UNIT I: Conventional Fuels and Their Environmental Impact

Duration: 18 Periods
Key Concepts:

- **Conventional Fuels**: Firewood, Plant, Animal, Water, Coal, and Gas.
- **Modern Fuels**: Methanogenic bacteria, Biogas, Microbial hydrogen production, Conversion of sugar to alcohol (Gasohol).

Period Breakdown:

1. **Introduction to Fuels** (3 periods)
    - **Topic**: Overview of fuels used historically and their types.
    - **Activity**: Group discussion on the daily use of conventional fuels.
    - **Goal**: To set the foundation for understanding fuels.
2. **Firewood and Plant Fuels** (3 periods)
    - **Topic**: Environmental impact of using firewood and plant-based fuels (deforestation, air pollution).
    - **Activity**: Case study analysis of deforestation in different parts of the world.
    - **Goal**: To evaluate the sustainability of traditional fuels.
3. **Animal and Water Fuels** (3 periods)
    - **Topic**: Use of animal-based fuels and hydropower, their environmental impact.
    - **Activity**: Video/documentary on the environmental effects of animal fuel usage.
    - **Goal**: To explore alternatives to animal-based fuels.
4. **Coal and Gas Fuels** (3 periods)
    - **Topic**: Coal mining, gas extraction, and their global environmental consequences (greenhouse gases, mining waste).
    - **Activity**: Debate on the use of coal vs. natural gas.
    - **Goal**: To critically evaluate the long-term sustainability of fossil fuels.
5. **Modern Fuels (Methanogenic Bacteria, Biogas)** (3 periods)
    - **Topic**: Overview of biogas production, microbial hydrogen production, and methanogenesis.
    - **Activity**: Lab demonstration of biogas production or a virtual tour of a biogas plant.
    - **Goal**: To introduce renewable energy sources and their ecological benefits.
6. **Conversion of Sugar to Alcohol and Gasohol** (3 periods)
    - **Topic**: Processes involved in converting sugar to alcohol and the benefits of gasohol as an alternative fuel.
    - **Activity**: Research and presentation on gasohol's environmental advantages.
    - **Goal**: To link biofuels with environmental sustainability.

UNIT II: Bioremediation and Microbial Degradation

Duration: 20 Periods
Key Concepts:

- **Bioremediation** of soil & water contaminated with oil spills, heavy metals, and detergents.
- **Degradation** of lignin, cellulose, pesticides, aromatic hydrocarbons, and petroleum products.

Period Breakdown:

1. **Introduction to Bioremediation** (3 periods)
    - **Topic**: What is bioremediation and how it works.
    - **Activity**: Case study of a successful bioremediation project.
    - **Goal**: To provide a foundational understanding of bioremediation.
2. **Oil Spill Remediation** (3 periods)
    - **Topic**: Microbial breakdown of oil spills and the role of microbes in cleaning up polluted environments.
    - **Activity**: Simulation of oil spill and remediation methods using microbial cultures.
    - **Goal**: To understand real-world applications of bioremediation.
3. **Heavy Metal Contamination** (4 periods)
    - **Topic**: The role of microbes in detoxifying soils and waters contaminated with heavy metals.
    - **Activity**: Experiment showing microbial absorption of heavy metals.
    - **Goal**: To explore the mechanisms behind heavy metal remediation.
4. **Detergent Degradation** (3 periods)
    - **Topic**: Impact of detergents on the environment and the microbial degradation process.
    - **Activity**: Lab work on microbial degradation of common detergent components.
    - **Goal**: To show how microbes can break down everyday pollutants.
5. **Degradation of Lignin and Cellulose** (3 periods)
    - **Topic**: Microbial decomposition of lignin and cellulose, key in recycling plant matter.
    - **Activity**: Research on the role of fungi in lignin degradation.
    - **Goal**: To understand how microorganisms contribute to nutrient cycling.
6. **Pesticides and Toxic Chemical Degradation** (4 periods)
    - **Topic**: Microbial degradation of pesticides, toxic chemicals, aromatic hydrocarbons, and petroleum products.
    - **Activity**: Presentation and discussion on the environmental impact of pesticides and microbial solutions.
    - **Goal**: To discuss the broader scope of microbial remediation in combating chemical pollution.

