RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR

Faculty of Science
B.Sc. III Year
Semester-V and VI
Environmental Science

Year	Semester	Paper	Paper Title	Total Periods Per Week	Marks		Total Marks	Grand Total
					Theory	Internal		
B.Sc. Final Year	V	XI	Air and Noise Pollution	03	50	10	60	150
		X	Environmental Management and Economics	03	50	10	60	
		Practical	Practical-I	06	30	-	30	
	VI	XI	Water Pollution: Monitoring and Management	03	50	10	60	150
		XII	Water Supply and Wastewater Treatment	03	50	10	60	
		Practical	Practical-II	06	30	-	30	

Note: The syllabus is based on six theory periods/week and six practicals/week/batch.

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR

B.Sc.-III

ENVIRONMENTAL SCIENCE

The examination shall comprise two theory papers of 3 hours duration of 50 marks each. One internal assessment based on two theory papers for 10 marks each. Practical examination will be of 6 to 8 hours for one day and carry 30 marks. Candidates are expected to pass separately in theory and practical examination.
Theory paper is divided into four units. Each unit shall be covered in 8 hours.

Semester- V

Paper IX
Air and Noise Pollution

Unit –I: Introduction to Air Pollution

Basic Concepts of Air Pollution: Air pollution: meaning and definition, sources and types of air pollutants, major air pollutants; types of air pollution – indoor air pollution, vehicular pollution, industrial pollution; status of air pollution in India, effects of air pollution on plants, animals, human and materials, smog and acid rains.

Air Pollutants: classification, primary air pollutants (sulphur dioxide, nitrogen dioxide, carbon dioxide, hydrocarbons & particulate matter), secondary air pollutants (ozone, PAN & photochemical smog) & their effects on human beings, plants, animals and materials,

Air Pollution and Meteorology: factors influencing air pollution, methods for measurement, temperature, inversion, lapse rates, stability, wind velocity, wind roses and turbulence.

(8 periods)

UNIT-II: Air Pollution Sampling

Air Sampling: Ambient air sampling site, selection criteria, duration of sampling period, location of sampling sites, gaseous and particulate air sampling. Stack sampling: Significance. consideration for accurate representative sample. Selection of sampling location, procedure for particulate matter sampling. Devices used for sampling: meters, probes, suction devices, absorbers, High Volume sampler, Dust fall jar, pitot tube with a differential manometer. National Ambient Air Quality Standard (2009). (IS10500:2012).

Toxicology of Gaseous Pollutants: Carbon monoxide, oxides of nitrogen, sulphur dioxides, petroleum and solvents global Environmental issues - ozone depletion, global warming and climatic change. Energy crisis and conservation, clean development mechanism, carbon emissions, carbon sequestration, carbon credits.

Analytical Methods for Monitoring Air Pollutants; Monitoring, carbon monoxide, nitrogen oxides, sulphur dioxide, hydrogen sulphide, hydrocarbons, particulate matter air pollution Accidents: Bhopal Gas Disaster, Chernobyl Disaster, London Smog. **(8 periods)**

Unit III: Control Measures of Air Pollution

Prevention and Control of Air Pollution: methods of control of air pollution, air pollution control equipments and devices - Gravity settling chambers, cyclone collectors, fabric filters, electrostatic precipitators (tube and plate type), Scrubbers-(cyclonic and ventury Scrubbers), standards prescribed for air quality in India

Sustainable Development. Conventions and protocols, climate change, Copenhagen outcome, Green House Effect: Introduction, sources of green house gases; major green house gases; emission of CO_2; impact of green house gases on global climate; consequences of green house effects; remedial measures of green house effects; impact of global warming on – human health, agriculture, biodiversity etc.

Legislative Measures of Air Pollution: Air Pollution Control Act, Constitutional Provisions, Powers and Responsibilities of CPCB and MPCB. **(8 periods)**

Unit IV: Introduction to Noise Pollution and vehicular pollution

Basic Concepts of Noise Pollution: Definition, sources of noise pollution, measurement of noise, The Decibel scale, Effects of noise pollution, Auditory and Non auditory effects.

