be more than 75 pages including tables and figures.

6. The Project/dissertation work should be structured under the section headings Introduction, Aims and Objectives, Review of Literatures, Materials and Methods, Results, Discussion (or Results and Discussion), Abstract and References.
Ethnobotany is the study of how people of a particular culture and region make use of indigenous plants, while Pharmaceutical Biotechnology is the science that covers all technologies required for the production, manufacturing and registration of biological drugs. Advances in recombinant genetics facilitate the routine cloning of genes and the creation of genetically modified organisms that can be used in industrial production. The objectives of this course are 1) to make the students well conversant with different molecules that exert a pharmacological action in the body and how the specific action is generated. 2) To impart knowledge how to identify and design drugs that could be potentially useful in the identification of the candidate drugs, which have efficacy in cell culture or animal models.

<table>
<thead>
<tr>
<th>UNIT</th>
<th>Hours</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>19</td>
<td>Herbal and naturally derived Products. Formulation development aspects - Delivery aspects for herbal and naturally derived medicinal products (Herbal extracts, crude extracts, incorporation of product performance enhancers, etc.). Product stabilization aspects with consideration of ICH guideline. - Regulatory considerations with consideration of global regulatory guidelines.</td>
</tr>
<tr>
<td>2</td>
<td>17</td>
<td>Industrial aspects: Stability studies of biotechnology derived products, Effects of various environmental /processing on the stability of the formulation and techniques for stabilization of the product against the same regulatory requirement related to stability testing with emphasis on matrixing bracketing techniques, Climatic zones.</td>
</tr>
</tbody>
</table>

Protein formulation: Different strategies used in the formulation of DNA and proteins, Analytical and biophysical parameters of proteins and DNA in pre-formulation, Liposomes, Neon-spears, Neon-particulate system, Pegilation, Biological Activity, Biophysical Characterization Techniques, Forced degradation studies of protein.

M.Sc. BIOTECHNOLOGY  IV SEMESTER

COURSE CODE: BTC D02  COURSE TYPE: ECC/CB

COURSE TITLE: PLANT PATHOLOGY

| CREDIT: 06 | HOURS: 90 |
| THEORY: 06 | THEORY: 90 |

MARKS: 100

THEORY: 70  CCA: 30

Plant Pathology is the science of plant health, including plant diseases, what causes plant diseases, the effects on the environment, and how to improve and manage plant health. During the study of this course, students will understand the nature of plant disease epidemics and how to manage them. The main objective of this course are; 1) Introduce students to the basic principles and concepts of plant pathology. 2) Introduce and illustrate the major groups of organisms that cause plant diseases.

<table>
<thead>
<tr>
<th>UNIT</th>
<th>18 Hours</th>
<th>13 Hours</th>
<th>19 Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNIT-1</td>
<td>Historical and developmental aspects of plant pathology. Mode of infection and role of enzymes and toxins in plant disease. Defense mechanisms of plants against infection: Preexisting structural and chemical defense, induced structural and chemical defense, hypersensitive reaction, the role of phytoalexins and other phenolic compounds.</td>
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<tr>
<td>UNIT-2</td>
<td>Management of plant diseases: Cultural, chemical, biological, biopesticides, breeding for resistant varieties, plant quarantine, integrated pest management. Post-harvest pathology: Fungal deterioration of food commodities, mycotoxins and health hazards, control measures.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UNIT-3</td>
<td>Molecular plant pathology: Molecular aspects of host pathogen interactions - PR proteins, degradation of phytoalexins, systemic resistance mechanism; application of molecular biology to plant disease control - transgenic approach for crop protection, engineering chemicals that elicit defense response to plants.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UNIT-4</td>
<td>Study of plant diseases caused by fungi, bacteria, viruses, nematodes and mycoplasma like organisms: Wart disease of potato, blight of colocasia, downy mildew of cucurbits, stem gall of coriander, peach leaf curl, ergot of bajra, smut of sugarcane, Karnal bunt of wheat, linseed rust, Tikka disease of groundnut, red rot of sugarcane.</td>
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</table>
### UNIT-5
15 Hours

Panama disease (*Fusarium* wilt) of banana, bacterial blight of rice, leaf curl of tomato, yellow vein mosaic of Bhindi, mosaic of sugarcane, potato spindle tuber mosaic, ear cockles of wheat, grassy shoot of sugarcane, phylloidy of sesamum, Citrus greening.

5. Experiments in Microbiology, plant Pathology, tissue culture and mushroom production technology, K. R. Aneja, New Age international (p) Ltd. New Delhi.  
Bionanotechnology refer to the intersection of nanotechnology and biology. Given that the subject is one that has only emerged very recently, Bionanotechnology and Nanobiotechnology serve as blanket terms of various related technologies. The main objectives of this course are; 1) To understand the basic physics of the behavior of molecules and molecular interactions. 2) To understand the experimental techniques used to characterize bio-nano systems.

