



**Swami Ramanand Teerth  
Marathwada University, Nanded.**

*Revised Curriculum  
B. Sc. Second year (Semester III & IV)  
Environmental Science*

***w.e.f. : June, 2014***

**Semester program for  
B. Sc. II Year Environmental Science**

- External 40 marks are Multiple choice questions Subjective questions for each paper
- Internal 10 marks are splitted in to 05 marks for home assignment and 05 marks for the midterm examination
- Work load for theory papers Env. 201, Env. 202, Env. 203, & Env. 204 is 03 periods per week. Paper Env. 205 & Env. 206
- (Laboratory courses) are annual and having work load 03 periods per week.

**Course Structure & Marking System  
B. Sc. II year (Semester III ) Environmental Science**

Sr. NO	Course Code	Title of the paper	No of periods per week	Total No of periods in the Semester	Internal Assessment Home & Internal		External Examination	Total Marks
01	ENV.201	Basic Concepts in Environmental Microbiology	03	45	05	05	40	50
02	ENV.202	Air Pollution and Meteorology	03	45	05	05	40	50

# Env. 201 : Basic concepts in Environmental Microbiology

## Unit I

**History , Diversity and Scope of Microbiology:** Beginning of Microbiology, Scope of Microbiology, Importance of microbiology, Contributions of Antony van leewenhoek, Louis Pasteur, Robert Koch, Alexander Fleming, The theory of spontaneous generation, Whittaker s Five kingdom concept.

General characteristics, Morphological Features and Significance: Virus, Bacteria Algae, Fungi and Protozoa

Branches of microbiology: Food Microbiology, Dairy Microbiology, Industrial Microbiology, Pharmaceutical Microbiology, Microbial Ecology, Medical Microbiology, Agricultural Microbiology, Geo-microbiology.

## Unit II

### **Growth and Reproduction of Bacteria:**

Concept of Growth and reproduction, Mechanism of binary Fission, Growth, Growth rate and Generation time, Growth curve of bacterial population and its practical applications, Quantitative measurement of bacterial growth, Structure & Function of: Glycocalyx, Flagella, Pilli, Cell Wall (Gram positive, Gram negative and Acid fast), Cytoplasmic membrane, Mesosomes, Nucleoid, Plasmid, ribosomes (70S), Cytoplasmic inclusions, PHB granule, glycogen, carbohydrates, Magnetosomes, gas vesicles, chromosome, sulphur granules and endospore (germination, sporulation)

**Anatomy of Eukaryotic cell:** Ultra-structure of Fungal, Algal and Protozoa Cell, Structure and Function and Chemical Composition of : Flagella, Cell wall (Fungi and algae), Nucleus, Mitochondria, Chloroplast, Golgi bodies, Ribosome(80S), Lysosome, comparison: pro & eucaryotes.

## Unit III

**Microscopy and Staining :** Microscope, Types( Light and Electron Overview), Magnification, Resolution, Numerical Aperture, Use of Oil immersion objective , Compound Microscope: Principle, Working and Significance, Concept and Types of Stains (Acidic and Basic stain, Mordant), Smear Preparation, Simple (Monochrome and Negative) and Differential staining Gram and Acid fast staining.

**Nutritional Requirements :** Classification of bacteria based on nutrition, Physical Factors: pH, Temperature, water activity, aeration (Oxygen) Chemical factors: Media, Types of media, Media Ingredients (water, Malt extract, Meat extract, Yeast extract, Trace elements) .

## **References:**

- 01. General microbiology Volume I & II :** C. B. Powar & H. F. Dagainawala ( Himalaya publishing House, Mumbai ), 2002
- 02. Fundamental principles of Bacteriology :** A. J. Salle, ( Tata McGraw-Hill Publishing Company, New Delhi ), 1974
- 03. Microbiology :** P. D. Sharma ( Rastogi publication Meerut )
- 04. Microbiology :** Pelizer, Reid & Chan ( Tata McGraw-Hill Publishing Company Limited, New Delhi ),
- 05. Hand book of Microbiology :** Yu. S. Krivashein ( Mir Publishers Mascow )
- 06. Microbiology for Environmental Engineering :** M. C. Kinnery ( Tata McGraw-Hill Publishing Company New Delhi ),
- 07. Introduction to Virology :** S. B. Biswas
- 08. General microbiology :** Stainer
- 09. Applied Microbiology :** imta Kale & Kishore Bhusari ( Himalaya Publishing House, Mumbai )
- 10. Medical Microbiology :** Day & Day, and Anant Narayan

