M.Sc. II year Environmental Science
Semester III

Gondwana University, Gadchiroli

Semester Pattern Syllabus for

M. Sc. II Year

Semester III and IV

Environmental Science

GONDWANA UNIVERSITY, GADCHIROLI

Faculty of Science
Semester Pattern Syllabus
M. Sc. II year
Semester III and IV
Environmental Science

Year	Semester	Paper no.	Paper Title	Marks		Total marks
				Theory	Int. Ass. *	
M.Sc. II Year	**III**	I	Water Treatment and Supply	80	20	100
		II	Wastewater Treatment	80	20	100
		III	Air Pollution Control	80	20	100
		IV	Solid and Hazardous Waste Management	80	20	100
		Practical I	Water Treatment and Supply	80	20	100
		Practical II	Wastewater and Air Pollution	80	20	100
	IV	V	EIA and Environmental Laws	80	20	100
		VI	Pollution Control and Industrial Safety	80	20	100
		VII	Environmental and Energy Management	80	20	100
		VIII	Sustainable Environment	80	20	100
		Practical I	Environmental Management and Sustainable Environment	80	20	100
		Project	Project (Dissertation)	80	20	100

Note: The syllabus is based on 4 theory periods per week per paper of one hour duration and 8 practical periods per week per batch.

General Instructions:

- The examination shall comprise of four papers in this semester and one practical and a dissertation (project work).
- Practical examination will be of twelve hours duration and will be extended over two days.
- Each theory paper will be of three hours duration and shall carry 80 marks.
- The examinee shall be required to pass in theory and practical's, separately.

Distribution of Practical Marks (Semester IV, practical I)		
1	One major experiment	30 marks
2	Two minor experiments	30 marks (15 marks each)
3	Certified practical record book	05 marks
4	Certified tour report/field diary	05 marks
5	Viva-voce	10 marks
	Total	**80 marks**

Scheme of Teaching and examination under credit grade semester pattern for M.Sc. II year (Semester III and IV) Environmental Science

Semester	Theory Paper/ Practical	Teaching Scheme (Hrs/week)			Examination Scheme					
		Th.	Pr.	Total	Duration (Hrs)	Max. Marks		Total Marks	Min. Passing Marks	
						Theory Marks	Internal Marks		Theory	Practical
III	I	4	--	4	3	80	20	100	40	--
III	II	4	--	4	3	80	20	100	40	--
III	III	4	--	4	3	80	20	100	40	--
III	IV	4	--	4	3	80	20	100	40	--
III	Practical I	--	8	8	12	80	20	100	--	40
III	Practical II	--	8	8	12	80	20	100	--	40
III	Seminar	2	--	2	--	---	25	25	10	
	Total	18	16	34	--	--	--	625	170	80

Semester	Theory Paper/ Practical	Teaching Scheme (Hrs/week)			Examination Scheme					
		Th.	Pr.	Total	Duration (Hrs)	Max. Marks		Total Marks	Min. Passing Marks	
						Theory Marks	Internal Marks		Theory	Practical
IV	V	4	--	4	3	80	20	100	40	--
IV	VI	4	--	4	3	80	20	100	40	--
IV	VII	4	--	4	3	80	20	100	40	--
IV	VIII	4	--	4	3	80	20	100	40	--
IV	Practical I	--	8	8	12	80	20	100	--	40
IV	Project	--	--	--	--	80	20	100	--	40
IV	Seminar	2		2	--	--	25	25	10	--
	Total	18	8	26	--	--		625	170	80

Semester III
Paper I
Water Treatment and Supply

Unit I: Water Sources

1. **Quality of water:** Wholesome water, reason for the analysis of water, impurities in water-suspended, colloidal, dissolved. Examination of water-physical, chemical and biological test, maintenance of purity of water.
2. **Quantity of water:** Measurement of rainfall, rate of demand, factors affecting rate of demand, variations in rate of demand, estimating population, factors affecting estimated population.
3. **Sources of water supply:** Surface and underground sources, types of well, yield of a well, test for yield of a well, design of intake, intake towers, infiltration wells.

Unit II: Physical Treatment

1. **Physical treatment:** Important unit operations, gas transfer, ion transfer, solute stabilization, solid transfer, schematic layout of water treatment plant.
2. **Preliminary treatment of water:** screens, purpose, types, aeration-theory, types of aerators, factors governing aeration, design consideration of aerator's.
3. **Sedimentation:** Theory, sedimentation tank-horizontal, circular, hopper bottom, design consideration.