Prevention and Control of Noise Pollution: Equipments used for noise measurements, noise control criteria, Noise control in Industrial establishments, Important parameters in noise control, Standards prescribed for noise with reference to Indian context.

Introduction to Vehicular Air Pollution : Genesis of vehicular emissions: vehicular pollution, sources of air pollution from automobiles ,Automobile emission, Population and pollution loads of vehicles, Automobile pollution control, Control at sources, Exhaust gas treatment devices, Alternate fuels comparison, diesel, CNG, Bio-fuels, Thermal reactor, Catalytic converter, Euro standards prescribed for vehicular emission, Motor vehicle Act, 1988. **(8 periods)**

SEMESTER-V

PAPER – X

Environmental Management and Economics

UNIT -I: Basic Concepts of Environmental Impact Assessment

Environmental Impact Assessment (EIA): Definition, basic concept, principles, objectives and needs of EIA, Environmental impacts of industrialization and urbanization, stages in EIA, types of EIA, Procedure of EIA, Environmental Inventory, EIA monitoring, role of EIA, positive and negative impacts. **Environmental Impact Statement (EIS):** Definition, steps for EIS preparation, Impact indicators, prediction of environmental impact, role of EIS in industrialization and urbanization.

Environmental Economics: Introduction, concept, definition, goals and components, types (Micro & Macro economics), Economic effects and environmental effects, modern issues of environmental economy. Gross National Products (GNP), formula and examples, Gross Domestic Product (GDP):Introduction, scope, effects. Ecological economics: concept, aim, definition, fundamental vision, Importance and scope of environmental economy.

Public Participation: Basic concept, Public Participation in Environmental Decision Making Activity, Advantages and disadvantages of public participation in different environmental projects.Public participation process. **(8 Periods)**

UNIT –II: Impact Assessment Methodologies

Methods of EIA: Assessment of Environmental Impact and Methods: Adhoc, Checklist, Matrices, Basic Steps for Prediction and Assessment of Air Environment and Water Environment, Environmental management plan, Green Belt(Importance for industries).

Role of Government in Environmental Protection: Legislation of EIA in India, Role of NGOs in Environmental Protection, Role of Statutory Agencies in EIA Clearance, Overview of Impacts, Case Studies- EIA of Water Resources and Mining.

Global and National Environmental Issues: Clean development mechanism, Concept of ISO 9000, 14000, 31000 & 50001, Environmental Management System, Ecological Restoration Plan (Aquatic and Terrestrial Ecosystem), Modern Concept of Capacity Building in Environmental Management.

UNIT –III : Environmental Audit (EA)

Introduction to Environmental Audit: Definition, Concepts of Environment Audit and its Importance for Industries, Benefits of EA, Scope and Objectives, Types of Audits, General Audit Methodology, Types- Pre-audit, Post-audit & Onsite audit, Basic Structure of Audit.

Environmental Audit in Polluting Industries: Introduction and Scope, Advantages of EA, Compliance Audit, Surveillance Audit, Audit process, Scope of audit in industries, Significance and Importance for industries, Guidelines for preparing audit report.

Significant Environmental Acts: The Environmental Protection Act 1986, The Wild life Protection Rules 1995, The Forest Conservation Act 1980, Salient Features of Coastal Zone Regulations (CZR) Notification. **(8 Periods)**

UNIT –IV : Environmental Awareness and Information Technology:

Sustainable Development: Definition, Basic Concept, Objectives of Sustainable Development, Principle of Sustainable Development, Case study of Sustainable Development, Key aspect of sustainable development, Challenges to sustainable development.

Environmental Management System (EMS): Basic concept, Aims, Objectives, Significance, Importance, Industrialization and Urbanization impacts on environment, Population explosion, Natural Resources Management(NRM).

