

# MICROBIOLOGY / MICROBIAL AND ENVIRONMENTAL BIOTECHNOLOGY

## SYLLABUS

**Course No : ENV-111 Course Title: Environmental Studies & Disaster Management**  
**Credits : 3(2+1) Semester : I**

### Theory

#### UNIT I

Multidisciplinary nature of environmental studies; Definition, scope and importance.

#### UNIT II

Natural Resources: Renewable and non-renewable resources; Natural resources and associated problems.

a) Forest resources: Use and over-exploitation; Deforestation; Case studies. Timber extraction, mining; Dams and their effects on forest and tribal people.

b) Water resources: Use and over-utilization of surface and ground water; Floods; Drought; Conflicts over water; Dams-benefits and problems.

c) Mineral resources: Use and exploitation; Environmental effects of extracting and using mineral resources; Case studies.

d) Food resources: World food problems; Changes caused by agriculture and overgrazing; Effects of modern agriculture; Fertilizer-pesticide problems; Water logging; Salinity; Case studies.

e) Energy resources: Growing energy needs; Renewable and non-renewable energy sources; Use of alternate energy sources; Case studies.

f) Land resources: Land as a resource; Land degradation; Man induced landslides; Soil erosion and desertification.

Role of an individual in conservation of natural resources; Equitable use of resources for sustainable lifestyles.

#### UNIT III

Ecosystems; Concept of an ecosystem; Structure and function of ecosystem; Producers, consumers and decomposers; Energy flow in ecosystem; Ecological succession; Food chains, food webs and ecological pyramids; Introduction, types, characteristic features, structure and function of forest ecosystem, grassland ecosystem, desert ecosystem and aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

#### UNIT IV

Biodiversity and its conservation; Introduction, definition, genetic, species and ecosystem diversity and biogeographical classification of India; Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values; Biodiversity at global, national and local levels; India as a mega-diversity nation; Hot-spots of biodiversity; Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; Endangered and endemic species of India; Conservation of biodiversity: *In-situ* and *Ex-situ* conservation of biodiversity.

## UNIT V

Environmental Pollution: definition, cause, effects and control measures air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution, nuclear hazards; Solid waste management: causes, effects and control measures of urban and industrial wastes; Role of an individual in prevention of pollution; Pollution case studies.

## UNIT VI

Social issues and the environment; From unsustainable to sustainable development; Urban problems related to energy; Water conservation, rain water harvesting, watershed management; Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust; Wasteland reclamation; Consumerism and waste products; Environment Protection Act; Air (Prevention and Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act; Issues involved in enforcement of environmental legislation; Public awareness.

## UNIT VII

Human population and environment: population growth, variation among nations, population explosion, Family Welfare Programme; Environment and human health: human rights, value education, HIV/AIDS; Women and child welfare; Role of information technology in environment and human health; Case studies.

## DISASTER MANAGEMENT

### UNIT I

Natural disasters - Meaning and nature of natural disasters; their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, heat and cold waves; Climatic change: global warming, sea level rise, ozone depletion.

### UNIT II

Man-made disasters - Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents.

### UNIT III

Disaster management - Effect to migrate natural disaster at national and global levels; International strategy for disaster reduction; Concept of disaster management; National disaster management framework; Financial arrangements; Role of NGOs, community-based organizations and media; Role of central, state, district and local administration; Armed forces, police and other organizations in disaster response.

## **Practical**

Visit to a local area to document environmental assets: river/ forest/ grassland/ hill/ mountain; Visit to a local polluted site - urban/ rural/ industrial/ agricultural; Study of common plants, insects, birds and study of simple ecosystems - pond, river, hill slopes, etc.; Visit to disaster management organizations; Collection of statistics of national disasters occurred since 20<sup>th</sup> century.

## **Text Book:**

- 1 Text book of Environmental Studies for undergraduate courses by Erach Bharucha University Grants Commission, New Delhi.
- 2 Ecology and Environment by P.D. Sharma, Rastogi Publication. Meerut.
- 3 Environmental Sciences by S.S. Purohit, Q.J. Shammi and A.K. Agrawal, Student Edition, Jodhpur.
- 4 A text book on Ecology and Environmental Science by M.Prasanthrajan and P.P. Mahendran., Agrotch Publishing Academy, Udaipur-313002.
- 5 The biodiversity of India, Maplin Publishing Pvt. Ltd., Ahmadabad.
- 6 Disaster Management by Sarthak Singh. Oxford Book Company.
- 7 Disaster – Strengthening community Mitigation and Preparedness by Dr. B.K. Khanna and Nina Khanna. New India Publication Agency.
- 8 Laboratory Manual of Ecology and Environmental Studies by Amrit Kaur, Paragon International Publisher, New Delhi.