Unit III: Chemical Treatment

1. **Coagulation:** Theory, common coagulants, chemical reactions, dosage of coagulants, optimum coagulant dose by Jar test apparatus. Flocculation- theory, operations.
2. **Filtration:** Theory, types of filters (Slow sand filter, rapid sand filter and pressure filter), construction and operations.
3. **Disinfection:** Basic theory, chlorination forms-(Bleaching powder, liquid chlorine and chlorine gas), ozonisation, ultra purification, UV radiation.

Unit IV: Distribution System

1. **Water distribution:** Classification, gravity system, direct pumping system, methods of supply, economical and topographical considerations.
2. **Distribution system:** Layout of distribution system, dead end system, grid iron system, ring system, radial system, design consideration of distribution system, maintenance of distribution system.
3. **Pumps and pumping**: Necessity of pumping, pumps classification (displacement pumps, centrifugal pumps), operation of pumps, detection and prevention of leakages.

Books for Reference:

1. Instrumental Methods of Analysis: Willered Merit and Dean (CBS Publication, New Delhi)
2. Wastewater Treatment for Pollution Control: Soli J. Arceivala, Tata McGraw Hill Publishing Company, New Delhi
3. Water Supply & Sanitary Engineering: G.S. Birdie
4. Textbook of Water Supply & Sanitary Engineering: S.K. Husain
5. Water Supply & Sanitary Engineering: R. C. Rangwala and S. C. Rangwala, Charotal Publishing House, Anand.
6. Wastewater Treatment: M. N. Rao, A. K. Datta, IBH Publishing Company, New Delhi.
7. A Textbook of Sanitary Engineering: Vinayak Gharpure, Engineering Book Publishing Company, Pune.
8. Water Pollution: V. P. Kudesia, Pragati Prakashan, Meerut.
9. Environmental Problems and Solution: D.K. Asthana, S.Chand and Company, New Delhi.
10. A Textbook of Environment: K. M. Agarwal and P.K. Sikdar, Macmillon India Ltd, Nagpur
11. Environmental Engineering: H S Peavy, D R Rowe and G Tchobanoglous, McGraw Hill.
12. Introduction to Environmental Engineering and Science: Gilbert M Masters and W P Ela, PHI publication.
13. Environmental Engineering: G Kiely, Tata McGraw Hill.

Semester III
Paper II
Wastewater Treatment

Unit I: Wastewater Sources

1. **Sources of wastewater**: Fundamentals of wastewater, domestic and industrial wastes, system of wastewater collection, concept of treatment.
2. **Quality of sewage**: Properties of sewage (physical, chemical and biological), cycles of decomposition, analysis of sewage (physical, chemical and bacteriological tests), relative stability, population equivalent.
3. **Quantity of sewage**: Measurement of wastewater, dry weather flow, storm water flow rates.

Unit II: Wastewater Engineering

1. **Basic terms and plant layout**: Concept of mass load, detention time (hydraulic retention time), horizontal and settling velocity, weir loading rate, organic loading, food to microorganism ratio, mean cell residence time, hydraulic loading, volumetric loading. Wastewater treatment plant layout: impact of flow rate and mass loading factors on design; evaluation and selection of design flow rates and mass loadings; elements of conceptual process, preparation of hydraulic profile. Design of sanitary sewers, construction and maintenance of sewers.
2. **Design of preliminary and primary units**: Design of sump and pump wells, equalisation basins, screen chambers, grit chambers, aerated grit chamber, oil and grease trap, settling and sedimentation tanks.
3. **Design of biological units:** Design of activated sludge process, secondary settling tank, waste stabilization pond, trickling filter tank, bio towers (vertical trickling filter), sludge drying bed.

Unit III: Primary Treatment

1. **Primary treatment:** Objectives and classification of wastewater treatment methods, screens- types, grit chamber: purpose, types, grit disposal.
2. **Primary treatment processes:** Detritus tank, skimming tank-operation plain sedimentation tanks (rectangular, hopper bottom and circular tank)
3. **Coagulation**: Necessity, principle of coagulation, different coagulant and their action, mixing devices for coagulation.