<table>
<thead>
<tr>
<th>UNIT</th>
<th>16 Hours</th>
<th>Introduction to Nano-Biotechnology; Nanotechnology definition and concepts; Cellular Nanostructures; Nanoprocess; Biomolecular motors; Criteria for suitability of nanostructures for biological applications. Nanostructures for diagnostics and biosensors; Nanoparticles for diagnostics and imaging; Nanodevices for sensor development.</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNIT-2</td>
<td>16 Hours</td>
<td>Molecular nanotechnology; Nanopowders and nanomaterials: Sol-gels and their use, Use of natural nanoparticles, Nanobiometrics, Lipids as nano-bricks, Proteins as nanomolecules, DNA in nanotechnology. Present and future of nanotechnology applications in Molecular biology and Medicine.</td>
</tr>
<tr>
<td>UNIT-3</td>
<td>16 Hours</td>
<td>Basic characterization techniques; Electron microscopy; Atomic force microscopy; Photon correlation spectroscopy, Thin films; Colloidal nanostructures; Nanovesicles; Nanospheres; Nanocapsules. Nanostructures for drug delivery, concepts, targeting, routes of delivery and advantage. Implications for Drug Delivery – Polymeric Nanoparticles as Drug Carriers and Controlled.</td>
</tr>
</tbody>
</table>
**UNIT-4**  
22 Hours  


**UNIT-5**  
20 Hours  


**SUGGESTED READINGS**

1. *Bionanotechnology: Lessons from Nature* Author: David S. Goodsell  
   Publisher:  


Food science is a multidisciplinary field that applies disciplines such as chemistry, microbiology, engineering and nutrition to develop new food products and design new processes to improve the safety and quality of foods. While Food microbiology is the study of the microorganisms that inhabit, create, or contaminate food, including the study of microorganisms causing food spoilage. This paper adds information about the role of microorganisms in many food industries, both in production and spoilage processes. The main objective of this course is to encode the importance of the role of microorganisms in food industries both in beneficial and harmful ways.

<table>
<thead>
<tr>
<th>UNIT</th>
<th>HOURS</th>
<th>TOPICS</th>
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</thead>
<tbody>
<tr>
<td>UNIT-1</td>
<td>20</td>
<td>Role of food lipids in favour; Effects of processing on chemical structure and physical properties, hydrogenated fat and irradiated foods. Food modification by enzymes, Immobilized enzymes in food processing, Enzymes and health/nutrition/food issues. Use of polysaccharides in food: Individual Polysaccharides; Agar, Xanthum, Pectins. Use of non-starch polysaccharides in food.</td>
</tr>
<tr>
<td>UNIT-2</td>
<td>16</td>
<td>Flavours: Methods of flavour analysis, Taste and non-specific saporous sensation, Individual aroma compounds: Vegetable, fruit and spice flavour, flavours from lactic acid / ethanol fermentation, flavour volatiles from fats and oils, flavour volatiles in muscles foods and milk, Interactions with other food constituents, Natural and synthetic flavours.</td>
</tr>
<tr>
<td>UNIT-3</td>
<td>16</td>
<td>Food Colorants: Pigments in animal and plant tissues, Food colours; Types and properties, regulatory aspects, safety issues. Beverages: Harvesting, processing and by-products; Coffee, tea, cocoa, alcoholic beverages. Problems of chemical residues in food: Recent advances in biotechnology; Recombinant DNA techniques, genetically modified foods.</td>
</tr>
</tbody>
</table>
## UNIT-4 20 Hours
Introduction to historical developments in food preservation, spoilage, infections and legislation, Factors affecting the growth of micro-organisms in food, Intrinsic and Extrinsic parameters that affect microbial growth, Methods of Isolation and detection of microorganisms or their products in food, Conventional methods, Newer techniques, Chemical methods: Thermo stable nuclear, and ATP measurement.

## UNIT-5 18 Hours
Spoilage of different groups of foods: Cereal and cereal products, vegetables & fruits, meat & meat products, eggs and poultry, fish and other sea foods, milk and milk products, canned food, Food borne diseases: bacterial, and viral food borne disorders, Food-borne important animal parasites, Mycotoxins, Role of microbes in fermented foods and genetically modified foods.