UNIT III: Waste Treatment and Biofertilizers

Duration: 12 Periods
Key Concepts:

- **Treatment of Municipal Waste and Industrial Effluents**.
- **Biofertilizers**: Role of nitrogen-fixing bacteria, algal and fungal biofertilizers.

Period Breakdown:

1. **Municipal Waste Treatment** (4 periods)
    - **Topic**: Methods for treating municipal waste, including composting and aerobic/anaerobic treatments.
    - **Activity**: Visit to a local waste treatment facility or simulation of waste treatment.
    - **Goal**: To teach methods of waste management and treatment.
2. **Industrial Effluents** (3 periods)
    - **Topic**: Strategies for treating industrial effluents using microbial methods.
    - **Activity**: Case study on industrial effluent treatment.
    - **Goal**: To understand the complexities and solutions in industrial waste management.
3. **Biofertilizers** (5 periods)
    - **Topic**: Role of symbiotic and asymbiotic nitrogen-fixing bacteria and algal and fungal biofertilizers in soil enrichment.
    - **Activity**: Laboratory experiment on the effectiveness of biofertilizers in plant growth.
    - **Goal**: To link microbial activity to agricultural productivity.

UNIT IV: Bioleaching and Environmental Significance of GMOs

Duration: 10 Periods
Key Concepts:

- **Bioleaching**: Enrichment of ores by microorganisms (Gold, Copper, Uranium).
- **Genetically Modified Organisms**: Environmental significance of GMOs.

Period Breakdown:

1. **Bioleaching and Ore Enrichment** (5 periods)

    - **Topic**: Bioleaching mechanisms and how microorganisms can be used to extract valuable metals from ores.
    - **Activity**: Virtual lab demonstration of bioleaching techniques.
    - **Goal**: To introduce alternative, sustainable mining methods.
2. **Environmental Significance of GMOs** (5 periods)
    - **Topic**: Role of genetically modified microbes, plants, and animals in environmental sustainability.
    - **Activity**: Debate on the pros and cons of GMOs in agriculture and environmental science.
    - **Goal**: To critically analyze the ethical and ecological considerations of GMOs.

Assessment Methods:

- **Quizzes and tests** at the end of each unit to gauge understanding.
- **Practical Lab Reports** and case studies for hands-on learning.
- **Group Projects** on topics like bioremediation, biofuels, and GMOs.
- **Class Presentations** for students to discuss real-world applications of microbial technology.

By the end of these units, students should have a comprehensive understanding of environmental challenges and the role of microbiology in addressing them.

Immunology

UNIT I: Immune Response and Immune System Components

Duration: 20 Periods
Key Concepts:

- **Immune Response Overview**: Basic understanding of the immune system.
- **Components of the Mammalian Immune System**: Key components involved in immune responses.
- **Molecular Structure of Immunoglobulins (Antibodies)**: Types of antibodies and their structure.
- **Humoral & Cellular Immune Responses**: How the immune system fights infections.
- **T-Lymphocytes and Immune Response**: Different types of T-cells and their roles in immunity.
- **T-Cell Receptors**: Mechanism of T-cell receptor activation.
- **B-Lymphocyte Differentiation & Antibody Affinity Maturation**: Genetic mechanisms in immune responses.

Period Breakdown:

1. **Introduction to Immune Response** (4 periods)
    - **Topic**: Overview of the immune system and its role in defending the body.
    - **Activity**: Diagram drawing of the immune system (primary and secondary lymphoid organs).
    - **Goal**: To understand the basic structure and function of the immune system.
2. **Components of the Mammalian Immune System** (4 periods)
    - **Topic**: In-depth study of lymphocytes, macrophages, dendritic cells, and other immune cells.
    - **Activity**: Video on immune cells in action (e.g., macrophage phagocytosis).
    - **Goal**: To learn about the cellular components involved in immunity.
3. **Molecular Structure of Immunoglobulins** (4 periods)
    - **Topic**: Structure of antibodies (heavy chains, light chains, variable and constant regions).
    - **Activity**: Interactive 3D modeling of immunoglobulins.
    - **Goal**: To understand the molecular structure and functional properties of antibodies.
4. **Humoral & Cellular Immune Responses** (4 periods)
    - **Topic**: Detailed mechanisms of humoral immunity (antibody production) and cellular immunity (T-cell activation).