Unit IV: Secondary and Tertiary Treatment

1. **Filters**: Contact beds- theory, construction and working, trickling filters- theory, working, design aspects, bio filters.
2. **Biological treatment process**: Definition, action of activated sludge, flow diagram, method of aeration (diffused air, mechanical aerator, extended aeration, aerated lagoons) sludge bulking, SVI, SDI. Stabilization ponds (oxidation ponds), oxidation ditch, aeration ponds, aerobic ponds, facultative ponds, rotating biological contactors, disposal of sewage
3. **Tertiary wastewater treatment**: Removal of suspended solids, removal of dissolved solids, nutrient removal, ion exchange, reverse osmosis, recovery of materials from process effluents. Granular media filtration, ammonia removal, chlorination. Wastewater treatment for pulp and paper, iron & steel, and cement industry.

Books for Reference:

1. Wastewater Treatment Concepts and Design Approach: G L Karia and R A Christian, PHI Learning Private Limited.
2. Environmental Chemistry: B. K. Sharma, Goel Publishing House, Meerut.
3. Wastewater Engineering: Metcalf and Eddy, Tata McGraw Hill Publishing Company, New Delhi.
4. Environmental Chemistry: A. K. De, Wiley Eastern Limited, New Delhi.
5. Environnemental Pollution: H. M. Dix, New York.
6. Environmental Chemistry: B. K. Sharma and H. Kour by Villa Publication, Meerut.
7. Introduction to Environmental Engineering: Mackenzie L. Davis & David A. Cornwell, McGraw Hill Publishing Company, New Delhi.
8. Basic Water Treatment: George Smethurst, Scientific Publishers, Jodhpur.
9. Chemical and Biological Methods for Water Pollution Studies: R. K. Trivedy, P. K. Goel, Environmental Publication, Karad.
10. Water Pollution and disposal of Waste water on Land : U. N. Mahida, Tata Mc-Grew Hill Publishing Company, New Delhi

Semester III
Paper III
Air Pollution Control

Unit I: Air Quality

1. **Air quality**: Definition, atmospheric composition and stratification, urban and rural air quality. Air quality of major cities of India and world. Influence of natural and manmade factors, activities for deterioration of urban quality.
2. **Sources of pollution**: Stationary and mobile sources, criteria and non criteria pollutants. Classification of pollutants-particulates and gaseous. Primary and secondary air pollutants. Fugitive emissions. Urban heat island phenomenon.
3. **Indoor air pollution**: Introduction; mats, coils and aerosol spray. Indoor air quality in urban and rural area. Indoor air pollution's effects on health. Environmental tobacco smoke, asbestos. Radon, odour and volatile organic compounds: sources, effects and reduction techniques. Infiltration, ventilation and air quality. Indoor air quality model.

Unit II: Atmospheric Sampling and Analysis

1. **Basic consideration**: Consideration for air sampling, various instruments used for air sampling- high volume sampler, respirable dust sampler, fine particulate sampler: components, principle, working. Duration of sampling period, location of sampling sites, sampling methods -sedimentation, filtration, impingement methods, electrostatic precipitation.
2. **Gaseous sampling:** Classification of gaseous pollutants, inorganic: oxides of carbon, oxides of nitrogen, oxides of sulphur, H_2S, ozone, ammonia, fluorine; organic: hydrocarbons, methane, organosulfur, organonitrogen compounds, alkenes, alkynes. Sulphation rate, chlorine, mercaptans, benzene, toluene and xylene and benzopyrene. Sampling of trace elements in air (viz. As, Pb, Ni etc.).
3. **Particulate sampling**: Analytical methods used for air pollutants SPM, RSPM, fine particulate matter, dust fall jar, heavy metals analysis in SPM.

Unit III: Stack Sampling and Analysis

1. **Stack monitoring**: Significance, planning, sampling train, sampling point selection for circular and rectangular duct, isokinetic sampling.
2. **Stack sampling and analysis**: Sampling system, stack monitoring parameters: particulate sampling, determination of gas composition, moisture content, temperature and velocity. Methodology for measurement of SO_2, NO_2 NH_3, and particulate matter at the source. Trace metals- As, Pb, Ni, Hg. Cascade impactor. Continuous monitors.
3. **Air pollution and meteorology**: Lapse rate, pressure system, wind, moisture, terrain w.r.t dispersion. Atmospheric dispersion-Gaussian, numerical, statistical, empirical and physical. Plume behaviour. Source apportionment.

