



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

*Revised Curriculum of  
B. Sc. Third Year (Annual Pattern)  
Environmental Science*

*W.e.f. : June, 2010.*

**Course Structure of Under - graduate Degree Course  
(B. Sc. III Year) Environmental Science**

<b>Class : B. Sc. III Year</b>				
<i>Sr. No.</i>	<i>Course Code</i>	<i>Title of the Paper</i>	<i>No. of Periods</i>	<i>Maximum marks</i>
08	Env. 301	Waste water Engineering	80	100
09	Env. 302	Instrumental methods in Environmental analysis	80	100
10	Env. 303	OR Environmental Education and Management	80	100
11	Env. 304	Laboratory Course	60	100
12	Env. 305	Laboratory Course	60	100
	Env. 306	OR Laboratory Course	60	100

## ENV. 301: Waste water Engineering

### 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 (05)

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 : Analysis of sewage & Natural Methods of sewage disposal:

Physical\_tests : Color, Odor, Temperature, Turbidity; Chemical tests : Chlorine, Oil & Grease, Nitrogen, Oxygen, Hydrogen ion concentration (pH), Total Solids; Bacteriological tests : MPN, IMVIC, Population equivalent. (10)

Disposal by dilution, Self purification of natural waters, Disposal by land treatment, Sewage as fertilizer; Methods of applying sewage: Basin method, Flooding method, furrow method, managed turf method, Zig Zag method. (10)

### Unit III : Sewage Pumps :

Necessity of pumps, Pumping of sewage, Pumping stations, Requirements of pumping stations, Types of sewage pumps: Centrifugal pumps, Reciprocating pumps, Propeller pumps, Air pressure pumps; Power for pumps (10)

### Unit IV : Primary treatment of sewage :

Screens; Grit chambers; Detritus tank, Skimming tank; Sedimentation: Plain sedimentation tank, Primary clarifiers, Secondary clarifiers, Coagulation of sewage. (12)

### Unit V : Aerobic and Anaerobic treatment of sewage :

**Aerobic Treatment** : Activated sludge process: Action of activated sludge, aeration tank, Step aeration, Tapered aeration, extended aeration, Advantages of activated sludge process, Disadvantages of activated sludge process; Trickling filters: Standard rate trickling filters, High capacity trickling filters.; Oxidation ponds: Action, Construction, Design aspects, Advantages, Disadvantages, Uses. (12)

**Anaerobic treatment** : Septic tank; Imhoff tank; Sludge digestion tank; Bio gas; (08)

### Unit V : Tertiary treatment and Solid waste disposal :

Chlorination; Garbage collection and removal; Garbage disposal : Controlled tipping, disposal in to sea, filling of low lying areas, incineration, mechanical compost plant, pulverization, trenching; Night soil collection and disposal (13)

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### References

01. **Waste water treatment for pollution control** : Soli J. Arceivala ( Tata Mc-Grew Hill Publishing Company, New Delhi )
02. **Water supply and sanitary engineering** : R. C. rangwala and S. C. rangwala ( Charotal publishing house, Anand)
03. **Waste water treatment** : M. N. Rao, A. K. Datta ( Oxford and IBH publishing company, New Delhi )
04. **A Text book of Sanitary Engineering** : Vinayak Gharpure ( Engineering Book Publishing Company, Pune)
05. **Water Pollution** : V. P. Kudesia ( Pragati Prakashan, Meerut )
06. **Environmental Chemistry** : B. K. Sharma ( Goel Publishing House, Meerut )
07. **Waste water Engineering** : Metcalf and Eddy ( Tata Mc-Grew Hill Publishing Company, New Delhi )
08. **Environmental Chemistry** : A. K. De ( Wiley eastern limited, New Delhi )
09. **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. 302: Instrumental methods in Environmental analysis

### Unit I : Introduction :

Classification of Instrumental methods, Types of errors : Determinate errors, Indeterminate errors, Precision and accuracy, Methods of expressing accuracy : Absolute errors, Relative errors. (05)

### Unit II : Nephelometry, Turbidometry Measurement of pH, Redox potential and conductivity :

**Nephelometry & Turbidometry** : Introduction, Theory, Factors affecting measurement, Turbidimeters, Nephelometers, Applications of Turbidometry and Nephelometry in Environmental studies (10)

