।। सा विद्या या विमुक्तये ।।
स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड
"ज्ञानतीर्थ" परिसर, विष्णुपूरी, नांदेड - ४३१६०६ (महाराष्ट्र)
SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY NANDED
"Dnyanteerth", Vishnupuri, Nanded - 431606 Maharashtra State (INDIA)
Established on 17th September 1994 – Recognized by the UGC U/s 2(f) and 12(B), NAAC Re-accredited with 'A' Grade
25 1994 - 2019 SILVER JUBILEE YEAR
ACADEMIC (1-BOARD OF STUDIES) SECTION
**Phone: (02462) 229542**
**Fax : (02462) 229574**
**Website: www.srtmun.ac.in**
**E-mail: bos.srtmun@gmail.com**

**संलग्नित महाविद्यालयांतील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदव्युत्तर स्तरावरील प्रथम वर्षाचे CBCS Pattern नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०१९–२० पासून लागू करण्याबाबत.**

# प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, **दिनांक ०८ जून २०१९ रोजी संपन्न झालेल्या ४४व्या मा. विद्या परिषद बैठकीतील ऐनवेळचा विषय क्र.११/४४–२०१९** च्या ठरावानुसार प्रस्तुत विद्यापीठाच्या **संलग्नित महाविद्यालयांतील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदव्युत्तर स्तरावरील प्रथम वर्षाचे** खालील विषयांचे **C.B.C.S. (Choice Based Credit System) Pattern** नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०१९–२० पासून लागू करण्यात येत आहेत.

1. Bioinformatics
2. Biotechnology
3. Boichemistry
4. Botany
5. Chemistry
6. Computer Management
7. Computer Science
8. Dairy Science
9. Environmental Science
10. Herbal Medicine
11. Information Technology
12. M.C.A.
13. Microbiology
14. Physics
15. Software Engineering
16. System Administration & Networking
17. Zoology

सदरील परिपत्रक व अभ्यासक्रम प्रस्तुत विद्यापीठाच्या **www.srtmun.ac.in** या संकेतस्थळावर उपलब्ध आहेत. तरी सदरील बाब ही सर्व संबंधितांच्या निदर्शनास आणून द्यावी.

'ज्ञानतीर्थ' परिसर,
विष्णुपुरी, नांदेड – ४३१ ६०६.
**जा.क्र.:** शैक्षणिक–१/परिपत्रक/पदव्युत्तर–सीबीसीएस अभ्यासक्रम/२०१९–२०/**४६४**
**दिनांक :** ११.०७.२०१९.

स्वाक्षरित/–
**उपकुलसचिव**
शैक्षणिक (१–अभ्यासमंडळ) विभाग

प्रत माहिती व पुढील कार्यवाहीस्तव :

१) मा. कुलसचिव यांचे कार्यालय, प्रस्तुत विद्यापीठ.
२) मा. संचालक, परीक्षा व मूल्यमापन मंडळ यांचे कार्यालय, प्रस्तुत विद्यापीठ.
३) प्राचार्य, सर्व संबंधित संलग्नित महाविद्यालये, प्रस्तुत विद्यापीठ.
४) साहाय्यक कुलसचिव, पदव्युत्तर विभाग, प्रस्तुत विद्यापीठ.
५) उपकुलसचिव, पात्रता विभाग, प्रस्तुत विद्यापीठ.
६) सिस्टम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ.

# SWAMI RAMANAND TEERTH
# MARATHWADA UNIVERSITY, NANDED

*Revised Structure of curriculum*
*M. Sc. I, and II year*
*Environmental Science*

**w.e.f. June 2019**

## Introduction

Environmental Science is an interdisciplinary area of study that includes both applied and theoretical aspects of human impact on the world. It also includes many areas that are not usually considered to be scientific. Environmental Science is a field of study that is still in the process of evolving, but its beginnings are rooted in the early of civilization.

The Environment essentially comprises our living ambience, which gives us the zest and verve in all our activities. The turn of the twentieth century saw the gradual onset of its degradation by often callous deeds without any concern for the well being of our surroundings. This sustainable development goals such actions are pronouncedly necessitated, particularly in developing countries like India, in view of the rapid developmental activities that are taking place in the last two decades after liberal opening up of the economy on a global scale.

The environmental movements reached enormous proportions and environment became a house hold word following Earth Day, April 22nd, 1970. Courses in the high school and colleges with the title “Environmental science” were began around Earth Day. Most of the concepts become covered by Environmental Science courses had been taught previously in Ecology classes or Conservation classes. There was also some input from the social science such as Economics, Sociology, and Political Science. So Environmental Science has evolved as an interdisciplinary field that draws information related to environmental concern from the social sciences as well as the biological and physical sciences.

Environmental Science from a verity of subject areas, which also influence decisions, related to the environment. The areas are Biology, Laws, Sociology, Economics, Physics, Chemistry, Agriculture, Philosophy, Earth Science, Computers and Engineering.

Man is a part of this earth than careless exploiter of it. If we exploit the nature in unwise it will be difficult to support even a small population. But if we protect the nature it will continue to meet the needs of all living things not only for man.

The consideration of Environment as natural heritage may be the integral part of Environmental Education. Only when our life is guided by respect for the earth and all living things, we will be able to live In harmony with our Environment.

## Scope

It has wide scope as it concerns with the problems from all walks of life. After the complication of post graduation the students may get opportunity in the State Pollution Control Boards, Central Pollution Control Board, and Research based Environmental projects. The students are also get jobs in the field of Energy, Forestry, Agriculture, Land use planning, Industrial processes, Wild life management, Population control, Sanitation etc.

**Resolution : Government of Maharashtra Environmental Department Resolution No. MPN / 1090 / 1250 / CR-169 / D-III, Dated 12th June 1991**

By the Government resolution, urban development and public health department No. WPB – 2476 / 1787 / UD-18 (506) dated 01st March 1977 recruitment rules for the various posts in Maharashtra Pollution Control Board have been prescribed. In the recruitment rules for the post of field officer mentioned in Annexure III to the said Government resolution, educational qualification graduate in civil / chemical engineering has been prescribed. It has been represented to Government that some Universities in Maharashtra are conducting Post graduate course in Environmental Science and it should be recognition as one of the qualification for the recruitment to the post of field officer in the board. Government has

carefully considered this request and directs that the recruitment to the post of field officer in the Maharashtra Pollution Control Board. The qualification M. Sc. Environmental Science of a statutory University should also be recognized as the minimum qualification for the post.

## Objectives of Environmental Education

The chief objectives of environmental education is that individual and social group should acquire awareness and knowledge Develop attitudes, skills and abilities and participates in solving real life environmental problems. The perspective should be integrated, interdisciplinary holistic in character. The lay public in rural, tribal slum and urban areas, women, students and teachers in schools, colleges and universities as well as planners and decision policy makers. Program implementers and R & D workers need to be educated about environment.

## Eligibility conditions

Admission to M. Sc. Environmental Science shall be made on the basis of aggregate percentage of three years optional subjects. The weightage of 1% will be given to the candidates who have offered Environmental Science as one of the optional subjects at the B. Sc. Level for seeking the admission to the M. Sc. Environmental Science.