# Env. 202 : Air Pollution & Meteorology

## **Unit I : Atmosphere & Meteorology :**

Structure of Atmosphere, Wind speed, direction and their vertical profiles, turbulence (mechanical and thermal), atmospheric stability characteristics and classes, Plume behavior, effects of micrometeorology on point source emission, wind-valley effects, land/sea breeze-effects, heat island effect, mixing height-boundary layer definition, temperature inversions, factors affecting on dispersion of air pollutants, micrometeorological instruments . (10)

## **Unit II : Types of Air Pollutants and Their Sources :**

Natural contaminants: Aerosols, Dust, Smoke, Mist, Fog, Fumes, Particulate matter (PM), Suspended particulate matter (SPM), Respirable suspended particulate matter (RSPM), Fly ash, Photochemical smog; Gaseous air pollutants: Sulphur dioxide, hydrogen sulphide, Hydrogen fluorides, Chlorine, Oxides of nitrogen, Carbon monoxide, Aldehydes, Organic vapors, Tetra ethyl lead, Radioactive gases. Natural sources: Volcano, Accidental fires in forests, Dust storms, Oceans; Bio pollutants : Pollen bio pollutants, Algal bio pollutants, Fungal bio pollutants, Combustion; Stationary sources: Fertilizer complex, Cement industries, Thermal power stations, Sulphuric acid industry, Fluoride industry, Nitric acid plants, Soap and detergent industry, Petroleum and Coal industry, Iron and steel industry, Stone and Clay products, Kraft pulp manufacturing, Incineration of refuse and solid wastes; Mobile sources: Automobiles, Aero planes. , HAPs (hazardous air pollutants), Indoor pollution- different sources. (20)

## **Unit III : Air Pollution Effects:**

**Effects of air pollution on human health:** Mechanism of action of air pollutants, Human health effects, Specific air pollutants and their health effects, Major Disasters showing health effects: Meuse Valley (Belgium disaster, Donora (USA) disaster, London disaster, Los Angeles disaster,

**Effects of air pollution on Animals:** Effects of Fluorine, Arsenic, Lead, Pests, Ionizing radiation.

**Effects of Air pollution on Plants:** Structure of normal leaf, Air pollutants affecting plants, Forms of damages to leaves, Kinds of injuries to plants, Effects of specific pollutants on plants: HF, Ozone, Chlorine, Hydrogen chloride, Nitric oxides, Ammonia, Hydrogen cyanide, Herbicides.

**Economic effects of Air Pollution:** Mechanism of deterioration in polluted atmosphere, Factors influencing atmospheric deterioration, Material damage : Effects on Building materials, Paints, Textiles, Rubber, Leather, Paper, Glass and ceramics, Effects on art treasure,

**Long term effects on the planet :** Green house effects, Ozone layer depletion, Acid rain (15)

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## References:

- 01. Air Pollution and its control** : Sumit malhotra ( Pointer publishers, Jaipur )
- 02. Air Pollution** : M. N. Rao ( Tata McGraw – Hill publishing company, New Delhi )
- 03. Air Pollution** : B. K. sharma, H. Kaur ( Krishna prakashan media, Meerut )
- 04. Pollution of our Atmosphere** : B. Henderson, ( Sellers Adam Hilger Limited, Bristol )
- 05. Fundamentals of Air Pollution** : Richard W. Bowbel, Donald L. Fox, D. Bruce Tunner, and Arthur C. Stern ( Academic Press, California)
- 06. Air Pollution control Engineering** : Noel De Nevers ( Mc Graw – Hill international, New York )
- 07. Air Pollution** : S. K. Agarawal ( A. P. H. Publishing corporation, New Delhi )
- 08. Air Pollution** : V. P. Kudesia ( Pragati Prakashan, Meerut )
- 09. General climatology** : Critichfield H. J.
- 10. Climatology : Fundamentals and Applications** : Mater J. R.
- 11. Climatology : Selected Applications** : Henry D. Foth