**Course No: ENT-PL.PATH - 231 Course Title : Fundamentals of Crop Protection**  
**Credits: 3(2+1) Semester : III**

## **Theory**

### UNIT I

Insects - their general body structure; Importance of insects in agriculture; Life cycle of insects; Insects diversity; Feeding stages of insects and kinds (modifications) of mouth parts; Concepts in population build-up of insects – GEP, DB, EIL, ETH and pest status; Causes of insect-pests out break; General symptoms of insects attack; Principles and methods of insect-pests management; Integrated Pest Management concept; Bioecology and management of important pests of major crops and storage products.

### UNIT II

Importance and scope of plant pathology; Concept of disease in plants; Nature and classification of plant diseases; Importance and general characters of fungi, bacteria, fastidious bacteria, nematodes, phytoplasmas, spiroplasmas, viruses, viroids, algae, protozoa and phanerogamic parasites; Pathogenesis due to obligate and facultative parasites; Variability in plant pathogens; Conditions necessary for development of disease epidemics; Survival and dispersal of plant pathogens; Management of key diseases and nematodes of major crops.

## **Practical**

Familiarization with generalized insect's body structure and appendages; Life stages; Acquaintance with insect diversity; Identification of important insect-pests of cereals, cotton, oilseeds, pulses, sugarcane, fruit and vegetables crops and stored-grains, and their symptoms of damage; Acquaintance with useful insects: predators, parasitoids, pollinators, honey bees and silk worms; Acquaintance with various pesticidal formulations; Principles and working of common plant protection appliances; Calculation for preparing spray material; Acquaintance to plant pathology laboratory equipment; Preparation of culture media for fungi and bacteria; Demonstration of Koch's postulates; Study of different groups of fungicides and antibiotics and methods of their evaluation; Diagnosis and

identification of important diseases of cereals, cotton, oilseeds, pulses, sugarcane, fruit and vegetables crops and their characteristic symptoms.

### **Text Books:**

1. Chapman RF. 1998. *The Insects: Structure and Function*. Cambridge Univ. Press, Cambridge.
2. Richards OW & Davies RG. 1977. *Imm's General Text Book of Entomology*. 10th Ed. Chapman & Hall, London.
3. Dhaliwal GS & Arora R. 2003. *Integrated Pest Management – Concepts and Approaches*. Kalyani Publ., New Delhi.
4. Atwal AS & Dhaliwal GS. 2002. *Agricultural Pests of South Asia and their Management*. Kalyani Publ., New Delhi.
5. Dhaliwal GS, Singh R & Chhillar BS. 2006. *Essentials of Agricultural Entomology*. Kalyani Publ., New Delhi.
6. David BV and Ramamurthy V.V. 2011. *Essentials of Economic Entomology*. Namrutha Publ., Chennai.

### **Text Book of Plant Pathology.**

7. G.L. Schumann & C. Darcy. *Essential Plant Pathology*, APS Press, USA.
8. G.N. Agrios. *Plant Pathology*, V<sup>th</sup> Edition. Elsevier Academic Press Publication.
9. R.S. Singh. *Introduction to Principles of Plant pathology*, Fourth edition. Oxford & IBH Publishing co. Pvt. Ltd., New Delhi.
10. R.S. Mehrotra & Ashok Agrawal. *Plant Pathology*. 2<sup>nd</sup> edition. McGraw Hill Education (India) Private Limited, New Delhi.

Course No : **MICRO-121**                      Course Title : **Microbiology**  
Credits : **3(2+1)**                              Semester : **II**

### **Theory**

#### UNIT I

History of Microbiology-its applied areas; Microorganisms and their role in fermentation; Germ theory of diseases and protection; Introduction to eukaryotic and prokaryotic cell; Major groups of eukaryotes- fungi, algae and protozoa; Major groups of prokaryotes – Actinomycetes, Cyanobacteria, Archaeobacteria, Rickettsias and Chlamydia; Preservation of microorganisms; Microbial repositories at national and international level.