B. Sc. With Environmental Science, Botany, Zoology, Physics, Chemistry, and especially the subjects from the biological sciences as one of the optional subjects shall be held eligible for the admission to M. Sc. Environmental Science.

Any Science graduate, ( B. Sc.), Agricultural Graduate ( B. Sc. Agriculture ) is eligible to seek admission to the M. Sc. Environmental Science.

**SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED**
**CHOICE BASED CREDIT SYSTEM (CBCS) SEMESTER PATTERN**
**Post Graduate (PG) Programs under Faculty of Science of Affiliated Colleges**
(w.e.f. June 2019)

| Name of the Faculty | Total credits | Average credits per semester |
|---|---|---|
| **Science** | **100** | **25** |

**Note:**

01. Assessment shall consist of Continuous assessment **(CA)** and End of Semester Examination **(ESE).**
02. **Weightage:** 75% for ESE & 25% for CA
03. **Paper- (Elective):** Transfer of Credit as per Student choice

# Distribution of credits and Syllabus Structure
# M.Sc. Environmental Science

| M. Sc. I Year (Semester I) | | | | |
|---|---|---|---|---|
| **Paper No.** | **Name of the Paper** | **External (ESE)** | **Internal (CA)** | **Credits** |
| Env. 401 | Environmental Dynamics | Credit-3<br>75 Marks | Credit: 1 (25 marks)<br>Test 15 Marks + Assignments 10 Marks | Credit- 4<br>100 Marks |
| Env. 402 | Environmental Chemistry | Credit-3<br>75 Marks | Credit: 1 (25 marks)<br>Test 15 Marks + Assignments 10 Marks | Credit- 4<br>100 Marks |
| Env. 403 | Waste water Treatment Technology | Credit-3<br>75 Marks | Credit: 1 (25 marks)<br>Test 15 Marks + Assignments 10 Marks | Credit- 4<br>100 Marks |
| Env. 404 | Environmental Resources | Credit-3<br>75 Marks | Credit: 1 (25 marks)<br>Test 15 Marks + Assignments 10 Marks | Credit- 4<br>100 Marks |
| Env. 405 | Seminar | Credit-1<br>25 Marks | | Credit- 1 |
| | | | **Total Credits for Semester I** | **Credit - 17** |
| **M. Sc. I Year (Semester II)** | | | | |
| Env. 406 | Environmental Biotechnology & Paste Management | Credit-3<br>75 Marks | Credit: 1 (25 marks)<br>Test 15 Marks + Assignments 10 Marks | Credit- 4<br>100 Marks |
| Env. 407 | Air Pollution Climatology and Meteorology | Credit-3<br>75 Marks | Credit: 1 (25 marks)<br>Test 15 Marks + Assignments 10 Marks | Credit- 4<br>100 Marks |
| Env. 408 | Environmental Health and Toxicology | Credit-3<br>75 Marks | Credit: 1 (25 marks)<br>Test 15 Marks + Assignments 10 Marks | Credit- 4<br>100 Marks |
| Env. 409 | Instrumentation for Environmental Monitoring and Analysis | Credit-3<br>75 Marks | Credit: 1 (25 marks)<br>Test 15 Marks + Assignments 10 Marks | Credit- 4<br>100 Marks |
| Env. 410 | Seminar | Credit-1<br>25 Marks | | Credit- 1 |
| | | | **Total Credits for Semester II** | **Credit - 17** |
| **Laboratory Course (Annual)** | | | | |
| Env. 411 | Laboratory Course - I | Credit-3<br>75 Marks | Credit: 1 (25 marks) | Credit- 4<br>100 Marks |
| Env. 412 | Laboratory Course – II | Credit-3<br>75 Marks | Credit: 1 (25 marks) | Credit- 4<br>100 Marks |
| Env. 413 | Laboratory Course – III | Credit-3<br>75 Marks | Credit: 1 (25 marks) | Credit- 4<br>100 Marks |
| Env. 414 | Laboratory Course - IV | Credit-3<br>75 Marks | Credit: 1 (25 marks) | Credit- 4<br>100 Marks |
| | | | **Total Credits for Laboratory Course (Annual)** | **Credit - 16** |
| | | | **Total Credits for M. Sc. I Year : Semester I + Semester II + Laboratory Course** | **Credit - 50** |

| M. Sc. II Year (Semester III) | | | | |
|---|---|---|---|---|
| **Paper No.** | **Name of the Paper** | **External (ESE)** | **Internal (CA)** | **Credits** |
| Env.501 | Environmental Microbiology | Credit-3 75 Marks | Credit: 1 (25 marks) Test 15 Marks + Assignments 10 Marks | Credit- 4 100 Marks |
| Env. 502 | GIS – Remote Sensing and Environmental Concentration | Credit-3 75 Marks | Credit: 1 (25 marks) Test 15 Marks + Assignments 10 Marks | Credit- 4 100 Marks |
| Env. 503 | Bio Statistics and Computational Techniques | Credit-3 75 Marks | Credit: 1 (25 marks) Test 15 Marks + Assignments 10 Marks | Credit- 4 100 Marks |
| Env. 504 A | Soil Pollution and Solid waste Management | Credit-3 75 Marks | Credit: 1 (25 marks) Test 15 Marks + Assignments 10 Marks | Credit- 4 100 Marks |
| **OR** | | | | |
| Env. 504 B | Environmental Sustainable Development | Credit-3 75 Marks | Credit: 1 (25 marks) Test 15 Marks + Assignments 10 Marks | Credit- 4 100 Marks |
| Env. 505 | Seminar | Credit-1 25 Marks | | Credit- 1 |
| | | | **Total Credits for Semester III** | **Credit - 17** |
| **M. Sc. II Year (Semester IV)** | | | | |
| Env. 506 | Environmental Clearance and Audit | Credit-3 75 Marks | Credit: 1 (25 marks) Test 15 Marks + Assignments 10 Marks | Credit- 4 100 Marks |
| Env. 507 | Occupational Health Safety and Management | Credit-3 75 Marks | Credit: 1 (25 marks) Test 15 Marks + Assignments 10 Marks | Credit- 4 100 Marks |
| Env. 508 | Environmental Policies, Law and Ethics | Credit-3 75 Marks | Credit: 1 (25 marks) Test 15 Marks + Assignments 10 Marks | Credit- 4 100 Marks |
| Env. 509 A | Agriculture and Environment | Credit-3 75 Marks | Credit: 1 (25 marks) Test 15 Marks + Assignments 10 Marks | Credit- 4 100 Marks |
| **OR** | | | | |
| Env. 509 B | Environmental Modelling and Research Methodology | Credit-3 75 Marks | Credit: 1 (25 marks) Test 15 Marks + Assignments 10 Marks | Credit- 4 100 Marks |
| Env. 510 | Seminar | Credit-1 25 Marks | | Credit- 1 |
| | | | **Total Credits for Semester IV** | **Credit - 17** |
| **Laboratory Course (Annual)** | | | | |
| Env. 411 | Laboratory Course – V | Credit-3 75 Marks | Credit: 1 (25 marks) | Credit- 4 100 Marks |
| Env. 412 | Laboratory Course – VI | Credit-3 75 Marks | Credit: 1 (25 marks) | Credit- 4 100 Marks |
| Env. 413 | Laboratory Course – VII | Credit-3 75 Marks | Credit: 1 (25 marks) | Credit- 4 100 Marks |
| Env. 414 | Laboratory Course – VIII | Credit-3 75 Marks | Credit: 1 (25 marks) | Credit- 4 100 Marks |
| | | | **Total Credits for Laboratory Course (Annual)** | **Credit - 16** |
| **Total Credits for M. Sc. II Year : Semester III + Semester IV + Laboratory Course** | | | | Credit - 50 |

