Course Title: Current Topics in Environmental Engineering (ENV 451)

Course Objectives:

- To explore the latest advancements and trends in environmental Sciences and biotechnology.
- To study innovative approaches to solving contemporary environmental issues using Molecular biology techniques.
- To critically assess the impact of new genetic engineering methods on environmental management.
- To understand emerging environmental Sciences' regulatory, ethical, and societal implications.

Topic 1: Introduction to Emerging Trends in Environmental Engineering (10 %)

- **Overview of Recent Advances:**
  - Key breakthroughs in biotechnology relevant to the environment and its work fore
  - The role of molecular biology and genetic engineering in addressing current environmental challenges.
- **Prospects:**
  - Areas of growth in environmental sciences, including synthetic biology, waste management using bioremediation methods, energy production, and ecosystem restoration.

Topic 2: Environmental Genomics (20 %)

- **Microbial genomics:**
  - An Introduction to Genes and Genomes
  - Recombinant DNA Technology and Genomics
  - Proteins as Biotechnology Products
  - Application of high-throughput sequencing to study environmental microbial communities.
  - Role of metagenomics in identifying microbial diversity and potential biotechnological applications.

Topic 3: Advances in Bioremediation Technologies (20 %)

- **Microbial Biotechnology**
- **Microbial Bioremediation:**
  - Recent advancements in the use of genetically engineered microbes for bioremediation.
  - Novel microbial consortia for treating emerging pollutants (e.g., pharmaceuticals, microplastics).
- **Phytoremediation:**
  - Recent developments in plant-based remediation include hyperaccumulator plants for heavy metals and nanomaterials.

    - Genetic modifications to enhance phytoremediation capabilities.
- **Nanotechnology in Bioremediation:**
    - Use of nanoparticles and nanomaterials to support microbial degradation processes.

Topic 4**: Marine Biotechnology and Climate Change (10 %)**

    - The role of marine organisms in carbon cycling and mitigation of ocean acidification.

Topic 5: Use of some bioinformatic tools in environmental sciences (10 %)

    - Use bioinformatics, gene editing, and microbial technologies to improve crop yield and soil health.

Topic 6: Ethics and Public Perception (10 %)

- **Ethical Issues:**
    - Ethical debates on gene editing, synthetic organisms, and environmental impacts of biotechnological interventions.

Assessment Methods:

- **Research Papers:** Students analyze and critique recent research papers on topics related to environmental science **(10 %)**
- **Presentations:** Students present on innovative bioengineering applications in environmental science **(10 %)**
- **Examinations:** Cover current trends, emerging technologies, and environmental implications as mentioned above **(80%)**
- **Midterm exam: 30%**
- **Final exam: 50%**

Recommended Textbooks and References:

- **"Environmental Biotechnology: Principles and Applications"** by Bruce E. Rittmann and Perry L. McCarty
- **"Introduction to Biotechnology"** by William J. Thieman and Michael A. Palladino
- **"Introduction to Genetic Engineering"** by Desmond S. T. Nicholl
- **Research Articles and Journals:**
    - *Journal of Environmental Biotechnology*
    - *Nature Biotechnology*
    - *Biotechnology Advances*

This syllabus focuses on the latest trends and innovations in environmental sciences, providing students with up-to-date knowledge and critical thinking skills to address modern environmental challenges.