

**DEPARTMENT OF MICROBIOLOGY**  
**PART III – SEC – II**  
**CO-CURRICULAR COURSES**  
 (To be offered from Semester – II – IV)

<b>16UMBCOC1</b>	<b>Biofertilizer</b>	<b>80 hrs Duration</b>	<b>1 Credits</b>
------------------	----------------------	----------------------------	------------------

**Course Profile:**

Constant use of land leads to loss of its fertility and thus the fertility needs to be replenished. The deficiency of any one or more nutrients in the soil may impair the growth and development of plants. Macro elements like nitrogen, phosphorous and potassium are required in larger quantities. CHEMICAL fertilizers like nitrogen, and phosphorous are applied to the land so that it regains its fertility. Materials of biological origin commonly used to maintain and improve soil fertility are called biofertilizers. These are categorized as Manures and Biofertilizers. Manures are organic wastes that after partial decay are added to the soil to increase crop productivity. Microorganisms that enrich the soil in nutrients by their biological activity are biofertilizers. Main sources are bacteria, cyanobacteria and fungi. Use of biofertilizers is one of the important components of integrated nutrient management, as they are cost effective and renewable source of plant nutrients to supplement the chemical fertilizers for sustainable agriculture.

**Employment Opportunities:**

**a. Job Prospects:**

1. As production in charge in Biofertilizer Producing Industry
2. In R&D Department of Biofertilizer Producing Industry
3. Agriculture Department of Government
4. National Institutes engaged in research on Biofertilizers

**b. Entrepreneur:**

1. Biofertilizer Production
2. Biofertilizer Marketing
3. Agro-consultant

## **Duration of course:**

The course shall extend over a period of Two Semester for 80 Hours. The course will normally commence in the month of August of every academic year.

## **Admission Procedure**

Candidates for admission to the course should be B.Sc or M.Sc degree students of Shree M. & N. Virani Science College, Rajkot, studying in Semester – I to IV only. Interested students shall apply for admission at the time of notification in the prescribed form, which would be normally in the month of July of every academic year. The students shall enroll with the Co-ordinator of the course. The course would commence as soon as the batch fills up.

## **Course Objectives:**

The Course is designed:

- To demonstrate the techno-economic viability of the biofertilizer to students.
- To introduce rural based economically viable & self income generation production of Biofertilizer.
- To demonstrate the effectiveness of biofertilizer cultural practices in the farmers fields for enhanced crop productivity
- To create self employment opportunities for students

### **UNIT I: Introduction**

**10hrs**

- Definition of Biofertilizer and brief History
- General account of the microbes used as Biofertilizer for various crop plants
- Advantages of Biofertilizer over chemical fertilizers.
- Mechanism of ability of the organisms to work as Biofertilizer

### **UNIT II: N<sub>2</sub> Biofertilizer**

**15hrs**

- Types and Characteristics
- Host-Rhizobium interaction
- N<sub>2</sub>-fixation in root-nodules
- N<sub>2</sub>-fixation in soil by free living microbes
- Production
- Methods of application

### **UNIT III: Azolla & BGA Bio fertilizers**

**10hrs**

- Characteristics
- N<sub>2</sub>-fixation process
- Production
- Methods of application

**UNIT IV: Mycorrhizae and : PSB Bio fertilizer (Phosphate solubilising Bacteria) 15hrs**

- Importance and types of mycorrhizae inoculum in agriculture
- Isolation and mass production of AM and VAM , their mass production and field applications
- Isolation and Characterization of PSB
- Mechanism of phosphate solubilisation
- Production and Methods of application

**UNIT V: Quality control of Bio fertilizers as per FCO (Fertilizer Control Order) 15hrs**

- Introduction of FCO specifications for bio fertilizers
- Sampling procedure
- Method of analysis
- Standards of bio fertilizers
- Biostability, Storage, shelf life, quality control and marketing of product bio fertilizer
- Introduction to IPM