# Curriculum
# M. Sc. I Year (Semester I )
# Subject : Environmental Science

| Env. 401 : Ecosystem Dynamics | CREDIT:4<br>Periods: 45 |
|---|---|

## Unit : I

Definition, History, Introduction of ecological status in India, Scope, Branches of ecology: Auto ecology, Synecology, Applied ecology, Basic concepts of ecology, ecological importance, Ecology and Environment. ecological energetics, Ecological principles. --------- (05)

## Unit : II

Community ecology: Definition and characteristics, Stratifications, Periodicity, Fluctuations, Eco-tone and edge effect, Ecological niche, Eco-types, Classification of Communities, Structure and features, Stability, Evolution of Community, Role of plants, animals and microorganisms. Ecological succession, Definition, Types of Succession, Primary, Secondary succession, Process, Pattern and significance, Models of succession. -------– (10)

## Unit : III

Population ecology: Basic concepts of population ecology, Population dynamics, Characteristics: Natality, Mortality, Fecundity, Density, Age distribution, Biotic potential, Pray predator relationship, Concept of carrying capacity and distribution of population, Dispersion and migration of population, Factors influencing dispersion and migration. ---------- (05)

## Unit : IV

Ecosystem and Productivity: Definition, Structure and function of an ecosystem, Food chain, Food web, Energy flow in an ecosystem, Types of ecosystem: Freshwater ecosystem, Pond ecosystem, Lake ecosystem, River ecosystem, Marine ecosystem; Estuarine ecosystem, Terrestrial ecosystem, Geographical barriers. Productivity: Definition, Concept of productivity, Measuring primary productivity: Harvest method, Oxygen production method, Carbon dioxide assimilation method, Chlorophyll method, Radioisotope method, Factors affecting primary production. ---------- (15)

## Unit : V

Biodiversity: Concept of biodiversity, Importance and biodiversity in indices, Levels of biodiversity, Major hotspots of biodiversity in India (any three), Types of biodiversity: Ecosystem, Species, Genetic, Measurement of biodiversity, Exsitu and Insitu conservation of biodiversity, Reasons of depletion of biodiversity, Gene pool, Germ plasm bank, Species conservation, Biodiversity legislation, National environmental policy. ---------- (10)

## Suggested Reading :


***1.Fundamentals of Ecology :*** *Eugene P. Odum, ( Natraj Publishers, Dehradun.)*
***2.Principles of Ecology :*** *P. S. Verma, V. K. Agarwal ( S. Chand and Co. New Delhi )*
***3.Environmental Biology :*** *P. D. sharma ( Rastogi Publications, Meerut )*
***04.Ecology and Environment :*** *P. D. sharma ( Rastogi Publications, Meerut )*
***5.Principles of Environmental Biology :*** *P. K. G. Nair ( Himalaya Publishing House, New Delhi )*
***6.Environmental Biology :*** *M. P. Arora ( Himalaya Publishing House, New Delhi )*
***7.Environmental Science :*** *Enger Smith, Smith, W. M. C. Brown ( Company Publishing )*
***8.Principles of Soil Science :*** *Watt K. E. F. ( 1973 ), ( McGraw Hill Book Company, New Delhi )*
**9.Introduction to Environmental Studies :** ***Turk & Turk***
***10.Ecology and Field Biology :*** *Robert Leo Smith ( Harper Collins college publication )*
***11.General Ecology :*** *H. D. Kumar ( Vikas Publishing house, New Delhi )*
***12.Elements of Ecology :*** *Brijgopal, N. Bharadwaj ( Vikas Publishing house, New Delhi )*
***13.Fundamentals of Environmental Science :*** *G. S. Dahliwal, G. S. Sangha, P. K. ralhan, Kalyani Publishers, New Delhi*
***14.Environmental Ecology :*** *Bill Freedman ( Academic Press, New York )*
***15.Concepts of Ecology :*** *N. Arumugam ( Saras Publication, Kottar, Dist. Kanyakumari )*
**16.Plant Ecology :** ***P. L. Kochhar***

| Env. 402: Environmental Chemistry | CREDIT:4<br>Periods: 45 |
|---|---|

## Unit : I

Introduction, Definition, Scope, Importance, Role of chemical agents in environment, Basic water chemistry, Atom, Chemical bonding, Solubility and ionization, Impurities, Basic principles and sources, Gases solubility in water, Heat influencing chemical reactions, Solubility of impurities, Alkalinity or Acidity of water, Characteristics of sanitary spent water, Concentration, Normality, Molarity, Concept of dilution, Serial dilution, General dilution, Single step dilution, Multiple step dilution, Analytical procedures, Sample collection guidelines, Sample preservation, Sampling order, Sample labeling, Data collection and record Keeping. --------- (09)

## Unit : II

Measures of quality assurance, Precision, Accuracy, Experimental explanation of procedure, Indicators and pH colour values, Chemicals used in water and spent water, Use of chemicals in potable water treatment, Potable water quality standards, Chemical potential, Chemical equilibrium, Acid base reactions, carbonate system, saturated and unsaturated hydrocarbons. -------– (09)

## Unit : III

Solutions and colloids, Types of solutions, Measure of concentrations, Buffer solutions and their role, Indicators, Common ion effect, Conductivity and control measures, Soaps, Detergent wastes, Surfactants and its effects, Control measures, Bleaching agents ---------- (09)

## Unit : IV

Industrial activity and environment, Air pollution, Air pollutants, Nitrogen oxides, Photochemical oxidants, Smog formation, Chemistry of acid rain, Formation of acid rain, Effects of acid rain, Efforts to control acid rain, International legislation, International agreements, Nuclear accidents, Three Miles Islands and the China syndrome, Chernobyl accident. ------- (08)

## Unit : V

Global warming, Measurement, Effects, Control of global warming, Carbon sequestration, National and local programmes, International agreements, Toxic chemicals in environment, Toxicity, Deficiency, Trace metal characteristics in relation to toxicity, Interpretation of trace element data, Biochemical effects of trace elements, Lead, Cadmium, Toxic effects, Remedial measures, Copper, Zinc, Selenium, Cyanide, Biochemical effects of nitrogen oxides, Sulphur dioxide, PAN, Nitrate and nitrate, Fluoride, Inter element effects, Carcinogens, Methyl isocyanate. ---------- (10)