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### ***Course Structure & Marking System B. Sc. II year ( Semester IV ) Environmental Science***

Sr. NO	Course Code	Title of the paper	No of periods per week	Total No of periods in the Semester	Internal Assessment Home & Internal		External Examination	Total Marks
01	Env.203	Applied Environmental Microbiology	03	45	05	05	40	50
02	ENV.204	Air and Noise pollution Control	03	45	05	05	40	50
03	ENV.205	Laboratory Course	03	60	-----		50	50
04	ENV.206	Laboratory Course	03	60	-----		50	50

# Env. 203 : Applied Environmental Microbiology

## **Unit I:**

**Methods in Microbiology:** Pure culture technique: Streak plate, Pour plate, spread plate and Roll tube method. Slide culture techniques for fungi, Isolation and Cultivation of Algae.

## **Unit II:**

**Sterilization methods :** Concept of Sterilization, Microbiocide, Microbiostatic, Sterilization by Physical agents –Dry heat (Hot air oven, Incineration) and Moist heat (Autoclave, Tyndallization), Radiation- (X-rays, Gamma rays, Chemical Sterilization : Ethylene oxide, Formaldehyde, Sterilization by Filtration Membrane filter,

**Control of Microbes: Disinfection** Concept of Disinfectant, Antiseptic, Sanitizer, Germicide, Antibiotics, Significance of following in control of microorganisms: Pasteurization, Ultraviolet light, Low Temperature, Desiccation, Osmotic pressure, Surface tension, Characteristics of an ideal antimicrobial chemical agent, Mode of action and application of Phenol and Phenolic compounds, Alcohols, Halogens, Heavy metals and their compounds, Dyes, Detergents, Quaternary ammonium compounds, H<sub>2</sub>O<sub>2</sub> .

## **Unit III:**

Air Microbiology, Microflora of air, Enumeration of bacteria in air: Liquid impingement, Solid impingement, Water microbiology, Microbial indicators of water pollution. Bacteriological examination of potable water (Presumptive, confirmative and completed tests) Soil Microbiology Soil Microflora, Rhizosphere.

Role of microbes in carbon cycle; Role of microbes in Nitrogen cycle: Ammonification, Nitrification, Nitrate reduction, Denitrification, Nitrogen fixation, Symbiotic nitrogen fixation, Non symbiotic nitrogen fixation,; Role of microbes in Sulphur cycle.

Food Microbiology : Initial contamination of fresh food, Microbial spoilage of foods, Preservation of foods, Microbiological examination of foods, Fermented foods, Food poisoning.

Microbiology of milk : Sources of microorganisms in milk, Types of microorganisms in milk, Microbial examination of milk, Pasteurization of milk



## References:

- 01. General microbiology Volume I & II :** C. B. Powar & H. F. Dagainawala ( Himalaya publishing House, Mumbai ), 2002
- 02. Fundamental principles of Bacteriology :** A. J. Salle, ( Tata McGraw-Hill Publishing Company, New Delhi ), 1974
- 03. Microbiology :** P. D. Sharma ( Rastogi publication Meerut )
- 04. Microbiology :** Pelizer, Reid & Chan ( Tata McGraw-Hill Publishing Company Limited, New Delhi ),
- 05. Hand book of Microbiology :** Yu. S. Krivashein ( Mir Publishers Mascow )
- 06. Microbiology for Environmental Engineering :** M. C. Kinnery ( Tata McGraw-Hill Publishing Company New Delhi ),
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- 09. Applied Microbiology :** imta Kale & Kishore Bhusari ( Himalaya Publishing House, Mumbai )
- 10. Medical Microbiology :** Day & Day, and Anant Narayan

# Env. 204 : Air & Noise Pollution Control

## **Unit I :**

### **Ambient Air Pollutants Sampling, Analysis and Measurement :**

**Sampling methods :** Sedimentation, Filtration, Impingement method, Electrostatic precipitation, Thermal precipitation, Centrifugal method,

**Particulate matter sampling and analysis:** Dust fall measurement, SPM and RSPM sampling using High volume air sampler;

**Gaseous pollutants sampling and analysis:** Carbon monoxide, Ozone, Hydrogen sulphide, Nitrogen dioxide, Sulphur dioxide, Hydrogen cyanide, Ammonia, Aldehydes.