**Practicals**

**15hrs**

1. Isolation of Azotobacter from soil
2. Isolation of Azospirillum from soil.
3. Isolation of Rhizobium from root-nodules.
4. Isolation of Phosphate solubilising bacteria from soil.
5. Isolation of VAM fungi from soil. (Demonstration).
6. Determination of heterocyst frequency of blue-green bacteria.
7. Microbial limit test for PSB market fertilizer product.
8. Preparation of Biofertilizer at laboratory level and their pot testing
9. Prepare chart for fertilizer classification with chemical formula and nutrient content.
10. Isolation of Azotobacter from soil
11. Isolation of Azospirillum from soil.
12. Isolation of Rhizobium from root-nodules.
13. Isolation of Phosphate solubilising bacteria from soil.
14. Isolation of VAM fungi from soil. (Demonstration).
15. Determination of heterocyst frequency of blue-green bacteria.
16. Microbial limit test for PSB market fertilizer product.
17. Preparation of Biofertilizer at laboratory level and their pot testing
18. Prepare chart for fertilizer classification with chemical formula and
19. nutrient content.
20. Estimate nutrient content (% N, %P<sub>2</sub>O, % K<sub>2</sub>O) in different fertilizers from their chemical formula.

21. Estimate percentage of Nitrogen in Ammonium chloride by substitution method.
22. Estimate percentage of Nitrogen in Ammonium sulfate by substitution method.
23. Estimate percentage of Nitrogen in Ammonium chloride by back titration
24. Estimate percentage of Nitrogen in Ammonium sulphate by back titration
25. Analysis of Urea by Formaldehyde method.
26. Estimate percentage of Nitrogen in Ammonium Chloride/Sulphate by Kjeldhal's method
27. Estimate biuret content in Urea sample by colour comparison
28. Estimate percentage of Nitrogen in DAP by Formaldehyde method
29. Estimate percentage of Nitrogen in DAP by Kjeldhal's method
30. Prepare potassium sulphate
31. Prepare potassium chloride
32. Estimate ratio from Ammonia to Phosphoric acid in DAP
33. Prepare potassium nitrate

### **Text Books**

- Purohit, S.S., P.R. Kothari and S.K. Mathur, 1993. Basic and Agricultural Biotechnology, Agro Botanical Pub. India.
- Subba Rao, N. S. 1988. Biological nitrogen fixation: recent developments, Mohan Pramlani for Oxford and IBH Pub. Co. (P) Ltd., India.
- Somani, L.L., S.C. Bhandari, K.K. Vyas and S.N. Saxena. 1990. Biofertilizers, Scientific Publishers - Jodhpur.
- Tilak, K.V.B. 1991. Bacterial Biofertilizers, ICAR Pub., New Delhi.

### **Reference books**

- Bio fertilizers –Vyas & Vyas( Ekta Publication).
- Bio fertilizers– Arun Sharma.
- Practical Microbiology–R. C. Dubey and D. K. Maheshwari
- Fertilizer Control Order–1985 amended up to June, 2011
- Subba Rao, N.S., G.S. Venkataraman and S. Kannaiyan 1993. Biological nitrogen fixation, ICAR Pub., New Delhi.

## SCHEME OF INSTRUCTION AND EXAMINATIONS

For Students Admitted From A.Y. 2016-2017 & Onwards

<b>Semester –I &amp; II</b>							
Course Code	Course	Total Hrs- of Instructions	Exam Duration hrs	Marks allotted			Credits
				CIE	CEE	Total	
<b>Part –III</b>							
<b>16UMBCOC1</b>	<b>SEC-II: Co- curricular course - Biofertilizers: 1. Theory 2. practical</b>	80 (40 hrs / Semester)	3 hrs	30 20	70 30	100 50	1
		<b>80</b>		<b>50</b>	<b>100</b>	<b>150</b>	<b>1</b>

### Examinations:

The course carries 1 credit and the students will be evaluated continuously based on their participation in learning experiences, theory, and evaluation through tests and assignments and will also be evaluated at the end of course under CEE which will be 100% internal. The pattern of evaluation with percentage weightage will be as specified below:

<i>Theory Courses</i>		<i>Practical Courses</i>	
Continuous Internal Evaluation (CIE)	30%	Continuous Internal Evaluation (CIE)	40%
Course End Exam (CEE)	70%	Course End Exam (CEE)	60%

### Issue of Certificate and Marks card

Certificates will be issued to the candidates on successful completion of the Course by the autonomous college.