## Suggested Reading :


***1.Environmental Chemistry :*** *B. K. Sharma & H. Kaur( Goel Publishing House, Meerut )*

***2.Water and Spent water Chemistry :*** *R. Jackson ( Van Nostrand Reinhold),1993.*

***3.Environmental Chemistry :*** *A.K.Dey,(Wiley Eastern Ltd),1987.*

**4.A Text book of Environmental Chemistry and Pollution Control : *S. S. Dara, (S.Chand & Company Ltd,) 2002.***

***5.A Text book of Environmental Chemistry :*** *O.D.Tyagi, M.Mehra (Anand Publications Pvt,Ltd) 1994.*

***6.Elements of Environmental Chemistry :*** *H. V. Jadhav ( Himalaya,Publishing House)1992.*

**7.Environmental Pollution : *H. M. Dix ( New York )***

***8.Water Pollution and disposal of Waste water on Land :*** *U. N. Mahida ( Tata Mc-Grew Hill Publishing Company, New Delhi )*

***9.Environmental Chemistry :*** *J. W. Moore and F. A. Moore ( Academic press, New Delhi ), 1976*

***10.Global Environmental Chemistry :*** *Parashar, Sharma, Mitra, ( Narosa Publishing House, New Delhi ), 1998*

***11.Waste water Engineering :*** *Metcalf and Eddy ( Tata Mc-Grew Hill Publishing Company, New Delhi )*

**12.Heavy metals in natural water : *Rammoorthy & Moor***

***13.Environmental Chemistry :*** *Samir K. banerji ( Prentice Hall, New Delhi )*

***14.Environmental Chemistry :*** *M. Satake & Y. Mido ( Discovery publishing house, New Delhi )*

| Env. 403: Waste Water Treatment Technology | CREDIT:4<br>Periods: 45 |
|---|---|

## Unit : I : Introduction and quality of sewage :

**Introduction :** Purpose of sanitation; Principles of sanitation; Sanitary projects; Site for sewage treatment works; Sewerage systems : separate system, combined system, partially separate system.
**Quality of sewage :** Physical properties: Colour, Odour, Turbidity, Temperature, Solids; Chemical properties: Hydrogen ion concentration, Dissolved oxygen, Dissolved carbon di oxide, Chlorides, Hardness, Nitrogenous wastes, Bio chemical oxygen demand, Chemical oxygen demand; Biological characteristics: Bacteria, Fungi, Rotifers, Protozoa, Crustaceans, Viruses, Population equivalent - (10)

## Unit : II : Primary treatment of sewage :

Pumping stations; Screening; Grit removal; Removal of oil and grease; Floatation unit; Equalization tank; **Sedimentation:** Primary sedimentation, chemically aided sedimentation, secondary sedimentation. -------– (07)

## Unit : III : Aerobic treatment of sewage :

Activated sludge process: aeration tank, sludge settling and recycling, surplus sludge removal and disposal, extended aeration, sludge handling; Trickling filters: construction, submerged media beds, rotating bed system; Aerated lagoons: Nutrient requirement, Performance, Sludge accumulation; Waste stabilization ponds: Types of ponds, Factors affecting pond ecosystem, Nutrient content of Algae, Algal growth and oxygen production, Pond detention time, Pond depth, Sludge accumulation; Role of aquatic macrophytes in waste water treatment: Eichornia, Crassipis, Pistia, Stratiotes, Azolla, Pinnata, Lemna, Spirodela. --------- (13)

## Unit : IV : Anaerobic treatment of sewage :

Septic tank; Imhoff tank; Up flow anaerobic sludge blanket process: Typical arrangements, Approach to design, physical parameters, sulphates and sulphides, gas production and COD balance, gas recovery, nutrients, toxicity, plant operation, post treatment requirements. ------- (10)

## Unit : V : Tertiary treatment and Natural methods of sewage disposal :

Chlorination; Sewage disposal: disposal by dilution, Disposal by land treatment, Sewage as fertilizer
--------- (05)

## Suggested Reading :


1. ***Waste water treatment for pollution control :*** *Soli J. Arceivala ( Tata Mc-Grew Hill Publishing Company, New Delhi )*
2. ***Water supply and sanitary engineering :*** *R. C. rangwala and S. C. rangwala ( Charotal publishing house, Anand)*
3. ***Waste water treatment :*** *M. N. Rao, A. K. Datta ( Oxford and IBH publishing company, New Delhi )*
4. ***A Text book of Sanitary Engineering :*** *Vinayak Gharpure ( Engineering Book Publishing Company, Pune)*
5. ***Water Pollution :*** *V. P. Kudesia ( Pragati Prakashan, Meerut )*
6. ***Environmental Chemistry :*** *B. K. Sharma ( Goel Publishing House, Meerut )*
7. ***Waste water Engineering :*** *Metcalf and Eddy ( Tata Mc-Grew Hill Publishing Company, New Delhi )*
8. ***Environmental Chemistry :*** *A. K. De ( Wiley eastern limited, New Delhi )*
9. **Environmental Pollution :** ***H. M. Dix ( New York )***
10. ***Aquatic Plants for the Waste Water Treatment :*** *Alkarani Upadhaya ( Daya Publishing House, New Delhi )*
11. ***Environmental Chemistry :*** *B. K. sharma and H. Kour ( Villa Publication, Meerut )*
12. ***Introduction to Environmental Engineering :*** *Mackenzie L. Davis & David A. Cornwell ( Mc-Grew Hill Publishing Company, New Delhi )*
13. ***Basic Water Treatment :*** *George Smethurst ( Scientific Publishers, Jodhpur )*
14. ***Water Pollution and disposal of Waste water on Land :*** *U. N. Mahida ( Tata Mc-Grew Hill Publishing Company, New Delhi )*
15. ***A Manual on Water and Waste Water Analysis :*** *National Environmental Engineering Research Institute, Nagpur*

| Env. 403: Environmental Resources | CREDIT:4<br>Periods: 45 |
|---|---|

## Unit : I : Introduction :

Natural resources; Renewable and Non renewable resources; Basic human requirements; Limitations of non renewable resources; Limitations of renewable resources; Man and the global resources - (05)

## Unit : II : Forest and Grassland resources :

Uses of forest resources; Wood products; Wood production; Wood consumption; Fuel wood; Wood demand; Non wood products; Trade of forest products; Forest and employment; Forest and Environment; Deforestation and Degradation; Forest consumption; Forest productivity; Afforestation; Reforestation; Social forestry; Agro forestry; Industrial forestry; Forest management; National forest policy; Grass land; Uses of grass land; Grass land and environment; Grazing; Fodder; Grass land management. -------– (10)

## Unit : III : Wild life resources :

Uses of wild life; Wild life and environment; Endangered plant and animal species; Causes of depletion of wild life; Wild life trade; Wild life management; Protection of wild life; Biosphere reserve; Characteristics of biosphere reserve; Objectives of biosphere reserve; Biosphere reserve in India; World wide fund; Wild life projects: Project tiger, The Gir Lion Sanctuary Project, Crocodile breeding project; National wild life action plan. --------- (10)

## Unit : IV : Soil and Water Resources :

Soil; Uses of soil resources; Management of soil; Soil erosion; Soil degradation; Desertification; Soil conservation; Soil and Environment; Water; Uses of water resources; Water demand and supply; Water scarcity; Water resource management; Water resource strategy; Ganga action plan; National water policy; Water disputes; Water and Environment. ------- (10)