Unit IV: Air Pollution Control

1. **Particulate emission control:** Atmospheric cleansing process, approaches to contaminant control. Gravitational settling chambers, centrifugal collectors, fabric filters (bag house filters), electrostatic precipitators (ESP), wet collectors.
2. **Gaseous emissions control**: Adsorption, absorption, combustion, automobile emission control. Air pollution control costs- coal fired power plants and automobiles emission. Carbon sequestration through forestry. Green belt development around industries.
3. **Cleaner technologies**: Particulate control: fuel substitution, process modification. Gas control: fuel substitution, fuel cleaning, flue gas desulfurization (FGD), NO_X removal. Condensation and flaring.

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 (McGraw – 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. Standard Handbook of Environmental Engineering: Second Edition, Robert A Corbitt, McGraw Hill Handbook.
10. Environmental Engineering: H S Peavy, D R Rowe and G Tchobanoglous, McGraw Hill.
11. Introduction to Environmental Engineering and Science: Gilbert M Masters and W P Ela, PHI publication.
12. Environmental Engineering: G Kiely, Tata McGraw Hill.

Semester III
Paper IV
Solid and Hazardous Waste Management

Unit I: Solid Waste

1. **Characteristics of solid waste**: Solid waste, changes in municipal solid waste, qualities and characteristics. Types of solid waste, factors affecting solid waste generation rate, composition (physical, chemical and biological) and classification of solid wastes.
2. **Collection system:** Collection services, types of collection systems, ease and frequency of pick up, collection equipment, transfer stations, location of transfer station, rail haul, route selection.
3. **Separation and processing:** At sources separation and processing, central separation and processing. Mechanical size alteration, component separation, magnetic and electrochemical separation, dewatering and drying. Material recovery.

Unit II: Municipal Solid Waste Management

1. **Conversion of MSW**: Incineration, composting, mechanical and thermal volume reduction, manual component separation.
2. **Land filling**: Design criteria for sanitary landfills and operation, problems with land filling, leachetes generation control and treatment, gas production, GIS based site selection for land filling. Land farming and deep well injection.
3. **Solid waste management**: Sources reduction, reuse, recycling and recovery. Energy from solid waste, refuse derived fuel, anaerobic digestion and power production. Gasification and pyrolysis. Integrated waste management.

Unit III: Hazardous Waste

1. **Hazardous waste**: Types of hazardous waste, nuclear waste, biomedical waste, chemical waste. Identification of hazardous waste, collection, transportation and storage of hazardous waste.
2. **Toxicity of hazardous waste:** Corrosivity, ignetivity and reactivity. Basic division of toxicity, acute and chronic toxicity, factors influencing toxicity, dose response relationship, toxicity testing methods, acute toxicity test, chronic toxicity test, TCLP.
3. **Public health hazard**: Bioaccumulation and biomagnification, mutagenicity, teratogenicity, carcinogenicity, genotoxicity, toxicity due to pesticides, heavy metals, food adulterants and radioactive substances.

Unit IV: Hazardous Waste Management

1. **Management:** Components of hazardous waste management plan, hazardous waste minimization. Treatment and disposal of chemical wastes-treatment and disposal by industry, offsite hazardous waste treatment and disposal. Waste treatment: solid waste treatment, liquid waste treatment and gaseous waste treatment. Solidification and stabilization. Thermal destruction.
2. **Secured landfill:** Function, acceptable wastes, site selection and approval, design and construction. Treatment and disposal of leachates. Site remediation.
3. **Waste minimization**: Elements of a waste minimization strategy, benefits of waste minimization, elements of waste minimization program, waste reduction techniques.

Books for Reference:

1. Solid waste pollution: Dr. Aradhana Salpekar, Jnanada Prakashan, New Delhi, 2008
2. Principals of Soil Science: M. M. Rai, McMillon Publication.
3. Soil pollution & Soil organisms: P. C. Mishra
4. Environmental Chemistry: B. K. Sharma, Goyal Publishing House, Meerut, U.P. 1984
5. Environmental Science: S. C. Santra, New Central Book Agency, Kolkata, 2005
6. Environmental Pollution Control Engineering: C. S. Rao, New age International, Mumbai, 2003
7. Fundamentals of Soil Science: Henry D. Foth, John Wiley & Sons, New York, 1984
8. Environmental Engineering: Davis & Cornwell, McGraw – Hill Publications, New York, 1998
9. Environmental Science Principles and Practices: R. C. Das, D. K. Behra, Prentice Hall, New Delhi, 2008
10. Basic Environmental Technology: Jerry A. Nathanson, Prentice Hall of India Ltd. New Delhi, 2004
11. Environmental Biology and Toxicology: P. D. Sharma, Rastogi Publisher, Meerut, 2005
12. Environmental Engineering: H S Peavy, D R Rowe and G Tchobanoglous, McGraw Hill.
13. Introduction to Environmental Engineering and Science: Gilbert M Masters and W P Ela, PHI publication.
14. Environmental Engineering: G Kiely, Tata McGraw Hill.