## SUGGESTED READINGS

**M.Sc. BIOTECHNOLOGY**

**IV SEMESTER**

<table>
<thead>
<tr>
<th>COURSE CODE: BTC D05</th>
<th>COURSE TYPE: ECC/CB</th>
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<tbody>
<tr>
<td>COURSE TITLE: ENVIRONMENTAL AND APPLIED MICROBIOLOGY</td>
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</table>

| CREDIT: 06 | HOURS: 90 |
| THEORY: 06 | THEORY: 90 |
| MARKS: 100 | CCA: 30 |
| THEORY: 70 | |

Environmental and applied microbiology is the study of the composition and physiology of microbial communities in the environment. The environment in this case means the soil, water, air and sediments covering the planet and can also include the animals and plants that inhabit these areas. Environmental microbiology also includes the study of microorganisms that exist in artificial environments such as bioreactors. The main objective of this course is to provide the student with an understanding of the current views of microbial evolution; to evaluate the continuing roles played by microbes in the environment.

<table>
<thead>
<tr>
<th>UNIT-1</th>
<th>18 Hours</th>
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<tbody>
<tr>
<td>Introduction to microorganisms: General characteristics, nutritional types, microbial diversity. Tools and techniques for exploration of microorganism. Types of interaction between plants and microbes. Microorganisms and soil fertility, nutrient cycling. Microorganisms in extreme environments.</td>
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<table>
<thead>
<tr>
<th>UNIT-2</th>
<th>18 Hours</th>
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<tbody>
<tr>
<td>Microbial toxins and environmental hazards. Brief account of plant diseases and their ecosystem level effects. Microbes and public health: Brief account of microbial diseases and their control. Microbially induced corrosion and biofilms. Microbes and environmental protection: Bioremediation of organic and inorganic contaminants; waste water treatment, microorganisms as regulator of atmospheric trace gases.</td>
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<tr>
<th>UNIT-3</th>
<th>18 Hours</th>
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<tbody>
<tr>
<td>UNIT 4 18 Hours</td>
<td>Microbes and environment: Pollution abatement, bioindicators, restoration of degraded ecosystems, biodegradation, bioremediation, biogenic gases, microbes in biological warfare. Application of microbes in fermentation processes: Types, design and maintenance of bioreactors, application of fermentation technology in the industry.</td>
</tr>
<tr>
<td>UNIT 5 18 Hours</td>
<td>Role of microbes in relation to agriculture: Nitrogen economy, plant health, biological control. Symbiotic associations: Concepts, types and applications. Microbes in food and dairy industry: Mushrooms, fermented foods, microbial spoilage of food and dairy products, toxins Extremophiles and their biotechnological applications.</td>
</tr>
</tbody>
</table>
This course entails the study of diversity existing at different levels of Biological organization and understanding the essential ecological and biological processes which ensures long terms stability of ecosystems. The course highlights the values of biodiversity and scientific approaches to conservation which only can lead to sustainable development and safeguard the interests of future generations.

<table>
<thead>
<tr>
<th>UNIT-1</th>
<th>15 Hours</th>
<th>Concepts: Organic Evolution through geological time scale. Ecosystems, Biomes etc. Levels of Biodiversity: Community diversity (alpha, beta and gamma biodiversity), Gradients of Biodiversity (latitudinal, insular), Ecosystems diversity: biomes, mangroves, coral reefs, wetlands and terrestrial diversity.</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNIT-2</td>
<td>21 Hours</td>
<td>Species diversity: richness and evenness, loss of species. Magnitude of biodiversity (Global and Indian data). Direct and indirect benefits, Bioprospecting (molecular techniques like RAPD, RFLP, AFLP, DNA sequencing etc). Genetic diversity: sub species, breeds, race, varieties and forms. Variation in genes and alleles at DNA sequence levels.</td>
</tr>
<tr>
<td>UNIT-3</td>
<td>20 Hours</td>
<td>Microbial diversity and useful prokaryotic genes. Speciation (amount of genetic variation is the basis of speciation). Consequences of monotypic agricultural practice (Detailed case studies). Threats to Biodiversity: Habitat loss and fragmentation; Disturbance and pollution; introduction of exotic species; extinction of species. Human intervention and Biodiversity loss: Global Environmental changes, land in water use changes.</td>
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</tbody>
</table>
### UNIT-4  
**16 Hours**


### UNIT-5  
**18 Hours**

Methods of conservation. In situ (Biosphere reserves, National Parks, Sanctuaries, Sacred groves etc) & ex situ (Botanical gardens, Zoological gardens, Gene banks, Pollen, seed and seedling banks, tissue culture and DNA banks etc) modes of conservation. Benefits of conservation: Biodiversity as a source of food and improved varieties; source of drugs and medicines; Aesthetics and cultural benefits. Sustainable development.

### SUGGESTED READINGS