(15)

## **Unit II :**

### **Air Pollution Control:**

Particulate emission control: Gravity settlers, Cyclone separators, Fabric filters, Electrostatic precipitators, Wet scrubbers; Gaseous emission control: Principles of absorption and adsorption; Packed towers, Plate towers, Spray towers; Odour control: Combustion: Removal methods: removal of Sulfur dioxide, Nitrogen oxides, Hydrocarbons.

(15)

## **Unit III :**

### **Noise Pollution :**

Introduction, Mechanism of hearing, Physiological response to noise, Sources of Noise, **Effects of Noise Pollution** :Speech interference, Physiological effects, Behavioral effects, Annoyance, Effects on efficiency, Fatigue, Mental health effects, Hearing loss, Biological effects, Noise level measurement, **Noise and vibration Control:** Barrier and enclosures, Silencers, Vibration dumping, Vibration isolation.

(15)

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## References:

- 01. Air Pollution and its control** : Sumit malhotra ( Pointer publishers, Jaipur )
- 02. Air Pollution** : M. N. Rao ( Tata McGraw – Hill publishing company, New Delhi )
- 03. Air Pollution** : B. K. sharma, H. Kaur ( Krishna prakashan media, Meerut )
- 04. Pollution of our Atmosphere** : B. Henderson, ( Sellers Adam Hilger Limited, Bristol )
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- 06. Air Pollution control Engineering** : Noel De Nevers ( Mc Graw – Hill international, New York )
- 07. Air Pollution** : S. K. Agarawal ( A. P. H. Publishing corporation, New Delhi )
- 08. Air Pollution** : V. P. Kudesia ( Pragati Prakashan, Meerut )
- 09. Introduction to weather and climate** : Trewartha
- 10. Air Pollution ( Volume I to X )** : A. C. Stern ( Academic Press )



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**Model Question Paper (Theory )**

**Class : B. Sc. Second Year**

Subject : Environmental Science

**Semester III**

**Paper : Env. 201 Basic Concepts in Microbiology and Env.202 : Air Pollution & Meteorology**

**Time : one Hour**

**Maximum Marks : 040**

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**Multiple Choice Questions with Four Options from Q. No- 1 to Q. No- 40**



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**Model Question Paper (Theory )**

**Class : B. Sc. Second Year**

**Semester IV**

Subject : Environmental Science

**Paper : Env.203 Environmental Microbiology and Env.204 : Air & Noise Pollution  
Control**

**Time : one Hour**

**Maximum Marks : 040**

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**Multiple Choice Questions with Four Options from Q. No- 1 to Q. No- 40**

### *Env. 205 : Laboratory Course*

01. Study of Microscope.
02. Study of Laboratory equipments ( Incubator, Hot air oven, Autoclave Inoculating chamber, Centrifuge ).
03. Acquainting basic microbiology tools: Cleaning and washing of Glassware, Wrapping the items prior sterilization, Cotton Plugging, Aseptic handling (LAF/Bunsen burner), Inoculation of bacterial culture, Biological Waste Disposal
04. Preparation and sterilization of culture media.
05. Study of Bacteria ( Types ).
06. Isolation of bacteria from Soil.
07. Isolation of Fungi from Soil.
08. Observation of motility of organisms by hanging drop technique.
09. Monochrome staining.
10. Differential ( Gram's ) staining.
11. Negative staining.
12. Isolation of bacteria by Streak plate, Pour plate, Spread plate method.
13. Total Viable Count of Water.
14. Determination of Total Coliforms from water.
15. Differentiation between Fecal and non fecal Coliforms by IMViC test.
16. Determination of Quality of Milk by Methylene Blue Reductase test.
17. Effect of pH on growth of bacteria.
18. Qualitative test for protein by biuret test.
19. Qualitative test for carbohydrate by Benedict's test.
20. Effect of temperature on growth of bacteria