    - **Activity**: Case study of humoral and cellular immune responses during a bacterial infection.
    - **Goal**: To differentiate between the two types of immune responses.
5. **T-Lymphocytes and Immune Response** (4 periods)
    - **Topic**: Functions of cytotoxic T-cells, helper T-cells, and suppressor T-cells.
    - **Activity**: Role-play of T-cell interactions in the immune response.
    - **Goal**: To understand the differentiation and role of T-cells in immunity.
6. **T-Cell Receptors & B-Lymphocyte Differentiation** (4 periods)
    - **Topic**: Genetic mechanisms behind T-cell receptor assembly and B-cell differentiation.
    - **Activity**: Animation showing T-cell receptor gene rearrangement.
    - **Goal**: To learn about genetic diversity and immune recognition mechanisms.

UNIT II: Regulation of Immunoglobulin Gene Expression

Duration: 15 Periods
Key Concepts:

- **Clonal Selection Theory**: The theory explaining how immune cells are selected and activated.
- **Allotypes & Idiotypes**: Variations in antibodies.
- **Allelic Exclusion**: Mechanism by which only one allele is expressed.
- **Immunologic Memory**: How the immune system remembers pathogens.
- **Genetic Basis of Antibody Diversity**: Mechanisms behind the creation of antibody diversity.
- **Hypotheses of Antibody Diversity**: Germ line theory and somatic mutation theory.

Period Breakdown:

1. **Clonal Selection Theory & Immunologic Memory** (5 periods)
    - **Topic**: How immune cells are selected to respond to a pathogen and how memory cells form.
    - **Activity**: Diagram the process of clonal selection and the formation of memory cells.
    - **Goal**: To understand the adaptive immune response and the formation of long-term immunity.
2. **Allotypes & Idiotypes** (3 periods)
    - **Topic**: Variations in the constant and variable regions of antibodies.
    - **Activity**: Case study on the significance of allotypes and idiotypes in immune responses.
    - **Goal**: To understand antibody variability and its functional significance.
3. **Allelic Exclusion** (3 periods)

    - **Topic**: The mechanism ensuring that each B-cell expresses only one type of immunoglobulin.
    - **Activity**: Classroom demonstration or simulation of allelic exclusion in B-cells.
    - **Goal**: To understand the genetic regulation that prevents the expression of multiple antibody types.
4. **Genetic Basis of Antibody Diversity** (4 periods)
    - **Topic**: How genetic recombination and mutations generate a vast repertoire of antibodies.
    - **Activity**: Class discussion of the germ line and somatic mutation hypotheses.
    - **Goal**: To explore the genetic mechanisms behind the diversity of antibodies.
5. **Somatic Mutation & Germ Line Theories** (3 periods)
    - **Topic**: The two hypotheses explaining how antibody diversity is generated.
    - **Activity**: Group project to create a presentation explaining each hypothesis.
    - **Goal**: To evaluate different theories of antibody diversity generation.

UNIT III: MHC, Infection Immunity, and Diseases

Duration: 13 Periods
Key Concepts:

- **Major Histocompatibility Complexes (MHC)**: Class I and Class II MHC molecules and antigen processing.
- **Immunity to Infection**: Immune responses to different pathogens.
- **Autoimmune Diseases**: Mechanisms and examples of autoimmune diseases.
- **Immunodeficiency & AIDS**: Causes and impact of immune system deficiencies.

Period Breakdown:

1. **Major Histocompatibility Complexes (MHC)** (5 periods)
    - **Topic**: Structure and function of MHC molecules in antigen presentation.
    - **Activity**: Diagram the process of antigen processing and presentation by MHC molecules.
    - **Goal**: To understand the role of MHC in immune surveillance.
2. **Immunity to Different Organisms** (3 periods)
    - **Topic**: How immunity varies for bacteria, viruses, fungi, and parasites.
    - **Activity**: Comparative analysis of immune responses to viral vs. bacterial infections.
    - **Goal**: To differentiate the immune responses to various pathogens.
3. **Autoimmune Diseases** (3 periods)
    - **Topic**: Mechanisms behind diseases where the immune system attacks the body's own cells.
    - **Activity**: Case study of autoimmune diseases (e.g., lupus, rheumatoid arthritis).