Practical
Semester III

Practical I: Water Treatment and Supply

1. Analysis of water for purity: pH, D.O. and free chlorine, conductivity, TDS, total, calcium and magnesium hardness.
2. Determination of impurities in water: suspended, dissolved and total solids.
3. Examination of water for various physical tests (temperature, odour, colour, taste, viscosity, density, surface tension).
4. Examination of water for different chemical tests (pH, conductivity, acidity, alkalinity, chloride, sulphate, phosphate, nitrate, fluoride).
5. Examination of water for bacteriological tests (presumptive, confirmed, completed).
6. Calculation of rate of demand with the help of data.
7. Collection and interpretation of data about surface water sources.
8. Study of design aspects of intake towers.
9. Draw schematic layout of water treatment plant.
10. Measurement of dissolved oxygen of aeration tank.
11. Design mechanical aerators by given set of data.
12. Calculate suspended solids from surface, middle layer of sedimentation tank.
13. Determination of optimum coagulant dose of water samples by Jar Test Apparatus.
14. Study of design aspect of flocculator.
15. Study of efficiency of rapid sand and pressure filter by analysis of inlet and filter outlet water samples.
16. Study of design aspects of rapid and pressure filters.
17. Determination of chlorine dose of a water sample.
18. Visit to water treatment plant and study different unit operations.
19. Study of layout of water distribution system.

Practical II: Wastewater and Air Pollution

1. List out the sources of domestic and industrial waste in your region.
2. Determination of properties of soil:
   - Determination of physical properties of soil (bulk density, porosity and water holding capacity).
   - Determination of chemical properties of soil (pH, EC, organic carbon, nitrogen, phosphorous and potassium).
   - Determination of biological properties of soil (total viable count, fungi, Actinomycetes, Rhizobium, Azatobactor).
3. Determination of pollution potential of wastewater by using Tiddys test.
4. Determination of Langelier calcium carbonate saturation index.
5. Calculate quantity of sewage by dry weather flow method by given set of data.
6. Study design aspects of grit chamber and sedimentation tank.
7. Pilot plant study for removal of colloidal solids by coagulation.
8. Determination of Sludge Volume Index of the sludge.
9. Determination of Sludge Density Index of the sludge.

10. Estimation of fixed solids, organic matter of sludge drying bed's sludge cake.
11. Determination of efficiency of wastewater treatment plant w.r.t. TDS, hardness, pH, acidity, COD and BOD from inlet and outlet.
12. Analysis of pulp and paper mill effluents for BOD, COD, sulphide and nitrogen.
13. Determination of iron and manganese from iron and steel mill waste.
14. Demonstration on impact of iron and manganese waste on water quality.
15. Undertake a study on impact of cement plant dust on crops and their productivity.
16. Enlist criteria pollutants, non criteria pollutants for pollution study.
17. Demonstration on fugitive emissions from industry.
18. Comparative analysis of air sampling from clean and polluted area using key parameter.
19. Determination of settable particles by dust fall jar method.
20. Analysis of trace metals from SPM.
21. Demonstration on ESP for removal of dust particles.

Gondwana University, Gadchiroli
Model Question Paper (Theory)

M. Sc. Environmental Science

Time: Three Hours **Maximum Marks: 80**

Q. 1: Long Question from unit I 16 marks

OR

a) Short Question from unit I 08

b) Short Question from unit I 08

Q. 2: Long Question from unit II 16

OR

a) Short Question from unit II 08

b) Short Question from unit II 08

Q. 3: Long Question from unit III 16

OR

a) Short Question from unit III 08

b) Short Question from unit III 08

Q. 4: Long Question from unit IV 16

OR

a) Short Question from unit IV 08

b) Short Question from unit IV 08

Q. 5: Short Answer questions 4x4 = 16

1) From unit I
2) From unit II
3) From unit III
4) From unit IV

The End