Information Technology: Definition, Concept, Scope, Uses, Types and benefits of information technology. Environmental awareness through media, Mass media, Print electronic media, Traditional and Environmental journalism, Application of Information Technology in environmental protection,

(8 Periods)

PRACTICAL SCHEDULE

Section A :

1. Determination of Suspended Particulate Matter (SPM) & (RSPM) in Ambient Air by using High Volume Sampler.
2. Comparative Analysis of Air Sampling from Residential, Commercial & Industrial Zone using key parameters like SOx & NOx.
3. Determination of Settleable Particles in Air using Dust Fall Jar Apparatus.
4. Preparation and Intepretation of Wind roses.
5. Concentration of Acid rain in a air sample.
6. Measurement of Noise Pollution by Noise Meter in Silent, Industrial, Residential, Commercial Zones & Comparison its Standards.
7. Demonstration of an Electrostatic Precipitator.
8. Demonstration of Scrubbers and it's working.
9. Demonstration of Cyclone Collector and it's working.
10. Demonstration of Gravity Settling Chamber and it's working.

Section B :

1. Preparation of Environmental Audit Report.
2. Study of Natural environment of the area with respect to air, noise, water, soil, socio-economics.

3. Study of environmental impacts of the industries with respect to air, noise, water, soil, socio-economics.
4. Study of EIA legislation for environmental protection.
5. Determination of Sulphonation Rate by Lead per oxide method.
6. Determination of Ammonia in Atmosphere.
7. Determination of Air Pollution Index (API).
8. Impact of air pollution on photo density flux of plant leaves.
9. To estimate the effect of exhaust gases on chlorophyll content in different plants.

FIELD VISITS :

1. Visit to National Environmental Engineering Research Institute (NEERI), Nagpur

2. Visit to Maharashtra Pollution Control Board (MPCB), Udyog Bhavan, Nagpur.
3. Visit to Common Effluent Treatment Plant

4. Visit to Indorama Synthetics, Butibori

All students shall under take field visits to the above mention research institution and industries which are important for understanding the subject. Soon after their visit, students shall submit study tour report which is certified by the HOD is to be submitted at the time of Annual Practical Examination.

FIELD DIARY :

The Student Shall Prepare their Field Diary Under the Following Heads:

1. Issue on Regional Problem of Environmental Interest (Case Studies)
2. Issue of National Interest (Case Studies)
3. New Acts & Judgments of Environmental Interest.
4. About Famous Personalities in Environmental Movements.

DISTRIBUTION OF MARKS :

1). Long Experiment (Any one) : 10 Marks
2). Short Experiment (Any two) : 10 Marks
3). Viva-voce : 04 Marks
4). Tour Report/ Field Diary : 03 Marks
5). Practical record : 03 Marks

Total Marks : 30 Marks

BOOKS FOR REFERENCE:

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. Agrawal, A. P. H. Publishing Corporation, New Delhi.
8. Air Pollution : V. P. Kudesia, Pragati Prakashan, Meerut.
9. Noise Pollution and Control Strategy: S.P. Singal, Narosa Publishing House, New Delhi.
10. Noise Pollution: B. K. Sharma, H. Kaur, Goel Publishing House, Meerut, 1994.
11. Biostatistics : P. N. Arora, P. K. Malhan, Himalaya Publishing House, Delhi, 2008.
12. Basic Concepts of Biostatistics : N. Arumugam, Saras Publications, Kanyakumari, 2003.
13. Biostatistics in Theory and Practice : T. K. Saha, Emkay Publications, Delhi, 1992.
14. Biostatistics: P. Ramakrishnan, Saras Publications, Kanyakumari, 1995.
15. Statistical Methods : S. C. Gupta, S. Chand & Sons Publishers, New Delhi, 1997.
16. Evolution Biostatistics & Computer Applications : A. Gopi, A. Meena, N. Arumugam, Saras Publications, Kanyakumari, 2003.
17. Environmental Impact Assessment : Principles and Procedures, John Wiley and Sons, New York.
18. Environmental Impact Assessment : A.K.Shrivastav, APH Publishing Corporation,New Delhi.
19. Environmental Impact Assessment: S.A.Abbasi, D.S.Arya,Discovery Publishing House,New Delhi.
20. Environmental Pollution Control: Neelima Rajvidya and Dilipkumar Markandey, APH Publishing Corporation,New Delhi. (2005).
21. Environment Problems and Solutions : D.K.Asthana and Meera Asthana, S.Chand & Co. Ltd. New Delhi.
22. An Introduction to Environmental Management : Dr.Anand S. Bal, Himalaya Publishing House, New Delhi.
23. Environmental Impact Analysis Handbook : John G.R. and David C.Wooten, McGraw Hill Publications. (1987).
24. Encyclopedia of Ecology and Environment : Environmental Impact Assessment Vol. 7 : By Trivedi P.R., Indian Institute of Ecology and Environment, New Delhi (1999).
25. Environmental Law and Policy in India : Divan S and Rosencraz A,Oxford University Press, New Delhi. (2001).
26. Environmental Laws of India - An Introduction: CPR Environmental Education Centre, Chennai (2001).
27. Environmental Impact Assessment Methodologies: Y.Anjaneyulu,Valli Manickam,Bs Publications.
28. Ecology Environmental Science Conservation by J. S. Singh and S. P. Singh and S. R. Gupta , S. Chand Company Ltd.
29. Environmental Pollution, R.K. Khitoliya, S. Chand Company Ltd.