    - **Goal**: To understand how autoimmune responses occur and their impact on health.
4. **Immunodeficiency & AIDS** (2 periods)
    - **Topic**: HIV/AIDS and other immunodeficiencies, including genetic and acquired forms.
    - **Activity**: Discussion and video on the immune response in AIDS patients.
    - **Goal**: To understand the effects of immunodeficiency on the immune system.

UNIT IV: Vaccines, Immunization, and Immunodiagnostics

Duration: 12 Periods
Key Concepts:

- **Vaccines and Vaccination**: Types of vaccines, adjuvants, and methods of vaccination.
- **Cytokines, DNA, and Recombinant Vaccines**: The future of vaccine technology.
- **Passive and Active Immunization**: Different types of immunization strategies.
- **Immunodiagnostics**: Techniques like RIA and ELISA.

Period Breakdown:

1. **Introduction to Vaccines & Vaccination** (4 periods)
    - **Topic**: Types of vaccines (bacterial, viral, recombinant) and the process of vaccination.
    - **Activity**: Presentation on the development of COVID-19 vaccines.
    - **Goal**: To understand the science behind vaccine development and function.
2. **Cytokines, DNA, and Recombinant Vaccines** (3 periods)
    - **Topic**: The role of cytokines and genetic manipulation in modern vaccines.
    - **Activity**: Research project on DNA vaccines and their impact on public health.
    - **Goal**: To explore advanced vaccine technologies.
3. **Passive vs Active Immunization** (2 periods)
    - **Topic**: Differences between passive and active immunization and examples of each.
    - **Activity**: Group discussion and case study of tetanus immunization.
    - **Goal**: To understand the different approaches to immunization.
4. **Immunodiagnostics (RIA, ELISA)** (3 periods)
    - **Topic**: Introduction to immunodiagnostic methods like Radioimmunoassay (RIA) and Enzyme-Linked Immunosorbent Assay (ELISA).
    - **Activity**: Lab demo or video on performing an ELISA.
    - **Goal**: To introduce diagnostic techniques used in detecting antibodies or antigens.

Assessment Methods:

- **Quizzes and tests** after each unit to assess students' understanding.
- **Practical lab reports** for immunodiagnostic techniques.
- **Group projects** for vaccine development and disease case studies.
- **Class presentations** on specific immune system topics.

Introduction to Microbiology and Microbial Diversity

Unit 1: History of Development of Microbiology

Duration: 15 Periods
Key Concepts:

- **Development of Microbiology as a Discipline**: From spontaneous generation to biogenesis.
- **Contributions of Key Scientists**: Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming.
- **Germ Theory of Disease and Microbiological Techniques**.
- **Development of Soil Microbiology and Contributions**: Martinus W. Beijerinck, Sergei N. Winogradsky, Selman A. Waksman.
- **Medical Microbiology and Immunology**: Contributions of Paul Ehrlich, Elie Metchnikoff, and Edward Jenner.
- **Overview of the Scope of Microbiology**: Importance and applications in various fields.

Period Breakdown:

1. **Introduction to Microbiology and Spontaneous Generation vs. Biogenesis** (3 periods)
    - **Topic**: Overview of the origins of microbiology and the debate between spontaneous generation and biogenesis.
    - **Activity**: Discuss the historical significance of experiments by Francesco Redi and Louis Pasteur.
    - **Goal**: To understand the evolution of the field and the key scientific debates.
2. **Contributions of Anton von Leeuwenhoek & Louis Pasteur** (3 periods)

- **Topic**: Anton von Leeuwenhoek's discoveries and Louis Pasteur's work in germ theory and fermentation.
- **Activity**: Presentation and discussion of Pasteur's Swan-neck flask experiment.
- **Goal**: To highlight foundational contributions in microbiology.