#### UNIT II

Bacterial growth; Metabolism in bacteria- ATP generation, chemoautotrophy, photoautotrophy, respiration, fermentation; Viruses: Bacteriophages - structure and properties, lytic and lysogenic cycles; virioids, prions.

#### UNIT III

Microbial groups in soil; Microbes in biotic and abiotic stressed environments; Microbial transformation of carbon, nitrogen and sulphur; Biological nitrogen fixation; Beneficial microorganisms in agriculture-biofertilizers, microbial pesticides; Plant microbe interaction; Microbes in composting and biodegradation; Microbiology of water and food.

### **Practical**

Microscope and other instruments in a microbiological laboratory; Media preparation, sterilization and aseptic methods for isolation, identification, preservation and storage; Identification of bacteria by staining methods; Enumeration of bacteria by pour plate and spread plate methods; Micrometry.

### Reference Book:

1. Brock TD. 1961. *Milestones in Microbiology*. Infinity Books.
2. Pelczar M.J, Chan E.C.S & Kreig N.R. 1997. *Microbiology: Concepts and Application*. Tata McGraw Hill.
3. Stainier RY, Ingraham J.L, Wheelis M.L & Painter P.R. 2003. *General Microbiology*. MacMillan.
4. Tauro P, Kapoor K.K.& Yadav K.S. 1996. *Introduction to Microbiology*. Wiley Eastern.
5. Prescott, L.M. Harley, J.P. and Klein, D.A (5ed) 2002. *Microbiology*. Mc Graw Hill Publishers, Newyork.
6. Jamaluddin, M. Malvidya, N. and Sharma, A. 2006. *General Microbiology*. Scientific Publishers, Washington.
7. Sullia, S.B, and Shantaram 1998. *General Microbiology*. Oxford and IBH.
8. Madigan, M. Martinkoj, M. and Parker (10 ed.) 2003. *Biology of Microorganisms*. PrenticeHall of India Pvt. Ltd., New Delhi.
9. Borkar, S.G. 2015. *Beneficial Microbes as Biofertilizers and its Production Technology* Woodhead Publisher, India, New Delhi

**Course No : MICRO-242 Course Title : Microbial Genetics**  
**Credits : 3(2+1) Semester : IV**

### Theory

#### UNIT I

Microorganisms as tools for genetic studies; Genetic variability in microorganisms; Genetic analysis of representative groups of bacteria, fungi and viruses; Random and tetrad spore analysis; Recombination and chromosomal mapping; Complementation - intergenic and intragenic.

#### UNIT II

Bacterial plasmids; Structure, life cycle, mode of infection and their role in genetic engineering; Transfer of genetic material in bacteria: Conjugation, transformation and transduction; Genetics of bacteriophage: T4, lambda and M13 - fine structure of gene, life cycle, mode of infection; Mutation: types, mutagens, DNA damage and repair; Transposable elements; Lac operon; Yeast genetics.

#### UNIT III

Concept and application of recombinant DNA technology; Use of genetic tools to improve the microbial strains with respect to industry, agriculture and health.

### Practical

Conjugation and transformation in bacteria; Spontaneous and auxotrophic mutation; Chemical and UV mutagenesis in fungi and bacteria; Complementation in fungi;

Identification of mutants using replica plating technique; Isolation of genomic DNA from *E. coli*; Isolation and curing of plasmid; Identification of plasmid by electrophoresis / antibiotic plates.

**Text Book:**

1. Gardner JE, Simmons MJ & Snustad DP. 1991. *Principles of Genetics*. John Wiley & Sons.
2. Lewin B. 1999. *Gene*. Vols. VI-IX. John Wiley & Sons.
3. Maloy A & Friedfelder D. 1994. *Microbial Genetics*. Narosa.
4. Scaife J, Leach D & Galizzi A 1985. *Genetics of Bacteria*. Academic Press.
5. William Hayes 1981. *Genetics of Bacteria*. Academic Press.
6. Maloy, S.R. J. E. Cronan, Jr. and David Freifelder; *Microbial Genetics*, 2006, Second Edition, Narosa Publishing House, New Delhi.
7. Srtickberger M.W. 2005. *Genetics*, Third Edition, by, Prentice Hall of India Private Ltd. New Delhi.
8. Singh, B.D. *Genetics*, 2006, First Edition, by, Kalyani Publishers, New Delhi.
9. Lewin Benjamin 2006. *Genes IX*, by, Pearson Prentice Hall, Pearson Education Inc., New Jersey.