**pH and Redox potential measurement** : Introduction, pH indicator method, potentiometry method, Types of electrodes, advantages and disadvantages, applications of pH meter. (08)

**Conductivity measurement** : Introduction, Definitions of various terms, Conductance measurement, Methods of conductance measurement, applications of conductivity measurement. (07)

### 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. (15)

### Unit IV : Colorimetry and Fluoride meter :

**Colorimetry** : Theory, Lambert's law, Beer's Law, Working of Colorimetry, Applications. (10)

**Fluoride meter** : Principle of operation, Salient features, Working Applications. (10)

### Unit V : 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. (20)

### Unit VI : Flame Photometry :

Introduction, Principle, Instrumentation, Applications of flame photometry in environmental analysis (15)

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### References

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

## ENV. 303 : Environmental Education and Management

### Unit I : Introduction :

Environment, Ecology, Environmental Science, Environmental education, Goals and objectives of Environmental education, Principles of Environmental education, Role of green teacher in Environmental education. (05)

### Unit II : Environmental education :

**Indoor Environmental education** : Environmental education through language, News papers, Art, Projects, T.V., Games, Establishment of nature club

**Out door Environmental education** : Nature trails, Nature camps, celebration of Environmental days.

**Environmental education in India** : Formal Environmental education, Environmental education at higher secondary stage, Environmental education at college, Non formal Environmental education. (20)

### Unit III : Natural Resources :

**Conventional Energy resources** : Coal, Petroleum and natural gas, Nuclear energy, Geothermal energy, Management of Conventional Energy resources.

**Non Conventional Energy resources** : Solar energy, Hydro energy, Tidal energy, Biomass energy, Wind energy, management of non Conventional Energy resources.

**Forest resources** : Uses of forest resources, wood products, wood consumption, wood demand, Non wood products, trade of forest products, deforestation, Afforestation, Social forestry, Forest management, National forest policy.

**Wild life resources** : Wild life and Environment, endangered species, causes of depletion of wild life, wild life trade, wild life management. (20)

### Unit IV : Environmental Management :

**Principles of Environmental Management** : Introduction, Evolution of Environmental Management, Basic principles of Environmental Management, Business charter of International chamber of commerce for sustainable development, Polluter pays principles.

**Frame work for Environmental Management** : Introduction, Checklist for environmental issues, Role of Environmental Management in the industry

**Waste minimization and pollution prevention** : Waste generating operations, Basics of the waste minimization, Careful operating procedures, Raw material changes, Manufacturing process changes, Equipment changes, Finished product changes, recycling of matter and energy (20)

### Unit V : Environmental Impact Assessment and Remote sensing :

**EIA** : EIA process, preparation of EIA statement, Cost benefit analysis, current status of EIA, Projects covered by EIA, Environmental audit. EMS ISO 14000.

**Remote sensing** : Remote sensing tools in environmental management, applications of remote sensing in oceanography, meteorology, wet land mapping, forest management, exploration of under ground water. (13)

### Unit VI : Environmental legislation :

Salient features of the Motor vehicle act 1988, Water prevention and control of pollution act 1974, Water prevention and control of pollution act 1977, Environmental protection act 1986, Wild life protection act 1972. (13)

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## References

01. **Environmental Education** : *Bombay Natural History Society*
02. **Principles of Ecology** : *P. S. Verma, V. K. Agarwal ( S. Chand and Co. New Delhi )*
03. **Environmental Management** : *Sandeep Joshi (shrishti Eco – Research Institute, Pune )*
04. **Environmental Biology** : *P. D. sharma ( Rastogi Publications, Meerut )*
05. **Ecology and Environment** : *P. D. sharma ( Rastogi Publications, Meerut )*
06. **Principles of Environmental Biology** : *P. K. G. Nair ( Himalaya Publishing House, New Delhi )*
07. **Environmental Biology** : *M. P. Arora ( Himalaya Publishing House, New Delhi )*
08. **Environmental Science** : *Enger Smith, Smith, W. M. C. Brown ( Company Publishing )*
09. **Pollution and Environmental laws** : *Satish Shastri*
10. **Introduction to Environmental Studies** : *Turk & Turk*
11. **Law Science and Environment** : *R. P. Anand*
12. **Conservation of Natural resources** : *David A. Castillan*
13. **Fundamentals of Environmental Science** : *G. S. Dahliwal, G. S. Sangha, P. K. ralhan, Kalyani Publishers, New Delhi*
14. **Earth resources, Energy and the Environment** : *Brookins*