## Unit : V : Fossil fuel and Mineral resources :

Uses of fossil fuel; Fossil fuel and environment; Coal: Types of coal, demand for coal; Petroleum and natural gas; Production and consumption of fossil fuel; Management of fossil fuel; Minerals: Minerals and Environment; Uses of minerals; Management of mineral resources. --------- (10)

## Suggested Reading :


1. ***Environment : Problems and solutions :*** *D. K. asthana, Meera Asthana ( S. Chand and company Ltd., New Delhi )*
2. ***Fundamentals of Environmental science :*** *G. S. Dahliwal, G. S. Sangha, P. K. Ralhan ( Kalyani Publishers, New Delhi)*
3. ***Environmental chemistry :*** *B. K. Sharma ( Goel publishing house, Meerut)*
4. ***Environmental Science :*** *Enger Smith, Smith, W. M. C. Brown ( Company Publishing )*
5. ***Principles of Soil Science :*** *Watt K. E. F. ( 1973 ), ( McGraw Hill Book Company, New Delhi )*
6. **Introduction to Environmental Studies :** ***Turk & Turk***
7. ***Introduction to Social Forestry :*** *Sitaram Rao ( Oxford & IBH Publishing company Pvt. Ltd., New Delhi ), 198879*
8. ***Environmental Science :*** *Charles E. Kupchella and Margaret C. Hyland ( Allyn and Bacon, Inc, Buston, ), 1986*
9. ***Forests in India :*** *V. P. agrawal ( Oxford & IBH Publishing company Pvt. Ltd., New Delhi ), 1988*
10. ***Plant ecology and Soil Science :*** *R. S. shukla, P. s. Chandel , ( S. Chand and company Ltd., New Delhi ), 2001*


| Env. 405: Seminars | CREDIT:1 |
|---|---|

# Curriculum
# M. Sc. I Year (Semester II )
# Subject : Environmental Science

| Env. 406: Environmental Biotechnology & Paste Management | CREDIT:4<br>Periods: 45 |
|---|---|

## Unit : I

Introduction, Definition and scope of biotechnology, Environmental biotechnology, Biotechnology and environmental protection, Sustainable development, Industrial ecology, bio-economy. Biological treatment, Bio-treatment impact, importance of microorganism, Role of enzymes, Principle of growth, Biotechnological approach of environmental pollution abatement, Biodegradation of pollutants, Toxic site reclamation, Removal of spilled oil and grease deposits, Reduction of herbicides, pesticides and fertilizers. -------- (08)

## Unit : II

Biotechnological approach of energy management, Biomass, Biogas generation and its significance in waste recycling, process of biogas production, Factors affecting biogas yield and Advantages and disadvantages. Bio- ethanol, Bio-diesel, Bio-hydrogen, Agricultural wastes, Public health aspects, Acidification, Salinization and sodification, Agricultural production management, Bio-fertilizer- bacteria and fungi. --------– (07)

## Unit : III

Natural composting, Vermi composting technology, Process of Vermi culture, Earthworm technology, Use of surface worms, Typical Vermi culture plant, Maintenance and limitations of vermi composting, Merits and demerits. Heavy metal contamination, Industrial sources of soil pollutants, Petroleum products as soil pollutants. --------- (08)

## Unit : IV

Biosensors and environmental pollutants, General features, Biochemical Oxygen Demand sensors, Ammonia sensors, Nitrate sensors, Sulphate ion sensors, its advantages and disadvantages. Bioreactors and its scope, Biological process, Aerobic biological treatment, Activated sludge process, Advanced activated sludge process, Biological filters, Rotating biological contractors (RBC) merits and demerits, Fluidized bed reactors, Inverse fluidized bed bio-filmreactor (IFBBR), Expanded bed reactor (EBR), Anaerobic biological treatment, Contact digester, Packed bed reactors (PCR), Anaerobic baffled digester, Up-flow anaerobic sludge blanket reactors (UASB), Periodic biological Sequencing batch reactor (SBR), Membrane bioreactor. ------- (15)

## Unit : V

Environmental and biotechnological management, Xenobiotic compounds and recalcitrance, Hazardous wastes, Biodegradation of xenobiotics, Toxic organics, Phenols as pollutants, Bioremediation, Bio-augmentation for bioremediation, Types of bioremediation, Natural bioremediation, Bio-remedial applications, Composting, Resource recovery, recycling.

**Paste Management:** Recent advance in pest control: Green Chemistry in pesticides: (15) Recent and insect attractants, chemo sterilents and repellents, mode of action and Applications Neem in plant protection: Introduction, Chemical constituents, Bio efficiency of neem preparation, Management of pest in Agricultural crops, Management of the forest pest, Management of insects and diseases in stored agricultural commodities, side effects of applications. --------- (10)

## Suggested Reading :


***01.Environmental Biotechnology :*** *S. N. Jogdand, Himalaya Publishing House, Mumbai (2006).*
***02. A Textbook of Biotechnology :*** *R. C. Dubey, S. Chand & Company, New Delhi (2002).*
**03.A textbook of Environmental Chemistry & Pollution Control :** *S S Dara, S. Chand & Company, New Delhi (2002).*
***04.Environmental Biology :*** *P. S. Verma & V. K. Agarwal, S. Chand & Company, New Delhi (2004).*
***05. Toxicology – Principles & Methods :*** *M. A. Subramanian, MJP, Publishers, Chennai (2004).*
***06.Industrial Toxicology :*** *Raymond D Harbison, A Times Mirror Company, 5th Edition, New Delhi (2006).*
***07. Environmental Science :*** *S.C. Santra, New Central Book Agency, Kolkata (2001).*
***08.Environmental Pollution Health & Toxicology :*** *S V S Rana, Narosa Publishing House, New Delhi (2006).*
***09.Environmental Science Hazardous Gas & Waste :*** *R K Sinha, Commonwealth Publisher, New Delhi (1994).*
***10.Industrial & Hazardous Wastes (Health Impacts & Management Plans) :*** *R K Sinha & Sunil Herat, Pointer Publisher, Jaipur (2004).*
***11.A textbook of Environmental Studies :*** *G R Chatwal & Harish Sharma, Himalaya Publication House, (New Delhi) (2004).*
***12.Environment & Biotechnology :*** *B.P. Singh, H. N. Verma & K. M. Srivastava, Today & Tomorrows & Publishers, New Delhi (1988).*
***13.Industrial Biotechnology ( Problems and remedies ) :*** *Indu shekhar Thakur, I. K. International Pvt. Ltd. New Delhi (2006)*
14.Insect Pest Management –David Bent.
15.Critical issues in insect pest Management –G.S.Dhaliwal and E.A.Heinrich.

| Env. 407: Air pollution, Climatology and Meteorology | CREDIT:4<br>Periods: 45 |
|---|---|

## Unit : I : 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 vapours, Tetra ethyl lead, Radioactive gases. Natural sources: Volcano, Accidental fires in forests, Dust storms, Oceans, Plants; Combustion; Stationary sources: Fertilizer complex, Cement industries, Thermal power stations, Sulphuric acid industry, Fluoride industry, Nitric acid plant, Acid manufacturing, Soap and detergent industry, Petroleum and Coal industry, Stone and Clay products; Mobile sources: Automobiles. -- (10)