### Evaluation norms: Theory

S.No	Components			
	CIE	Marks	CEE	Marks
1	Assignment – 1	05	Semester End Test (after 2 <sup>nd</sup> Semester)	70
2	Assignment - 2	05		
3	Internal Test - 1	10		
4	Internal Test - 2	10		
<b>TOTAL</b>		<b>30</b>		<b>70</b>

### Evaluation norms: Practical

S. No	Components			
	CIE	Marks	CEE	Marks
1	Internal practical – I - MCQ	10	Semester End Test (after 2 <sup>nd</sup> Semester)	30

2	Internal Practical – II – Short Answer Questions	10		
<b>TOTAL</b>		<b>20</b>		<b>30</b>

**Shree Manibhai Virani & Smt. Navalben Virani Science College, Rajkot**  
**Autonomous**  
**Affiliated to Saurashtra University, Rajkot**

**DEPARTMENT OF MICROBIOLOGY**

**Part III: SEC-II -CO-CURRICULAR COURSE**  
**Environmental Monitoring and Auditing and (EMA)- Semester I & II**

**Regulations for Students Admitted From A.Y.2016-2017 and Onwards**

**DURATION OF THE PROGRAMME**

The programme shall extend over a period of one year comprising of two semesters. Each semester normally consists of 1 theory paper and 12-13 Practicals.

**STRUCTURE OF THE PROGRAMME**

Each COP-EAM programme will be a blend of theory courses and practicals. The medium of instruction and examinations shall be English. The instruction hours will be outside the stipulated instructional hours for core and allied courses

**EVALUATION**

The evaluation shall be 100% internal as Continuous Internal Evaluation (CIE) and Course End Examination (SEE) with percentage weightage as specified below.

<i>Theory Courses</i>		<i>Practical Courses</i>	
Continuous Internal Evaluation (CIE)	30%	Continuous Internal Evaluation (CIE)	40%
Course End Exam (CEE)	70%	Course End Exam (CEE)	60%

**GUIDELINES FOR THE PROGRAMME**

1. Minimum 80% attendance is required, if not able to fulfil it then only by the permission of Programme Coordinator and the principal will be allowed to compensate in the next year.
2. Degree will be awarded only after receiving of the certificate.

**ISSUE OF MARKSHEET AND DEGREE CERTIFICATE**

The college shall publish the result after evaluation and with the recommendations of Result Passing Board at the end of each semester. On approval of the results by the Programme Coordinator, the candidate will be recommended for the award of the Certificate.

**Shree Manibhai Virani & Smt. Navalben Virani Science College, Rajkot**  
**Autonomous ,**  
**Affiliated to Saurashtra University, Rajkot**

**DEPARTMENT OF MICROBIOLOGY**

**Part III: SEC-II -CO-CURRICULAR COURSE**  
**Environmental Monitoring and Auditing and (EMA)- Semester I & II**

**OBJECTIVES OF THE PROGRAMME**

On successful completion of this course a student will be able to:

- To develop skills and knowledge for translating the theory and concepts of resource and environmental management into practice relevant to communities and workplaces today.
- To apply monitoring and environmental management tools used by resource and environmental practitioners.
- To consider the impacts of flows (energy, water, resources/waste) within the built, urban, agricultural and natural environments.

<b>16UMBCOC2</b>	<b>Introduction to Environmental and Natural resources</b>	<b>Theory 8hrs week</b>
------------------	------------------------------------------------------------	-------------------------

**Unit 1 : Multidisciplinary nature of environmental studies 10hrs**

- Definition, scope and importance, need for public awareness.
- **Ecosystems :**
  - Concept of an ecosystem.
  - Structure and function of an ecosystem.
  - Producers, consumers and decomposers.
  - Energy flow in the ecosystem.
- Ecological succession.
- Food chains, food webs and ecological pyramids.
- Introduction, types, characteristic features, structure and function of the following ecosystems :-
  - a. Forest ecosystem
  - b. Grassland ecosystem
  - c. Desert ecosystem
  - d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

**Unit 2 : Biodiversity and its conservation 10hrs**

- Introduction – Definition : genetic, species and ecosystem diversity.
- Biogeographical classification of India



- Importance of biodiversity : 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 3 : Social Issues and the Environment**

**10hrs**

- From Unsustainable to Sustainable development
- Environmental ethics : Issues and possible solutions.
- Public awareness.
- 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.