### ENV. 304 : Laboratory Course

01. Study of sewage sampling Equipments.
02. Methods of sample collection.
03. Preservation of sewage samples.
04. Determination of Color of sewage sample.
05. Determination of pH of provided sewage sample.
06. Determination of Turbidity of provided sewage sample by turbidity meter method.
07. Determination of Total solids from the sewage sample.
08. Determination of Total dissolved solids from the sewage sample.
09. Determination of Volatile solids from sewage sample.
10. Determination of Conductivity of sewage sample.
11. Determination of Chlorides from provided sewage sample.
12. Determination of dissolved oxygen from sewage sample.
13. Determination of Carbon di oxide from sewage sample.
14. Determination of Oil & Grease from Sewage sample.
15. Determination of silica.
16. Determination of Ammonia from sewage sample.
17. Determination of Nitrates from sewage sample.
18. Estimation of hydrogen Sulphide from the wastewater.
19. Estimation of Biochemical oxygen demand of wastewater.
20. Estimation of Chemical oxygen demand waste water.

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## References

01. **Practical Methods in Ecology and Environmental Science.**  
*R. K. Trivedy, P. K. Goel, Trisal ( Environmental Publication, Karad )*
02. **Manual of Environmental Pollution Analysis**  
*N. N. Bandela, Masarat Sultana, Uday P. Patil ( Prathivi Publication, Aurangabad )*
03. **A Manual of Fresh water ecology**  
*R. Santhanam, P. Velayutham, G. Jegatheesan ( Daya Publishing House, Delhi )*
04. **Physico-Chemical Examination of Water, Sewage & Industrial effluents**  
*N. Manivasakam ( Pragati Prakashan, Meerut )*
05. **Manual on Water and Waste Water Analysis**  
*National Environmental Engineering Research Institute, Nagpur*
06. **Methodology for Water Analysis**  
*Dr. Mohan S. Kodarkar, ( Indian Association of aquatic Biologist's, Hyderabad )*
07. **Chemical and Biological methods for Water Pollution Studies**  
*R. K. Trivedy, P. K. Goel ( Environmental Publication, Karad )*
08. **Methods in Environmental Analysis : Water, Soil, Air**  
*P. K. gupta, ( Agrobios India, Jodhpur )*
09. **Chemical methods for Environmental analysis: Water & Sediments**  
*R. Ramesh & M. Anbu ( Macmillan India Limited )*

### ENV. 305 : Laboratory Course

#### Principle, Working, Standardization and applications of Instruments

01. pH meter
02. Turbidity meter
03. Conductivity meter
04. Thin layer chromatography
05. Column chromatography
06. BOD Incubator
07. Water testing Kit ( Temperature measurement )
08. Water testing Kit ( ORP measurement )
09. Water testing Kit ( Salinity measurement )
10. Fluoride meter
11. Colorimeter (Estimation of Copper )
12. Colorimeter (Estimation of Zinc )
13. Colorimeter (Estimation of Manganese )
14. Colorimeter (Estimation of Ferrous )
15. Spectrophotometer (Estimation of Phosphate )
16. Spectrophotometer (Estimation of Sulphate )
17. Flame photometer ( Estimation of Sodium )
18. Flame photometer ( Estimation of Calcium )
19. Flame photometer ( Estimation of Lithium )
20. Submission of Excursion Report

## ENV. 306 : Laboratory Course

01. Determination of wind speed by anemometer.
02. Analysis of bleaching powder.
03. Analysis of Alum.
04. Analysis of activated carbon.
05. Determination of Detergents.
06. Activated sludge Studies.
07. Analysis of Bleaching Powder.
08. Estimation of Lime.
09. Determination of optimum coagulant dose by Jar test apparatus.
10. Estimation of chlorine dose for disinfection of sewage.
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 Walk ley's black method.
15. Determination of sewage and wastewater strength.
16. Estimation of hydrogen Sulphide from the wastewater.
17. Preparation of Air quality Impact Assessment Check list.
18. Preparation of Water quality Impact assessment Check list.
19. Preparation of Noise Impact assessment Check list.
20. Study of relative stability of organic effluent's.