## Unit : II : Air Pollution Effects:

Effects of air pollution on human health, Vegetation, Animals, Material and structure, Long term effects on the planet:, Greenhouse gases, Types of greenhouse gases, Effects, Sources, Effects and remedies, Technological options, Kyoto protocol, Ozone depletion, Sources and effects, Control efforts. --------– (08)

## Unit : III : Ambient Air Pollutants Sampling, Analysis and Measurement :

Particulate matter sampling and analysis: Dust fall measurement, High volume air sampler; Gaseous pollutants sampling and analysis: Carbon monoxide, Ozone, Hydrogen sulphide, Nitrogen dioxide, Sulphur dioxide, Hydrogen cyanide, Ammonia, Aldehydes. --------- (07)

## Unit : IV : 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. ------ (10)

## Unit : V : Climatology and Meteorology :

**Classification of climates:** World climatic classification - Koppen classification, Thornthwaite classification, Troll classification. **Weather Forecasting:** Importance of forecasting, forecast requirements, Types of weather forecast, forecasting monsoon rainfall, Satellite in weather forecasting. Weather, climate, Major climatic regions of the world based on latitude and distribution of vegetation, Classification of climate, Climatogram studies. Meteorological factors influencing air pollution, Wind velocity, Atmospheric stability, Temperature inversion, Adiabatic lapse rate, Mixing height, Plume behavior; Methods for measurement of meteorological variables: Wind direction recorder, Wind speed recorder, Temperature measurement, Solar radiation measurement. ------ (10)

## Suggested Reading :


**1.Air Pollution and its control : Sumit malhotra ( Pointer publishers, Jaipur )**
**2.Air Pollution : M. N. Rao ( Tata McGraw – Hill publishing company, New Delhi )**
**3.Air Pollution : B. K. sharma, H. Kaur ( Krishna prakashan media, Meerut )**
**4.Pollution of our Atmosphere : B. Henderson, ( Sellers Adam Hilger Limited, Bristol )**
**5.Fundamentals of Air Pollution : Richard W. Bowbel, Donald L. Fox, D. Bruce Tunner, and A. C. Stern ( Academic Press, California)**
**6.Air Pollution control Engineering : Noel De Nevers ( Mc Graw – Hill international, New York )**
**7.Air Pollution : S. K. Agarawal ( A. P. H. Publishing corporation, New Delhi )**
**8. Air Pollution : V. P. Kudesia (Pragati Prakashan, Meerut.**
**9.General climatology : *Critichfield H. J.***
**10.Climatology : Fundamentals and Applications : *Mater J. R.***
**11.Climatology : Selected Applications : *Henry D. Foth***
**12.Introduction to weather and climate : *Trewartha***
**13.The Atmosphere : An Introduction to Meterology : *Fedrik K. Lutgen, E. J. Tarbuck***
**14.Air Pollution ( Volume I to X ) : *A. C. Stern ( Academic Press )***
***15.General Meteorology : H. R. Byers ( Tata Mc Grew – Hill Publications, New Delhi )***
***16. Agrometeorology: SR Reddy, DS Reddy ( Kalyani Publishers- Ludhiana New Delhi- Noida(UP))***

| Env. 408: Toxicology and hazardous waste management | CREDIT:4<br>Periods: 45 |
|---|---|

## Unit : I : Introduction :

Introduction to toxicology and scope, Hazardous waste problems, Toxic substances, Basic principles of toxicology, Inhalation, Eye absorption, Ingestion. Responses to toxin exposures, Duration, Frequency of exposure, Dose response relationship. Chemical carcinogenesis, Mutagens, Teratogens. Natural detoxification routes, Saturated aliphatic hydrocarbons, Aromatic hydrocarbons, Alcohol, Methyl alcohol, Ethyl alcohol. ------ (07)

## Unit : II : Soil Toxicology :

Introduction, Organic chemicals in soil and environment. Water solubility, soil adsorbents, Plant uptake, Inorganic chemicals in soil and environment. Metals, Plant nutrients, Acids and bases, Salts, Halides. Metal toxicity- Metals in bio-sorption- Air, Water, Soil, Plants, Animals, Microorganisms, PCB's, Bio-methylation, Arsenic, Barium, Cadmium, Chromium, Cobalt, Copper, Iron, Lead, Mercury, Nickel, Zinc. (08) -------– (08)

## Unit : III : Pesticide Toxicology :

Pesticide toxicity – Introduction, Growth regulation, Organo-chlorines, DDT, Carbamates, Heterocyclic compounds, Organo-phosphotes, Chlorinated phenoxy substances, Amides and ureas, Pesticides and environment. Pesticides and human health, Acute poisoning, Chronic poisoning. Exposure to ionizing radiations, Natural, Cosmic, Terrestrial, Internal, Ecotoxicology, Reproduction, Genetic effects, Acute radiation syndrome, Accumulation of toxicants in organisms, Toxic residues, Residual analytical methods, Factors affecting toxicity, Evaluation of toxicity, Bioassays. --------- (10)

## Unit : IV : Xenobiotics :

Routes of entry of xenobiotics, Absorption and distribution of toxicants, Excretion of toxicants, Biliary, Renal, Lungs, Faeces, Saliva, Milk, Eggs, Placenta, Bio-magnification, Biotransformation, Phase I and Phase II reaction, Chemical safety evaluation of toxicants, Environmental hazards and environmental risk assessments, Environmental toxicology, Environmental pollution, Environmental contamination, Environmental toxicants, Effects of xenobiotics. ------- (10)

## Unit : V : Advanced Hazardous Waste Management :

Conventional methods of treatment of industrial wastewater, Future trends - Physical, Chemical and Biological, Joint treatment of industrial wastewater, Reduction methods by Reduce, Reuse, Recycle, Recovery, Economics of recycling, Consumer and waste education, Cleaner production, Equipment modification, Indian policy and legislation on industrial waste management, Hazardous waste and chemical (management & handling rules) India 1989. Categories of bio-medical wastes. --------- (10)

## Suggested Reading :


***01. Water Toxicology :*** *V. V. Metelev, A. I. Kanaev, N. G. Dzasokhova, Amerind Publishiing Company, Pvt, Ltd, New Delhi (1971).*

***02.Water Pollution and Toxicology :*** *S. K. Shukla & P. R. Srivastava,, Commonwealth Publisher, New Delhi (1992).*

***03.Toxicology – Principles & Methods :*** *M. A. Subramanian, MJP, Publishers, Chennai (2004).*

***04.Industrial Toxicology :*** *Raymond D Harbison, A Times Mirror Company, 5th Edition, New Delhi (2006).*

***05. Environmental Science :*** *S.C. Santra, New Central Book Agency, Kolkata (2001).*

***06.Environmental Pollution Health & Toxicology :*** *S V S Rana, Narosa Publishing House, New Delhi (2006).*

***07. Environmental Science Hazardous Gas & Waste :*** *R K Sinha, Commonwealth Publisher, New Delhi (1994).*

***08. Toxicology :*** *P D Sharma, Rastogi & Company, Meerut (1995).*

***09.Principles of Environmental Toxicology :*** *Ian Shaw & John Chadwick, Taylor & Francis, Padstow UK (1998).*

***10.Industrial & Hazardous Wastes (Health Impacts & Management Plans) :*** *R K Sinha & Sunil Herat, Pointer Publisher, Jaipur (2004).*