30. Textbook of Environmental Chemistry , Balram Pani,I.K. Internat.
31. Fundamental of Information Technolgy by Chavi Ghosh
32. Environmental Economics by Stephen Smith.
33. Environmental Economics by Charles D Kolstad.
34. Handbook of Environmental Economics by Partha Dasgupta.

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B.Sc.-III

ENVIRONMENTAL SCIENCE

The examination shall comprise two theory papers of 3 hours duration of 50 marks each. One internal assessment based on two theory papers for 10 marks each. Practical examination will be of 6 to 8 hours for one day and carry 30 marks. Candidates are expected to pass separately in theory and practical examination.

Theory paper is divided into four units. Each unit shall be covered in 8 hours

Semester VI
Paper-XI
Water Pollution: Monitoring and Management

Unit- I : Introduction to Water Pollution

Basic Concepts of Water Pollution: Definition, Causes, Sources and Effects of Water Pollution, Ground Water Pollution, Requirement of Fresh Water in India, Case Studies Status of Polluted Rivers like Nag and Kanhan, Ganga Action plan, Interlinking of rivers, Minimata epidemic in Japan.

Water Pollutants: Classification of Water Pollutants and Their Detrimental Effects, Approaches to Prevent and Control of Water Pollution and Legislative Measures.

Water Quality Monitoring and Management: Basic concept, Significance and Measurement of BOD & COD, Heavy Metals Sources, Industrial Uses, Prescribed standards, Effects, Chemical Speciation Scheme, Speciation of Mercury (Hg), Cadmium (Cd) Instrumental Methods of Analysis viz Atomic Absorption Spectrophotometer and UV Visible Spectrophotometer and Gas Chromatography, Principle, Components and Application in Environmental Analysis. **(8 Periods)**

Unit- II : Global Problems Associated with Water Pollution

Marine Pollution: Types, Sources and Consequences, Specifications for Disposal of Sewage and Industrial Waste into Sea, Disposal of Sewage & Wash Water from Marine Vehicle (Cargo & Ships).

Oil Pollution: Sources, Effects, Coastal Management and Episodes, Counter Measures Against Oil Spills.

Eutrophication: Definition, Sources of Nutrients, N/P Ratio, Types of Eutrophication, Effects, Control and Treatment, Self Purification, Factors Affecting Self Purification, Oxygen Sag Curve, Zones of Pollution, Restoration of Indian lakes. **(8 Periods)**

Unit- III: Global Environmental Movements and Controversies:

Environmental Movements: Environmental movements and peoples responses;. Indian environmental movements and initiatives Chipko Movement , Apikko Movement, Narmada Bachoao Andolan, Save Western Ghats,

Environmental Controversies : Social, political and economic issues in the controversies, Narmada Project, Almatti dam, Sarda Sarovar Project, Tehri dam, Koyna dam, MIC gas tragedy, Chernobyl tragedy, Matura Refinery case, Silent valley,

Statistical analysis of data: Determination of mean, median, mode, Dispersion, standard deviation, Standard errors of data, Co-relation study, Significance of studies and Regression analysis of data . **8 Periods**

Unit IV: Bioremediation Soil Environment:

Biotechnologies for Ex-situ and In-situ: Ex-situ and In-situ remediation of soil, Bio-leaching, biosorption and oil degradation, creation of superbug, Phyto-remediation technology for soil Decontamination, Sequestering Carbon Dioxide Air Environment:

Biological Filtration Processes: Air Stream, Bio-filtration, Bio-trickling filtration and Bio-scrubbers

Water Environment: Ex-situ and In situ Decontamination of Groundwater, Bio-augmentation, Landfill Leachate Bio-treatment Biotreatment of Metals: Microbial Transformation of Metals, Bio-leaching and Bio-benificiation, Bio-accumulation Oxidation/Reduction Processes, Bio-methylation, Bio-monitoring. **8 Periods**

SEMESTER VI

Paper XII

Water Supply and Wastewater Treatment

Unit I: Water Distribution System

Water Supply: Classification, Gravity System, Direct Pumping System, Methods of Supply, System of Supplying Water (Continuous and Intermittent Systems), Economical and Topographical Considerations.

Distribution System: Service Reservoir, Classification and their Functions, Layout of Distribution System, Dead End System, Grid Iron System, Ring System, Radial System, Design Consideration of Distribution System, Maintenance of Distribution System,

Pumps and Pumping- Necessity of Pumping, Pumps Classification (Displacement Pumps, Centrifugal Pumps), Operation of Pumps, Detection and Prevention of Leakages, Preventive Methods of Leakage. **(8 Periods)**

Unit II : General Aspect of Wastewater Treatment

Wastewater Treatment: Sources of Wastewater, Objectives of Treatment, Importance and Significance, Need of water treatment.

Preliminary Treatment: Selection and Applications of Screens (Bar Screens, Fine Screens), Grit Chambers (Aerated & Plain), Primary Treatment-Sedimentation (Septic Tank & Imhoff Tank).

Primary Treatment: Plane Sedimentation with Coagulation, Filtration & Disinfection Methods.

(8 Periods)

Unit III: Biological Wastewater Treatment

Secondary Treatment (Biological Methods): Aeration Activated Sludge Process, Oxidation Pond & Trickling Filter and Up-flow Anaerobic Sludge Blanket Reactor.

Tertiary Treatment: Adsorption, Reverse Osmosis & Treatment with Activated Carbon.

Sludge Handling Treatment and Disposal: Composition & Characteristics of Sludge, Need for Disposal, Operation & Maintenance of Wastewater Treatment Plant.

(8 Periods)

Unit IV : Industrial Pollution and Treatment Options

Industrialization: Scope and Importance, Distribution of Industries, Sources and Types of Industrial Effluents, Nature and Origin of Pollutants, Industrial Wastewater and Environmental Impacts on Air, Water and Soil Environment.

Industrial Wastewater Pollutants: Waste water from some typical Industries, Sources, Effects and Treatment Options for Textiles Industry, Paper and pulp Industry, Dairy Industry, Plastic Recycling Techniques, Biodegradable Plastics.

Unit Operations: Basic concept, Definition, Selection of Appropriate Unit Operations, Monitoring and Designing for the Treatment and Flow Chart of Wastewater Treatment Plant for Electro-plating, Leather Tanning Industry, Low Cost Waste Treatment and Design. **(8 Periods)**

PRACTICAL SCHEDULE

Section A :

1. Determination of Zn++ in water by complexometric titration.
2. Determination of Cd++ in water by complexometric titration.
3. Determination of Pb++ in water by complexometric titration.
4. Determination of Sulphate in a given water sample.
5. Determination of Phosphate in a given water sample.
6. Estimation of total Kjeldahl's nitrogen in a given water sample.
7. Estimation of Biochemical Oxygen Demand (B.O.D) by three day method in a given sample.
8. Determination of Chemical Oxygen Demand (C.O.D) in a given sample.
9. Demonstration on Eutrophication on polluted lakes.

Section B:

1. Determination of Sludge Volume Index (SVI) of wastewater sample.
2. Estimation of Sodium and Potassium in given sewage sample.
3. Demonstration of UV-Visible spectrophotometer.
4. Demonstration of Atomic Absorption Spectrophotometer (AAS).
5. Determination of oxygen consumption in normal fish/snail at different temperature.
6. Toxicity estimation of heavy metals using fish/snail as test animal determination LC50 value.
7. Estimation of chromium in a given waste water sample.