**Reference Books:**

1. Birge EA. 1981. *Bacterial and Bacteriophage Genetics*. Springer Verlag.
2. Freifelder David 2005, *Molecular Biology*, Second Edition, by; Narosa Publishing House, New Delhi.

**Course No** : CS-3510      **Course Title** : Computer Application in Biotechnology  
**Credits** : 3(1+2)      **Semester** : V

**Theory:**

Introduction to computers and window O.S. introduction to MS word, MS power point, MS Excel. Network & its type Internet, www. Multimedia and its types. Data base management sys. Introduction to programming with C – language. Introduction to web sites, E-mail, programming in Perl.

**Practicals:** Internet, E-Mail, Internet surfing. Database management sys. Programming in C. Programming in Perl.

**Reference books:**

1. The concept guide to Microsoft office. Mansfield Ron 1994 BPB publications, New Delhi.
2. Mastering the internet- Glee Harrah Cady and Pat Mc Gregor 1995 BPB publications, New Delhi.
3. Rapidex computer course 4th Edn. 1996. Gupta V., Pustak Mahal, Delhi.
4. Windows 95 A to Z. Galgotia S. 1996. Galgotia Publications (P) ltd., New Delh

**Course No** : CS-3611

**Course Title** : Management of major insect pests and diseases of field and horticulture crops

**Credits : 2(1+1) Semester : VI**

**Theory :**

Scientific names taxonomic position, host range, nature of damage life history, bionomics and management of important pests infesting cereals, fibres, oilseeds, pulses, sugarcane, forage crops, vegetables and fruit crops. Different pest control methods, IPM concept, Insecticide resistance management; Economic importance, symptoms, etiology, and integrated management of major diseases of rice, sorghum, bajra, wheat, sugarcane, turmeric, ginger, groundnut, sunflower, safflower, cotton, red gram, Bengal gram, soybean, citrus, mango, banana, grapevine, pomegranate, papaya, guava, betelvine, chili, brinjal, lady finger, potato, crucifers, cucurbits, tomato, onion, beans, rose, chrysanthemum, gladiolus, carnation, tuberose, and gerbera.

**Practical:**

Collection, identification and preservation of insect pests and natural enemies of above crops. Pesticide application technique; Study of symptoms, epidemiology and disease cycle, and specific control measures of major diseases of rice, sorghum, bajra, wheat, sugarcane, turmeric, ginger, groundnut, sunflower, safflower, cotton, red gram, Bengal gram, soybean, citrus, mango, banana, grapevine, pomegranate, papaya, guava, betelvine, chili, brinjal, lady finger, potato, crucifers, cucurbits, tomato, onion, beans, rose, chrysanthemum, gladiolus, carnation, tuberose, and gerbera. Field visits at appropriate time during the semester. Survey and collection of disease samples of above crops and their preservation. Isolation, methods of preserving cultures, production of different commercial formulations, and quality control of bioagents.

**Text Books:**

1. Elements of economic entomology – B.V. David & T. Kumarswami.
2. Insects and Fruits: D.K. Batani.
3. Insects in Vegetables : D.K. Batani and M.G. Jotwani
4. Handbook of economic entomology for South India – T.V.R. Ayer.
5. Agril. Pests of India and South East Asia – A.S. Atwal.
6. Diseases of tropical and subtropical field, fibre and oil plants by Cook, A. A. 1981, Mac Millan Pub New York
7. Diseases of crop plants in India by Rangaswamy G. and Mahadevan. 2006.
8. Plant Diseases by Singh, R. S. 1996, Oxford & IBM Ltd New Delhi.
9. Plant Pathology by G. N. Agreose 5th Edition.
10. Diseases of fruit crops by Pathak, V. N. 1980 Oxford & I BH Pub.
11. Diseases of ornamental plants in India by Sohi, H. S. 1992 ICAR, New Delhi.
12. Diseases of vegetable crops. Singh, R. S. 1994, Oxford & IBM, New Delhi.