3. **Robert Koch, Joseph Lister, and Alexander Fleming** (3 periods)
   - **Topic**: Contributions of Koch's postulates, Lister's antiseptic techniques, and Fleming's discovery of penicillin.
   - **Activity**: Role-play debate on the impact of these discoveries on modern medicine.
   - **Goal**: To discuss how these breakthroughs shaped modern microbiology and medicine.
4. **Germ Theory of Disease and Development of Microbiological Techniques** (3 periods)
   - **Topic**: Understanding the germ theory of disease and the microbiological techniques developed in the golden era.
   - **Activity**: Group discussion and analysis of the significance of sterilization, culturing, and staining techniques.
   - **Goal**: To connect microbiological techniques with their impact on disease prevention.
5. **Soil Microbiology and Contributions of Beijerinck, Winogradsky, Waksman** (2 periods)
   - **Topic**: The development of soil microbiology and the contributions of Beijerinck, Winogradsky, and Waksman in microbiology.
   - **Activity**: Case study on nitrogen fixation and the role of microorganisms in soil.
   - **Goal**: To understand the importance of soil microbiology in environmental science.
6. **Medical Microbiology, Immunology, and Contributions of Ehrlich, Metchnikoff, and Jenner** (2 periods)
   - **Topic**: Establishment of medical microbiology and immunology through key scientists.
   - **Activity**: Research project on Edward Jenner's development of the smallpox vaccine.
   - **Goal**: To explore the foundations of immunology and medical microbiology.
7. **Overview of the Scope of Microbiology** (2 periods)
   - **Topic**: The vastness of microbiology and its applications in health, agriculture, industry, and the environment.
   - **Activity**: Brainstorming session on microbiology's applications in different sectors.
   - **Goal**: To connect the theoretical understanding of microbiology with its real-world applications.

Unit 2: Diversity of the Microbial World

Duration: 15 Periods
Key Concepts:

- **Systems of Classification**: Binomial Nomenclature, Whittaker's Five Kingdom Classification, Carl Woese's Three Kingdom Classification.
- **Prokaryotic vs. Eukaryotic Microorganisms**: Key differences and characteristics.
- **Acellular Microorganisms**: Viruses, Viroids, and Prions.
- **Cellular Microorganisms**: Bacteria, Protozoa, Algae, Fungi.
- **Protozoa**: Special reference to specific genera.

Period Breakdown:

1. **Classification Systems in Microbiology** (3 periods)
    - **Topic**: Binomial nomenclature, Whittaker's five-kingdom system, and Carl Woese's three-domain system.
    - **Activity**: Classify a set of microorganisms using different classification systems.
    - **Goal**: To understand the evolution of classification systems and their utility.
2. **Prokaryotic vs. Eukaryotic Microorganisms** (3 periods)
    - **Topic**: Key differences in the structure and characteristics of prokaryotes and eukaryotes.
    - **Activity**: Comparison chart activity to highlight structural and functional differences.
    - **Goal**: To differentiate between prokaryotic and eukaryotic microorganisms.
3. **Acellular Microorganisms: Viruses, Viroids, and Prions** (3 periods)
    - **Topic**: Characteristics and examples of acellular microorganisms.
    - **Activity**: Group discussion on the significance of viruses, viroids, and prions in diseases.
    - **Goal**: To understand the diversity of non-living microorganisms and their biological impact.
4. **Cellular Microorganisms: Bacteria, Protozoa, Algae, and Fungi** (4 periods)
    - **Topic**: General characteristics of bacteria, protozoa, algae, and fungi with emphasis on morphology, reproduction, and economic importance.
    - **Activity**: Lab work on microscopy to observe the different cellular microorganisms.
    - **Goal**: To explore the diversity of cellular microorganisms and their ecological roles.
5. **Protozoa: Amoeba, Paramecium, Plasmodium, Leishmania, and Giardia** (2 periods)
    - **Topic**: Characteristics and significance of specific protozoa.
    - **Activity**: Video on the life cycle of Plasmodium and the transmission of malaria.
    - **Goal**: To understand the role of protozoa in human health and disease.