***11.Environmental Pollution: Radiation :*** *D Prasad & M L Choudhary, Venus Publishing House, New Delhi (1992).*

**12.A textbook of Environmental Chemistry & Pollution Control :** ***S S Dara, S Chand & Company Ltd, New Delhi (2002).***

***13.Industrial Water Pollution Control :*** *W Wesley Eckenfelder Jr, McGraw Hill International Edn, New York (1989).*

***14.A textbook of Environmental Pollution & Control :*** *R N Trivedi, Amol Publications Pvt Ltd, New Delhi (1998).*

***15.A textbook of Environmental Studies :*** *G R Chatwal & Harish Sharma, Himalaya Publication House, (New Delhi) (2004).*

| Env. 409: Instrumentation for Environmental Monitoring and Analysis | CREDIT:4<br>Periods: 45 |
|---|---|

## Unit : I : Introduction and sampling Techniques :

Sample preparation, Preservation and Processing of Air, Water and Soil samples; Sampling equipments, Separation and sampling techniques, Precipitation, Fractional crystallization, Fractional distillation, Solvent extraction. ------ (05)

## Unit : II : Meteorological Instrumentation :

**Pressure measurement:** Principle, Barometer, Operation and measurement; **Temperature measurement:** Principle, Types of thermometers, Operation and measurement; **Turbidity measurement:** Principle, Operation and measurement; **Manometer:** Principle, Operation, and measurement; **Prizometer:** Principle, Operation and measurement; **Pyrometer:** Principle, Operation and measurement; **Rain gauges:** Types: Recording type rain gauge, Non recording type rain gauge; **Ventury meter:** Principle, Operation and measurement. -------- (10)

## Unit : III : Chromatography :

Principles, Methods and applications of **Thin Layer Chromatography (TLC)**: working and applications; **Column chromatography:** working and applications; **Gas chromatography (GC):** working and applications; **High performance liquid chromatography (HPLC):** working and applications; **Gas-liquid chromatography (GLC):** working and applications; **Ion exchange chromatography:** working and applications --------- (10)

## Unit : IV : Spectrophotometry :

Principle and Operation of Spectrophotometer, **Ultra Violet (UV) Spectrophotometer:** working and applications; **Infra Red (IR) Spectrophotometer:** working and applications, **Nuclear Magnetic Resonance (NMR):** working and applications; **Atomic Absorption Spectrophotometer (AAS):** working, applications and its importance; **Flame Photometer:** working and applications; **Fluoride meter :** utility and significance; **Conductivity meter:** Working and applications; **Nephalo turbidity meter:** working and utility; **pH meter:** working and applications. --------- (10)

## Unit : V : Air Sampling Equipments :

Theory and applications of High volume air sampler (HVAS) construction, Respirable Suspended Particulate Matter Sampler (RSPM) measurement and its scope, Suspended Particulate Matter Sampler (SPM) analytical significance, Particulate Matter (PM), its measurement and practical importance, Anderson, Tilak Air Sampler. ------- (10)

## Suggested Reading :


1. **Instrumental Methods of Analysis : Willered Merit and Dean (CBS Publication, New Delhi)**
2. **Instrumental Methods of Environmental Analysis : Karan Sareen, ( Sarup ans Sons Publishers, New Delhi ), 2001**
3. **Instrumental Methods of Chemical Analysis : B. K. Sharma, Goel Publishing House, Meerut (1996).**
4. **Standard Methods for the Examination of Water and Waste Water : ( APHA, AWWA & WPCF ), 1985**
5. **Instrumental Methods and chemical Analysis : H. Kaur, Pragati Prakashan, Merrut (2009).**
6. **Instrumental Analysis : Shoog Holler (Harcourt Asia Publishers Ltd., New Delhi), 1952**
7. **Instrumental Methods of chemical Analysis : Chatwal and Anand (Himalaya Publishing House, New Delhi), 1994**
8. **Instrumental Analysis : Gurdeep Chatwal (Himalaya Publishing House, New Delhi), 2000**
9. **Instrumental Methods : V. B. Borade (Nirali Prakashan, Mumbai)**
10. **Instrumental Analysis for science and technology : W. Ferren (Agrobios India, Jodhpur)**


| Env. 410: Seminars | CREDIT:1 |
|---|---|

| Env. 411: Laboratory Course – I (Annual) | CREDIT:4<br>Periods : 80 |
|---|---|

1.Estimation of Dissolved oxygen from provided sample by Winklers method.

2.Estimation of Total Hardness from provided water sample.

3.Estimation of Permanent Hardness from provided water sample.

4.Estimation of Carbonates and Bicarbonates from provided soil sample.

5.Quantitative analysis of plankton's by Sedgwick cell.

6.Determination of light intensity by Lux meter.

7.Determination of chlorophyll pigments by paper chromatography.

8.Determination of Primary production by light and dark bottle technique.

9.Identification and Enumeration of Phyto planktons in water body.

10.Identification and Enumeration of Zoo planktons in water body.

11.Ecological adaptation: Hydrophyte.

12.Ecological adaptation: Mesophyte.

13.Ecological adaptation: Xerophyte.

14.Preparation of Acidic and Basic buffer solutions for standardization.

15.Determination of Iron by Titrometric method.

16.Determination of Zinc by Titrometric method.

17.Determination of Manganese by Titrometric method.

18.Determination of atmospheric pressure by Barometer.

19.Estimation of calcium by Murexide method.

20.Estimation of magnesium by titrometric method.

## Suggested References :


**1.Practical Methods in Ecology and Environmental Science.**
*R.K. Trivedy, P. K. Goel, Trisal ( Environmental Publication, Karad )*
**2.Manual of Environmental Pollution Analysis**
*N.N. Bandela, Masarat Sultana, Uday P. Patil ( Prathivi Publication, Aurangabad )*
**3.A Manual of Fresh water ecology**
*R.Santhanam, P. Velayutham, G. Jegatheesan ( Daya Publishing House, Delhi )*
**4.Physico-Chemical Examination of Water, Sewage & Industrial effluents**
*N.Manivasakam ( Pragati Prakashan, Meerut )*
**5. Manual on Water and Waste Water Analysis**
NEERI, Nagpur
**6. Methodology for Water Analysis**
**Dr. Mohan S. Kodarkar, ( Indian Association of aquatic Biologist's, Hyderabad )**
**7. Chemical and Biological methods for Water Pollution Studies**
*R.K. Trivedy, P. K. Goel ( Environmental Publication, Karad )*
**8.Methods in Environmental Analysis : Water, Soil, Air**
*P.K. gupta, ( Agrobios India, Jodhpur )*
**9.Chemical methods for Environmental analysis: Water & Sediments**
*R. Ramesh & M. Anbu ( Macmillan India Limited )*

| Env. 412: Laboratory Course – II (Annual) | CREDIT:4<br>Periods :80 |
|---|---|

1.Determination of pH of provided sewage sample.

2.Determination of Turbidity of provided sewage sample by turbidity meter method.

3.Determination of Total solids from the sewage sample.

4.Determination of Volatile solids from sewage sample.

5.Determination of Chlorides from provided sewage sample.

