Syllabus Prescribed for B. Sc. III Year

UG Programme Programme: Semester Vth

Code of the Course/Subject:
Title of the Course/Subject : **Principles of immunology and plant biotechnology**
Total Number of Periods: 90 Hours

CO's:

- Understanding immunological processes and plant biotechnology
- Critically analyze and case studies related to immunology and plant biotechnology
- Proficiency in laboratory techniques relevant to immunology and plant biotechnology
- Students will understand the importance of immunity in day to day life
- Proficiency in Laboratory Techniques

Unit 1: Introduction to Immunology
Overview of the historical development of immunology, Fundamental concepts: immune system components, self vs. non-self recognition, The significance of immunology in health and disease, Principles of vaccination: types, efficacy, and adverse effects.

Unit 2: Innate and Adaptive Immunity
Cellular and molecular components of innate immunity, Mechanisms of pathogen recognition and response, Role of inflammation, phagocytosis, T Lymphocytes and Cell-Mediated Immunity, B Lymphocytes and Humoral Immunity

Unit 3 : Plant Cell and Tissue Culture Techniques
Basics of plant tissue culture: media preparation, sterilization, culture initiation, Techniques for plant regeneration: organogenesis, somatic embryogenesis, Applications in micropropagation and germplasm conservation.

Unit 4 : Genetic Engineering in Plants:
Tools and techniques for genetic modification: restriction enzymes, vectors, gene transfer methods, Development and characterization of transgenic plants,
Applications in crop improvement, biopharming, and industrial biotechnology.

Unit 5 : Applications of Plant Biotechnology
Engineering plants for stress tolerance: drought, salinity, and pests, Nutritional enhancement of crops, Industrial applications: biofuel production, pharmaceuticals, and biomaterials.

Unit 6: Skill Enhancement Module: Techniques in Immunology and Plant biotechnology
Hands-on training in ELISA

Micrscopic study of Blood cells
Western blotting
Hands-on training in sequence alignment
Genome annotation
Phylogenetic analysis
Case studies on ethical dilemmas in genetically modified organisms (GMOs)

Practicals:

1) Microscopic study of blood cells to identify different types of immune cells (e.g., lymphocytes, neutrophils)
2) Microscopic examination of stained blood smears
3) Demonstration of different types of vaccines (e.g., live attenuated, inactivated)
4) ELISA assay to quantify levels of specific antibodies in serum samples
5) Preparation of plant tissue culture media and sterilization using autoclave or pressure cooker.
6) Demonstrations of organogenesis
7) Transformation of plant tissues using Agrobacterium-mediated gene transfe
8) Germination of seeds on agar plates or moist paper towels.
9) Introduction to micropropagation techniques
10) Observation and measurement of seedling growth over time.
11) Observation of plant growth under different environmental conditions (e.g., light intensity, temperature).
12) Sectioning and staining of plant tissues for microscopic observation.
13) Gel electrophoresis of DNA samples in agarose gel.

Suggested Books Reference:

1. Janeway's Immunobiology by Kenneth Murphy et al.
2. Immunology: A Short Course by Richard Coico et al.
3. Plant Biotechnology and Genetics: Principles, Techniques, and Applications by C. Neal Stewart Jr.
4. Molecular Biology of the Cell by Bruce Alberts et al.
5. Principles of Genetics by D. Peter Snustad et al.
6. Plant Biotechnology: The Genetic Manipulation of Plants by Adrian Slater et al.

Syllabus Prescribed for B. Sc. III Year

UG Programme Programme: Semester VIth

Code of the Course/Subject:
Title of the Course/Subject : **Environmental biotechnology & Animal biotechnology**
Total Number of Periods: 90 Hours

Unit 1: Introduction to Environmental Biotechnology
Overview of environmental biotechnology and its applications, Importance of biotechnology in addressing environmental challenges, Historical development and current trends in the field. Microbial degradation: Role of microorganisms in biodegradation processes, Mechanisms of microbial degradation of pollutants, Xenobiotics, Applications of microbial biodegradation in environmental remediation.

Unit 2: Bioremediation Techniques
Overview of bioremediation strategies: in situ vs. ex situ methods, Biostimulation and bioaugmentation approaches, Case studies on the use of bioremediation in soil, water, and air pollution control. Waste Treatment and Resource Recovery: Anaerobic digestion for organic waste treatment and biogas production, Composting techniques for organic waste management

Unit 3 : Phytoremediation and Biotechnology
Principles of phytoremediation: uptake, translocation, and detoxification of pollutants by plants, Genetic engineering approaches to enhance phytoremediation efficiency, Applications of phytoremediation in heavy metal contamination and soil restoration.

Unit 4: Introduction to Animal Biotechnology
Overview of animal biotechnology and its applications in agriculture, medicine, and industry, Historical development and ethical considerations in animal biotechnology, Artificial insemination (AI) and IVF

Unit 5: Applications of Animal Biotechnology
Production of recombinant proteins in animals: pharmaceuticals and biologics, Animal models in biomedical research: disease modeling and drug development,
Xenotransplantation and organ engineering, Applications of genetic engineering in livestock improvement and disease resistance

Unit 6 : Skill Enhancement Module: Techniques in Environmental and Animal Biotechnology
1. Environmental physical factors monitoring
2. Case study of waste water treatment plant
3. Case study for IVF
4. PCR
5. DNA isolation

Practicals:

1) Isolation of microorganisms from environmental samples (e.g., soil, water).
2) Characterization of isolated microorganisms using morphological, biochemical, and molecular techniques.
3) Assessment of microbial degradation of organic pollutants using spectrophotometric or chromatographic methods.
4) Setup of small-scale anaerobic digesters using biodegradable materials (e.g., food waste, plant biomass).
5) Measurement of biogas production using a simple gas collection setup.
6) Collection of water samples from different sources (e.g., tap water, pond water).
7) Basic water quality parameters analysis using test kits (e.g., pH, turbidity, dissolved oxygen).
8) Setup and optimization of bioremediation experiments using microbial consortia or genetically engineered microorganisms.
9) Evaluation of bioremediation efficiency through monitoring of pollutant concentrations over time.
10) Setup and operation of anaerobic digesters for the treatment of organic waste.
11) Case study of biogas production
12) Collection of suitable plant species for phytoremediation experiments.
13) Extraction of genomic DNA from animal tissue sample
14) Visualization of extracted DNA using agarose gel electrophoresis.
15) Handling and passaging of immortalized cell lines.
16) Examination of fertilized eggs

Suggested Books Reference:

Environmental Biotechnology: Principles and Applications by Bruce Rittmann and Perry McCarty.
Principles of Environmental Biotechnology by R. K. Trivedi and B. P. Nagendra Prasad.
Animal Biotechnology: Models in Discovery and Translation by Ashish Verma and Bhanuprakash Reddy.
Animal Biotechnology: Science-Based Concerns by Committee on Defining Science-Based Concerns Associated with Products of Animal Biotechnology.
Biotechnology for Beginners by Reinhard Renneberg, Arnold L. Demain, and Dragana Nikodinovic-Runic.
Principles of Genetics by D. Peter Snustad et al.