FIELD VISITS:

1. Visit to Thermal Power Plant, Koradi or Khaparkheda
2. Paper & Pulp. Industry, Bazargaon, Nagpur
3. Diary Plant, Nagpur
4. Jawaharlal Nehru Aluminium Research Design Development Center, Wadi, Nagpur

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5). Practical record	: 03 Marks
Total Marks	: 30 Marks

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2. Environmental Problems and Solutions by D.K. Asthana & Meera Asthana, S.Chand & Company Ltd. New Delhi, 2003.
3. Environmental Science by S.C.Santra, New Central Agency Ltd. Kolkata, 2005.
4. Manual of Water and Wastewater Analysis by Dr. D.S. Ramteke, C.A. Moghe & R.Sarin, NEERI, Nagpur.
5. Our Environment Pollution Control and Future Strategies by M.P.Mishra, S.Chand & Company Ltd. New Delhi, 2000.
6. Principals of Environmental Science by H.V. Jadhav, Himalaya Publishing House, New Delhi, 1994.
7. Water Pollution by B. K. Sharma, Krishna Prakashan Media Pvt. Ltd., 2001.
8. Ecology, Environment and Resource Conservation (2006): Singh JS, Singh SP andGupta SR; Anamaya Publication, New Delhi.
9. Fundamental of Ecology (1971): EP Odum; WB Saunders Company.
10. Environmental Chemistry: B. K. Sharma, Goel Publishing House, Meerut.
11. Waste Water Engineering: Metcalf and Eddy, Tata McGraw Hill Publishing Company, New Delhi.
12. Environmental Chemistry: A. K. De, Wiley Eastern Limited, New Delhi.
13. Environmental Pollution: H. M. Dix, New York.
14. Environmental Chemistry: B. K. Sharma and H. Kour by Villa Publication, Meerut.
15. A Text book of Sanitary Engineering : Vinayak Gharpure, Engineering Book Publishing Company, Pune.
16. Water Pollution : V. P. Kudesia, Pragati Prakashan, Meerut.
17. Environmental Chemistry : B. K. Sharma, Goel Publishing House, Meerut.
18. Environmental Chemistry : A. K. De,Wiley eastern limited, New Delhi.
19. Water Supply & Sanitary Engineering: G.S. Birdie.
20. Textbook of Water Supply & Sanitary Engineering: S.K. Husain.
21. Water supply and sanitary engineering : R. C. Rangwala and S. C. Rangwala, Charotal Publishing House, Anand.
22. Water and Wastewater Technology by Mark J. Hammer, Prentice Hall of India Pvt. Ltd., New Delhi, 1998.
23. Water Treatment Technologies and Environment by S.N. Kaul, Lidia Szpyrkowicz & Arvind Kumar, Dyaya Publishing House Delhi, 2004.
24. Introduction to Environmental Engineering: Mackenzie L. Davis & David A. Cornwell, McGraw Hill Publishing Company, New Delhi.
25. Basic Water Treatment: George Smethurst, Scientific Publishers, Jodhpur.
26. Chemical And Biological Methods For Water Pollution Studies: R. K. Trivedy, P. K. Goel, Environmental Publication, Karad.
27. Water Pollution and disposal of Waste water on Land : U. N. Mahida (Tata Mc-Grew Hill Publishing Company, New Delhi.
28. Waste water treatment for pollution control : Soli J. Arceivala (Tata Mc-Grew Hill Publishing Company, New Delhi).

29. Waste Water Treatment: M. N. Rao, A. K. Datta (Oxford and IBH Publishing Company, New Delhi).
30. Waste Water Engineering : Metcalf and Eddy,Tata Mc-Grew Hill Publishing Company, New Delhi.
31. Wastewater Treatment: M. N. Rao, A. K. Datta, IBH Publishing Company, New Delhi.
32. Elements of Environment Engineering: K.L. Duggal, S. Chand and Company Ltd.
33. A Technical Manual for Water and Wastewater Analysis: Sunil Pande and Leeana Deshpande, Himalaya Publishing House.
34. Environmental Engineering, Water supply, sanitary engineering and pollution A Kamala, D L Kanth Rao, Tata Mc-Grew Hill Publishing Company, New Delhi.