6.Determination of Conductivity of sewage sample.

7.Determination of optimum coagulant dose by Jar test apparatus.

8.Estimation of chlorine dose for disinfection of sewage.

9.Estimation of Biochemical oxygen demand of wastewater.

10.Estimation of Chemical oxygen demand wastewater.

11.Determination of sludge volume index of a sludge sample.

12.Determination of sludge density index of sludge sample.

13.Determination of alum dosage for Defluoridation of water by Nalgonda process.

14.Determination of organic matter from soil by Walkley's black method.

15.Determination of sewage and wastewater strength.

16.Estimation of hydrogen Sulphide from the wastewater.

17.Determination of Sulphate by Barium chloride method (spectrophotometer).

18.Problems on construction and design of Primary clarifiers.

19.Problems on construction and design of Trickling Filters.

20.Problems on construction and design of Septic tank.

## Suggested References :


**1.Practical Methods in Ecology and Environmental Science.**
*R.K. Trivedy, P. K. Goel, Trisal ( Environmental Publication, Karad )*
**2.Manual of Environmental Pollution Analysis**
*N.N. Bandela, Masarat Sultana, Uday P. Patil ( Prathivi Publication, Aurangabad )*
**3.A Manual of Fresh water ecology**
*R.Santhanam, P. Velayutham, G. Jegatheesan ( Daya Publishing House, Delhi )*
**4.Physico-Chemical Examination of Water, Sewage & Industrial effluents**
*N.Manivasakam ( Pragati Prakashan, Meerut )*
**5. Manual on Water and Waste Water Analysis**
NEERI, Nagpur
**6. Methodology for Water Analysis**
**Dr. Mohan S. Kodarkar, ( Indian Association of aquatic Biologist's, Hyderabad )**
**7. Chemical and Biological methods for Water Pollution Studies**
*R.K. Trivedy, P. K. Goel ( Environmental Publication, Karad )*
**8.Methods in Environmental Analysis : Water, Soil, Air**
*P.K. gupta, ( Agrobios India, Jodhpur )*
**9.Chemical methods for Environmental analysis: Water & Sediments**
*R. Ramesh & M. Anbu ( Macmillan India Limited )*

| Env. 413: Laboratory Course – III (Annual) | CREDIT:4<br>Periods : 80 |
|---|---|

01. Estimation of chlorophyll from the given plant material.

02.Estimation of nitrite-nitrogen from the sample by Spectrophotometer. 03. Determination of phosphate from the sample by Spectrophotometer. 04. Determination of ammonia from the sample by Spectrophotometer.

05.Preparation of azofertilizers.

06.Preparation of rhizofertilizers.

07.Study of enzyme activity (oxidase test).

08.Estimation of alcohol by bakers Yeast.

9.Study of High Volume Air Sampler.

10.Study of Rotorod air sampler, Tilak air sampler and Durhams Sampler.

11.Determination of SPM from the ambient air.

12.Dust fall measurement by HVAS.

13.Preparation of Potato Dextrose Agar and isolation of air microbes (Fungi) .

14.Preparation of Nutrient Agar and isolation of air microbes (Bacteria).

15.Study of decibel and measurement of noise level at local.

16.Estimation of SO2 by HVAS and Spectrophotometer.

17.Estimation of NO2 by HVAS and Spectrophotometer.

18.Determination of Co2 by Zincondroff technique.

19.Interpretation of wind rose diagram.

20.Determination of Air pollution index.

## Suggested References :


**1.Practical Methods in Ecology and Environmental Science.**
*R.K. Trivedy, P. K. Goel, Trisal ( Environmental Publication, Karad )*
**2.Manual of Environmental Pollution Analysis**
*N.N. Bandela, Masarat Sultana, Uday P. Patil ( Prathivi Publication, Aurangabad )*
**3.A Manual of Fresh water ecology**
*R.Santhanam, P. Velayutham, G. Jegatheesan ( Daya Publishing House, Delhi )*
**4.Physico-Chemical Examination of Water, Sewage & Industrial effluents**
*N.Manivasakam ( Pragati Prakashan, Meerut )*
**5.Manual on Water and Waste Water Analysis**
*National Environmental Engineering Research Institute, Nagpur*
**6.Chemical and Biological methods for Water Pollution Studies**
*R.K. Trivedy, P. K. Goel ( Environmental Publication, Karad )*
**7.Methods in Environmental Analysis : Water, Soil, Air**
*P.K. gupta, ( Agrobios India, Jodhpur )*
**8.Chemical methods for Environmental analysis: Water & Sediments**
*R.Ramesh & M. Anbu ( Macmillan India Limited )*
**9.Standard Methods for the examination of water and waste water *APHA 16th Edition (1985)***

| **Env. 414: Laboratory Course – IV (Annual)** | **CREDIT:4**<br>**Periods : 80** |
|---|---|

01.Estimation of pesticide toxicity on oxygen consumption (CuSO4).

02.Estimation of pesticide toxicity on oxygen consumption (HgCl2).

03.Estimation of pesticide toxicity on oxygen consumption (ZnSO4).

04.Lethal concentration test LC-10, LC-50.

05.Estimation of cadmium from the provided sample.

06.Estimation of metal content of plant part prior and after exposure to toxic Solution.

07.Estimation of iron concentration from the sample by Spectrophotometer.

08.Estimation of Nickel from the sample by Spectrophotometer.

9.Estimation of copper from the sample by Spectrophotometer.

10.Determination of mortality rate by various Toxicants.

11.Study of effect of salinity on respiration.

12.Study of minimum and maximum temperature.

13.Estimation of turbidity from the samples by turbidity meter.

14.Separation of chlorophyll pigments by TLC.

15.Estimation of sodium by flame photometer.

16.Estimation of potassium by flame photometer.

17.Measurement of conductance of ions and its study.

18.Measurement of pH and working of pH meter.

19.Separation of algae by centrifugation.

20.Estimation of fluoride concentration by fluoride meter.

## Suggested References :


**1.Practical Methods in Ecology and Environmental Science.**
*R.K. Trivedy, P. K. Goel, Trisal ( Environmental Publication, Karad )*
**2.Manual of Environmental Pollution Analysis**
*N.N. Bandela, Masarat Sultana, Uday P. Patil ( Prathivi Publication, Aurangabad )*
**3.A Manual of Fresh water ecology**
*R.Santhanam, P. Velayutham, G. Jegatheesan ( Daya Publishing House, Delhi )*
**4.Physico-Chemical Examination of Water, Sewage & Industrial effluents**
*N.Manivasakam ( Pragati Prakashan, Meerut )*
**5.Manual on Water and Waste Water Analysis**
*National Environmental Engineering Research Institute, Nagpur*
**6.Chemical and Biological methods for Water Pollution Studies**
*R.K. Trivedy, P. K. Goel ( Environmental Publication, Karad )*
**7.Methods in Environmental Analysis : Water, Soil, Air**
*P.K. gupta, ( Agrobios India, Jodhpur )*
**8.Chemical methods for Environmental analysis: Water & Sediments**
*R.Ramesh & M. Anbu ( Macmillan India Limited )*
**9.Standard Methods for the examination of water and waste water *APHA 16th Edition (1985)***


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