### *Env. 206 : Laboratory Course*

01. Study of High Volume Air Sampler.
02. Study of Rotorod Air Sampler and Tilak Air Sampler.
03. Dust Fall measurement by tiles exposure method.
04. Determination of Carbon Di Oxide ( CO<sub>2</sub> ) by Zincondroff Technique.
05. Determination of Carbon monoxide ( CO ) by Co detector.
06. Detection of SO<sub>2</sub> from ambient air.
07. Detection of H<sub>2</sub>S from ambient air.
08. Detection of Ammonia from ambient air.
09. Interpretation of wind rose diagram.
10. Determination of wind velocity.
11. Determination of Air pollution index.
12. Determination of Suspended Particulate Matter by HVAS.
13. Determination of Respirable Suspended Particulate Matter by HVAS.
14. Estimation of SO<sub>x</sub> from air by High Volume Air Sampler and Spectrophotometer.
15. Estimation of NO<sub>x</sub> from air by High Volume Air Sampler and Spectrophotometer.
16. Estimation of Ammonia from air by High Volume Air Sampler and Spectrophotometer.
17. To Study the effects of SO<sub>2</sub> on plant.
18. To Study the effects of H<sub>2</sub>S on plant.
19. To Study the effects of Ammonia on plant.
20. Determination of Noise Level by dB meter.



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**Model Question Paper ( Practical )**

**Class : B. Sc. Second Year**

Subject : Environmental Science

**Paper : Env. 205 : Laboratory Course**

**Time : Three Hours**

**Maximum Marks : 050**

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- Q. 1: Stain the bacterial culture by Monochrome / Gram's / Negative staining Technique. 10
- Q. 2: Determine number of Total Coliforms / Effect of pH on growth of bacteria 10  
OR  
Differentiate between Fecal Coliforms and Non fecal Coliforms by IMViC test  
OR  
Determine Total Viable Count of Bacteria from provided water sample
- Q. 3: Determine the quality of milk by Methylene blue Reductase test. 10  
OR  
Effect of temperature on grown of bacteria  
OR  
Observe the motility of the microorganisms by hanging drop technique.  
OR  
Isolate bacteria / Fungi from provided soil sample.
- Q. 4: Isolate Bacteria from provided sample by Streak / Pour / Spread plate method. 10  
OR  
Test protein qualitatively by Biuret test.  
OR  
Test carbohydrates Qualitatively by Benedict's test.
- Q. 5: a) Record Book submission 05  
b) Viva Voce 05



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**Model Question Paper ( Practical )**

**Class : B. Sc. Second Year**

Subject : Environmental Science

**Paper : Env. 206 : Laboratory Course**

**Time : Three Hours**

**Maximum Marks : 050**

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Q. 1: Determine Suspended Particulate Matter / Respirable Suspended Particulate Matter by High Volume Air Sampler. 10

OR

Estimate SO<sub>x</sub> / NO<sub>x</sub> from air by High Volume Air Sampler and Spectrophotometer

Q. 2: Determine Dust Fall rate by tiles exposure method. 10

OR

Determine Carbon Di Oxide ( CO<sub>2</sub>) from air by Zincondroff Technique.

Q. 3: Detect of SO<sub>2</sub> / H<sub>2</sub>S / Ammonia from ambient air by Qualitative tests. 10

OR

Interpret wind rose diagram. / Determine wind velocity.

OR

Determine Co by Co detector from Ambient air.

Q. 4: Determine Noise Level of the ambient air by dB meter. 10

OR

Determine Air pollution index.

OR

Study the Effects of SO<sub>2</sub> / H<sub>2</sub>S / Ammonia on plant material.

Q. 5: a) Record Book submission 05

b) Excursion Report 05