Unit 3: Algae

Duration: 15 Periods
Key Concepts:

- **History of Phycology**: Contributions of Indian scientists.
- **General Characteristics of Algae**: Occurrence, thallus organization, cell structure, pigments, reproduction.
- **Types of Algal Life Cycles**: Haplobiontic, Haplontic, Diplontic, Diplobiontic, and Diplohaplontic.
- **Applications of Algae**: In agriculture, industry, environment, and food.

Period Breakdown:

1. **History of Phycology and Indian Contributions** (3 periods)
    - **Topic**: Overview of the history of phycology with a focus on Indian contributions.
    - **Activity**: Research project on prominent Indian phycologists.
    - **Goal**: To appreciate the historical development of the study of algae.
2. **General Characteristics of Algae** (4 periods)
    - **Topic**: Characteristics such as thallus structure, ultrastructure, pigments, and reproduction in algae.
    - **Activity**: Microscopic observation of algae (e.g., Chlorella, Spirogyra).
    - **Goal**: To understand the morphology and diversity of algae.
3. **Algal Life Cycles** (4 periods)
    - **Topic**: Detailed study of the different types of life cycles in algae.
    - **Activity**: Group presentation on the life cycles of selected algae species.
    - **Goal**: To understand the complexity of reproduction in algae.
4. **Applications of Algae** (4 periods)
    - **Topic**: Applications of algae in various industries, agriculture, and food production.
    - **Activity**: Research and presentation on the commercial uses of algae.
    - **Goal**: To explore the ecological and economic importance of algae.

Unit 4: Fungi

Duration: 15 Periods
Key Concepts:

- **History of Mycology**: Contributions of eminent mycologists.

- **General Characteristics of Fungi**: Habitat, distribution, nutritional requirements, and fungal ultrastructure.
- **Reproduction in Fungi**: Asexual, sexual, heterokaryosis, and parasexual mechanisms.
- **Economic Importance of Fungi**: In agriculture, medicine, industry, food, and biodeterioration.

Period Breakdown:

1. **History of Mycology and Contributions of Mycologists** (3 periods)
    - **Topic**: Overview of the historical development of mycology.
    - **Activity**: Presentation on significant mycologists and their contributions.
    - **Goal**: To understand the development of mycology as a field.
2. **General Characteristics of Fungi** (4 periods)
    - **Topic**: Habitat, nutritional modes, fungal cell structure, and thallus organization.
    - **Activity**: Lab demonstration of fungal growth (e.g., on agar plates).
    - **Goal**: To observe the characteristics of fungi in a laboratory setting.

4. **Economic Importance of Fungi** (4 periods)
    - **Topic**: The role of fungi in agriculture, industry, and medicine, including biodeterioration and mycotoxins.
    - **Activity**: Case study on the role of fungi in antibiotic production.
    - **Goal**: To highlight the economic and ecological significance of fungi.

Assessment Methods:

- **Written tests and quizzes** after each unit to assess theoretical understanding.
- **Practical lab reports** based on microscopy and fungal culture observations.
- **Group projects and presentations** on microbial applications, historical contributions, and life cycles.
- **Case studies** on diseases caused by protozoa, algae, and fungi.

Virology

Unit 1: Nature and Properties of Viruses

Duration: 12 Periods
Key Concepts:

- Discovery of viruses and their historical significance.
- Nature and definition of viruses.
- Viroids, virusoids, satellite viruses, and prions.
- Theories of viral origin.
- Structure of viruses, including capsid symmetry, enveloped and non-enveloped viruses.
- Methods of virus isolation, purification, and cultivation.
- Viral taxonomy and classification.

Period Breakdown:

1. **Introduction to Viruses** (2 periods)
    - **Topic**: History of virus discovery (e.g., Dmitri Ivanovsky, Wendell Stanley) and the nature and definition of viruses.
    - **Activity**: Lecture and discussion on the significance of virus discovery in microbiology.
    - **Goal**: To understand the history and importance of viruses in science.
2. **Concepts of Viroids, Virusoids, Satellite Viruses, and Prions** (2 periods)
    - **Topic**: Explore the nature of viroids, virusoids, and prions, highlighting their structural and functional differences from traditional viruses.
    - **Activity**: Case study on diseases caused by prions (e.g., BSE, Creutzfeldt-Jakob disease).
    - **Goal**: To differentiate between various non-virus entities and their impact on health.
3. **Theories of Viral Origin** (2 periods)
    - **Topic**: Discuss the leading theories of viral origin (e.g., regressive theory, cellular origin theory, co-evolution theory).
    - **Activity**: Class debate on which theory is most plausible, supported by evidence.
    - **Goal**: To understand the different hypotheses surrounding the evolution of viruses.
4. **Structure of Viruses** (3 periods)
    - **Topic**: Detailed study of viral structure, including capsid symmetry, enveloped and non-enveloped viruses.
    - **Activity**: Visual aids, such as diagrams and 3D models, to illustrate viral structures.

    - **Goal**: To understand the structural features of viruses and how these relate to their infectivity.
5. **Isolation, Purification, and Cultivation of Viruses** (2 periods)
    - **Topic**: Methods used for isolating, purifying, and cultivating viruses in the laboratory.
    - **Activity**: Lab demonstration (if possible) or video on viral isolation and propagation in cell culture.
    - **Goal**: To grasp the techniques used for studying viruses in controlled environments.
6. **Viral Taxonomy and Classification** (3 periods)
    - **Topic**: Overview of viral classification and nomenclature, understanding how viruses are classified into families, genera, and species.
    - **Activity**: Group project on classifying different viruses based on their characteristics.
    - **Goal**: To learn the basic principles of viral taxonomy and how viruses are categorized.

Unit 2: Viral Transmission, Salient Features of Viral Nucleic Acids and Replication

Duration: 20 Periods
Key Concepts:

- Modes of viral transmission: persistent, non-persistent, vertical, and horizontal.
- Salient features of viral nucleic acids, including unusual bases, overlapping genes, alternate splicing, and segmented genomes.
- Viral multiplication and replication strategies.
- Baltimore classification of viruses.
- Replication strategies for specific viruses (e.g., phiX174, Retroviridae, Vaccinia).
- Assembly, maturation, and release of virions.

Period Breakdown:

1. **Modes of Viral Transmission** (3 periods)
    - **Topic**: Explore the different modes of viral transmission, including persistent, non-persistent, vertical, and horizontal transmission.
    - **Activity**: Case study on the transmission dynamics of HIV, Hepatitis B, or Influenza.
    - **Goal**: To understand how viruses spread and their impact on host populations.
2. **Salient Features of Viral Nucleic Acids** (4 periods)

    - **Topic**: Discuss unusual bases (e.g., TMV, T4 phage), overlapping genes (e.g., phiX174), alternate splicing (e.g., HIV), terminal redundancy (T4 phage), and segmented genomes (e.g., Influenza virus).
    - **Activity**: Detailed analysis of the genome structure of specific viruses and their unique features.
    - **Goal**: To explore the complexities of viral genomes and how they influence replication.
3. **Viral Multiplication and Replication** (5 periods)
    - **Topic**: Interaction of viruses with host cellular receptors, entry into cells, and viral replication.
    - **Activity**: Demonstration or video showing viral entry and replication in a host cell.
    - **Goal**: To understand how viruses replicate within host cells and the steps involved in viral infection.
4. **Replication Strategies of Viruses (Baltimore Classification)** (5 periods)
    - **Topic**: Explanation of viral replication strategies according to the Baltimore classification system, including examples like phiX174, Retroviridae, Vaccinia, and Picornaviridae.
    - **Activity**: Group work to analyze the replication strategy of one virus in detail.
    - **Goal**: To understand the diversity of viral replication strategies and the factors influencing these strategies.
5. **Assembly, Maturation, and Release of Virions** (3 periods)
    - **Topic**: Process of assembling new virions, their maturation, and release from the host cell.
    - **Activity**: Animation or model to demonstrate virion assembly and budding or lysis.
    - **Goal**: To understand the final stages of the viral life cycle and how new virus particles are released.

Unit 3: Prevention and Control of Viral Diseases

Duration: 14 Periods
Key Concepts:

- Antiviral compounds and their mechanisms of action.
- Interferons and their role in antiviral defense.
- Principles of viral vaccination and types of vaccines.
- Viruses and Cancer: Oncogenic DNA and RNA viruses, oncogenes, and proto-oncogenes.