### **Unit 4 : Natural resources and associated problems**

**10hrs**

- Introduction to Natural Resources, Types of Natural Resources, Role of an individual in conservation of natural resources.
  - a) Forest resources :**
    - Types of forest ecosystems and its importance, Forest Wealth in India
    - Human impact on forest: Timber extraction, dams, mining and their effects on Forest and tribal people
    - Use and over-exploitation, deforestation, case studies.
  - b) Water resources :**
    - Water distribution and Water bearing properties of rocks and soils,
    - Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
    - Conservation of water
  - c) Energy & Mineral resources :**
    - Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources.
    - environmental effects of extracting and using mineral resources, case studies.
  - d) Food resources :**
    - World food problems, changes caused by agriculture and over-grazing,
    - effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
  - e) Land resources :**
    - Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

<b>16UBCCOC3</b>	<b>Fundamentals Of Environmental Auditing &amp; Monitoring</b>	<b>Theory 8 Hr/week</b>
------------------	----------------------------------------------------------------	-------------------------

### **UNIT 1 Environmental Pollution**

**10hrs**

- Definition, Cause, effects and control measures of :-
  - a. Air pollution
  - b. Water pollution
  - c. Soil pollution
  - d. Nuclear hazards
  - e. Noise pollution
  - f. Thermal pollution
- Solid waste Management : Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution.
- Disaster management : floods, earthquake, cyclone and landslides.
- Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust.

### **Unit 2: Environment AUDIT:**

**10hrs**

- Definition of Environment Audit
- Importance of Environment auditing for industries.
- Types of audits, General audit methodology and basic structure of audit.
- Elements of an audit process and its importance. Concept of ISO14000

### **Unit 3: Environmental Monitoring**

**15hrs**

- **Air Quality Parameters**
- Relevant instruments/equipments and procedures (High Volume Sampler, Handy Sampler, Noise Meter, Spectrophotometer etc) TSPM, RSPM, SO<sub>2</sub>, NOX, Stack Monitoring, Noise Level Measurements etc.
- **Water Quality Parameters**
- Water Quality Guidelines for Human Uses
- Relevant instruments/equipments and procedures (Flame Photometer, Water Testing Kits, Digital pH meter, BOD Incubator, Dissolved Oxygen Meter) Alkalinity, Ammonical Nitrogen, BOD, COD, DO, Coliform, Fluoride, Nitrate-Nitrogen, pH etc.
- **Soil Quality Parameters**
- Introduction to Soils and Sediments
- Relevant instruments/equipments and procedures (Soil Testing Parameters)
- pH, EC, Soil Moisture, Phosphate, Potassium, Sodium, etc.

16UBCCOC4	Combined Practicals	2-3 Hr/week
-----------	---------------------	-------------

## List of Practicals:

### 1. Water testing (According to BIS permissible limits):

#### 1. Physical parameters:

- 1.1 To estimate the TS, TSS and TDS of given water samples
- 1.2 To check the turbidity of given water sample
- 1.3 To check the water temperature

#### 2. Chemical parameters:

- 2.1 To check the pH content of water
- 2.2 To check the chloride content of given water sample
- 2.3 To check the total hardness of given water sample
- 2.4 To check the calcium content of water
- 2.5 Estimation of sulphate in given water sample
- 2.6 Estimation of nitrogen in given water sample
- 2.7 Estimation of phosphorus in given water sample
- 2.8 Estimation of residual free chlorine in given water sample
- 2.9 Estimation of DO in given water sample
- 2.10 Estimation of BOD in given water sample
- 2.11 Estimation of COD in given water sample

#### 3. Microbial testing:

- 3.1 To check the total plate count in given water sample
- 3.2 MPN test

### 2. Soil testing:

#### 1. Physical parameters:

- 1.1 To check the particle size of soil sample
- 1.2 To check the soil temperature
- 1.3 To check the pH of soil
- 1.4 To check the conductivity of soil
- 1.5 To check the moisture content of soil
- 1.6 To check the water holding capacity of soil
- 1.7 To determine the colour of soil

#### 2. Chemical parameters:

- 2.1 To check the chloride content of soil
- 2.2 To check the organic content of soil
- 2.3 To check the nitrogen content of soil
- 2.4 To check the carbonate content of soil

### 3. Air testing:

1. Detection of particulate pollutants present in air
2. Detection of gaseous pollutants present in air

#### **4. Field Visit (Any One)**

- 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 simple ecosystems-pond, river, hill slopes, etc.