**Course No : CS-3612 Course Title : Marketing and Export of Biotechnological Products**

**Credits : 2(1+1) Semester : VI**

**Theory:**

External trade in Agricultural products, Present status, policy and prospects under WTO regime, Export import policy, Regulation of Agricultural marketing system , Infrastructural facilities for exporting efficiency, Biotechnological Products in India, Quality parameters and

quarantine procedures of export. Market integration :Types and effects Marketing costs margins and price spread. Biotech industries & institutes in India & world, Concepts of Biotech park/ Biotech Hub

### **Practicals :**

Visit to different small scale and large scale Agro-based products. Study the production techniques of biotech products. Collecting the information on export import data on biotech products, quality standards for export and their potential. Analyze data in relation to demand supply . Comparison between non biotechnological products and biotechnological products. Safety and licensing for import and export of biotechnological products.

### **Reference books:**

1. Agriculture Marketing in India by Acharya and Agrawal 1999, Oxford IBH, N. Delhi.
2. Principles of Marketing by Kotlar and Armstrong 1997, Prentice-Hall, N. Delhi.

**Course No : CS-4715    Course Title : Biofertilizer Production Technology**  
**Credits : 4(1+3)      Semester : VII**

### **Theory:**

Distribution of soil microflora Biological properties of soil and factors affecting biological properties, Role of soil microorganisms in maintenance of soil fertility and productivity Biochemistry of humus formation Biochemistry of nitrogen fixation, Phosphate solubilization –mechanism. Organic matter decomposition. Types and scope of biofertilizers Quality control of biofertilizers, Use of Genetically Engineered Micro-organisms for improvement of biofertilizers.

### **Practical:**

1. Introduction to different microorganisms used in biofertilizer production
2. Introduction, definition, types, scope of biofertilizers
3. Isolation of Phosphate solubilizing micro-organisms from rhizosphere
4. Isolation of *Rhizobium* from root nodules of leguminous crop
5. Isolation and purification of *Azotobacter* from soil
6. Isolation and purification of *Beijerinckia* form soil
7. Isolation of *Azospirillum*
8. Isolation Blue Green Algae from soil
9. Isolation of organic matter decomposing microorganisms
10. Mass multiplication of *Rhizobium*, *Azotobacter*, and *Azospirillum* inoculum
11. Production and application of blue green algae
12. Production of *Azolla* biofertilizers
13. Methods of application of biofertilizers
14. Standards for commercial production of biofertilizers- Quality control of biofertilizers.



**References:**

1. Soil microorganisms by N.S.Subba Rao, Oxford and IBH Publication Co. New Delhi
2. Advances in Agril. Microbiology by N.S. Subbarao, Oxford and IBH Publication Co, New Delhi
3. Bergy's manual of systematic bacteriology by Krieg N.R. and J.G. Holt, 1984, Williams and Witkins, Baltimore, U.S.A.
4. Agricultural Microbiology by Rangaswamy G. and D.J. Bhagyaraj 1988, Oxford and IBH Publication Co. New Delhi.

**Course No** : CS-4717      **Course Title** : Seed Production Technology  
**Credits** : 4(1+3)      **Semester** : VII

**Theory:**

The Indian Seed Act (1966). Classes of quality seed, Breeder seed, Foundation seed, certified seed. Requirements for certified seed genetic purity, physical purity, germination percentage. Seed production: Isolation, seed crop cultivation. Seed processing: drying, cleaning, garding, testing, treating, bagging and labeling. Seed Certification: Field inspection, seed tests, sampling, purity tests, germination tests, moisture control. Maintenance of improved seed. Seed production organizations.

**Practical:**

Seed Tests: - Sampling, Purity test, germination test, moisture content, physical purity.  
Grow out tests: - Breeding of new varieties. Certified seed production of selected crops, Isolation distance, Cultural Practices, Planting, Plant Protection, Detaselling, Roughing, Harvesting, Dying of Hybrid Maize/Wheat/ Jowar/Chickpea/ Pigeonpea/ Onion/ Chilli/ Brinjal/Tomato/ Cotton, etc.

**References:**

1. Techniques in Seed science and Technology by Agrawal, P. K and Dadlani, M 1987, South Asian Publishers, New Delhi.
2. Principles of plant breeding by Allard, R. W. 1960, John Wiley and Sons Inc., New York.