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**Model Question Paper ( Theory )**

**Class : B. Sc. Third Year**

**Subject : Environmental Science**

**Paper : Env. 301 : Waste water Engineering**

**Paper : Env. 302 : Instrumental Techniques in Environmental Analysis**

**Paper : Env. 303 : Environmental Education and Management**

**Time : Three Hours**

**Maximum Marks : 100**

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Q. 1: Essay Type Question	20 marks
OR	
a) Short Question	10 marks
b) Short Question	10 marks
Q. 2: Essay Type Question	20 marks
OR	
a) Short Question	10 marks
b) Short Question	10 marks
Q. 3: Essay Type Question	20 marks
OR	
Essay Type Question	20 marks
Q. 4: Essay Type Question	20 marks
OR	
Essay Type Question	20 marks
Q. 5: Short Notes ( Any Four )	20 marks
i)	
ii)	
iii)	
iv)	
v)	
vi)	



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**Model Question Paper ( Practical )**

**Class : B. Sc. Third Year**

**Subject : Environmental Science**

**Paper : Env. 304 : Laboratory Course**

**Time : Three Hours**

**Maximum Marks : 100**

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- Q. 1: Determine Ammonia / Phosphates / Sulphates / Nitrates from provided sewage sample. 20
- Q. 2: Estimate BOD / COD / Volatile solids from provided sewage sample. 20
- OR
- Estimate Dissolved oxygen / Oil and Grease / TDS from provided Sewage sample 20
- Q. 3: Determine pH / Turbidity / Silica / Conductivity / Color from sewage sample. 15
- Q. 4: Determine Total solids / Chlorides / CO<sub>2</sub> / H<sub>2</sub>S from sewage sample 15
- Q. 5: a) Record Book submission 10  
b) Viva Voce 10  
c) Excursion Report 10
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**Model Question Paper ( Practical )**

**Class : B. Sc. Third Year**

**Subject : Environmental Science**

**Paper : Env. 305 : Laboratory Course**

**Time : Three Hours**

**Maximum Marks : 100**

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Q. 1: Describe Principle, Working and applications of Flame photo meter and estimate Sodium / Calcium / Lithium by using Flame photo meter. 20

OR

Discuss Principle, Working and applications of Spectro photo meter and estimate Phosphate / Sulphate by using Spectro photo meter. 20

Q. 2: Describe Principle, Working and applications of Water testing Kit and determine Temperature / Salinity / ORP by using water testing Kit. 20

OR

Discuss Principle, Working and applications of Colorimeter and estimate Copper / Zinc / Manganese / Ferrous by using Colorimeter. 20

Q. 3: Describe Principle, Working and applications of Fluoride meter and determine Fluorides by using Fluoride meter. 15

OR

Discuss Principle, Working and applications of Turbidity meter and determine Turbidity of provided sample by using Turbidity meter. 15

Q. 4: Describe Principle, Working and applications of pH meter and determine pH of provided sample by using pH meter. 15

OR

Describe Principle, Working and applications of Column chromatography / Thin layer chromatography. 15

Q. 5: a) Record Book submission 10  
b) Viva Voce 10  
c) Excursion Report 10

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**Model Question Paper ( Practical )**

**Class : B. Sc. Third Year**

**Subject : Environmental Science**

**Paper : Env. 306 : Laboratory Course**

**Time : Three Hours**

**Maximum Marks : 100**

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- Q.1 : Determine Detergents / Bleaching powder / Lime from provided sample. 20  
OR  
Determine optimum coagulant dose by using Jar test 20
- Q.2 : Determine alum dose for Defluoridation by using Nalgonda technique. 20  
OR  
Determine Chlorine dose for disinfection of water 20  
OR  
Analyze Alum / Activated carbon / from treated sewage sample. 20  
OR  
Determine Organic matter from soil by using Walkley's and Black method. 20
- Q.3 : Determine Sludge volume index / Sludge density index 15  
OR  
Determine sewage and waste water strength 15
- Q.4 : Prepare Air Quality Impact Assessment Check list / Water Quality Impact Assessment Check list / Noise Impact Assessment Check list 15  
OR  
Determine relative stability of organic effluents. 15
- Q. 5: a) Record Book submission 10  
b) Viva Voce 10  
c) Excursion Report 10
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