Period Breakdown:

1. **Antiviral Compounds and Their Mode of Action** (4 periods)
    - **Topic**: Discuss antiviral drugs and their mechanisms of action (e.g., nucleoside analogs, protease inhibitors).
    - **Activity**: Case study on the use of antivirals for treating HIV or Hepatitis C.
    - **Goal**: To understand how antiviral drugs work at the molecular level.
2. **Interferons and Their Mode of Action** (3 periods)
    - **Topic**: Overview of interferons and how they help in the defense against viral infections.
    - **Activity**: Lecture and discussion on the use of interferons in treating viral diseases.
    - **Goal**: To explore the immune response and therapeutic potential of interferons.
3. **General Principles of Viral Vaccination** (4 periods)
    - **Topic**: Concepts of active and passive immunization, types of viral vaccines (e.g., inactivated, live attenuated, subunit, recombinant).
    - **Activity**: Debate on the advantages and disadvantages of different types of vaccines.
    - **Goal**: To understand the principles and methods of viral vaccination.
4. **Viruses and Cancer: Oncogenic Viruses** (3 periods)
    - **Topic**: Discuss the role of DNA and RNA viruses in cancer development, the concept of oncogenes and proto-oncogenes.
    - **Activity**: Case study on the role of HPV in cervical cancer and the development of vaccines against it.
    - **Goal**: To understand how certain viruses can contribute to cancer development.
5. **Introduction to Oncogenes and Proto-Oncogenes** (2 periods)
    - **Topic**: Discuss the molecular basis of oncogenes and proto-oncogenes in viral carcinogenesis.
    - **Activity**: Review of the role of the Epstein-Barr virus and its link to Burkitt's lymphoma.
    - **Goal**: To explore the molecular mechanisms by which viruses contribute to oncogenesis.

Unit 4: Bacteriophages and Applications of Virology

Duration: 14 Periods
Key Concepts:

- Diversity and classification of bacteriophages.
- One-step multiplication curve, lytic and lysogenic phages (lambda phage).
- Use of viral vectors in cloning and gene therapy.
- Phage display technology and its applications.

Period Breakdown:

1. **Diversity and Classification of Bacteriophages** (3 periods)
    - **Topic**: Overview of bacteriophages, their diversity, and classification into lytic and lysogenic types.
    - **Activity**: Discussion on the importance of bacteriophages in microbiology.
    - **Goal**: To understand the diverse nature and classifications of bacteriophages.
2. **One-Step Multiplication Curve of Phages** (3 periods)
    - **Topic**: Study of the one-step growth curve for bacteriophages.
    - **Activity**: Diagram-based exercises on phage infection and replication.
    - **Goal**: To understand the stages of bacteriophage replication and quantification.
3. **Lytic and Lysogenic Phages: The Lambda Phage** (4 periods)
    - **Topic**: Detailed study of lytic and lysogenic cycles with special focus on lambda phage.
    - **Activity**: Simulation of lambda phage infection using models.
    - **Goal**: To compare

the lytic and lysogenic cycles and understand their biological implications.

4. **Applications of Viral Vectors in Cloning and Gene Therapy** (2 periods)
    - **Topic**: Introduction to the use of viral vectors in molecular biology and gene therapy.
    - **Activity**: Research-based discussion on viral vectors used in gene therapy (e.g., adenovirus, lentivirus).
    - **Goal**: To understand how viral vectors can be used in modern biotechnology.
5. **Phage Display Technology** (2 periods)
    - **Topic**: Basics of phage display and its applications in biotechnology and medicine.
    - **Activity**: Group discussion on the use of phage display in drug discovery.
    - **Goal**: To explore the applications of phage display in research and therapy.

Assessment Methods:

- **Written Tests**: Quizzes after each unit to assess theoretical knowledge.
- **Practical Lab Reports**: Hands-on experience with viral techniques, if possible.
- **Group Projects**: Presentations on viral diseases, vaccines, or phage applications.
- **Case Studies**: Analysis of real-world applications of virology (e.g., gene therapy, viral infections).