

University of Pune
M.Sc. Environmental Science
Revised Course Structure 2007-08

Term	Courses /Credits	New Course Number	Title of Course	Theory /Thesis Optional /Practicals
I		101	Environmental Geosciences	Theory
		102	Environmental Chemistry	Theory
		103	Environmental Biology	Theory
		104	Statistical and Research Methods	Theory
		105	Practical Courses + Field Work	Practicals
II		201	Environmental Economics	Theory
		202	Water and Wastewater Engineering	Theory
		203	Environmental Pollution: Water and Soil	Theory
		204	Environmental Law, Ethics and Policy	Theory
		205	Practical Courses + Field Work	Practicals
III		301	Air pollution and Climate Change	Theory
		302	EIA and Environmental Auditing	Theory
		303	Remote Sensing and GIS	Theory
			Any one of the optional	
		311	Restoration Ecology	Theory-Option 1
		312	Biodiversity & Conservation	Theory-Option 1
		304	Practical Based on courses opted	Practicals
			Selection of topic for Dissertation should be assigned at the end of second semester and assessed at the end of fourth semester) and Summer Training placement	
IV		401	Forestry and Habitat Management (Syllabus is to be taken from UPSC)	Option-1
		401	Watershed Management	Option-1
		401	Environmental Management Systems (Theory & Job Licensing)	Option-1
		402	Environmental Toxicology, Health and Safety	Theory
		403	Environmental Planning	Theory
		404	Practical based on above	Practical
		405	Dissertation (Continue)	Thesis

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1. **The syllabus is for regular courses offered at various university centers**
2. **Each course of 48 lectures**
3. **Each theory course will have 6 practical wherever is possible**
4. **Practical course will be of 24 practical. In case of fourth practical course will contain 18 practical.**

M.Sc. Part – 1: Semester-I

ENV-101 – Environmental Geosciences:

1. **Atmosphere:** Earth's Atmosphere: Evolution, structure and chemical composition of atmosphere. 5
2. Solar radiation and terrestrial radiation electromagnetic spectrum latitudinal and seasonal variations, effect of atmosphere, green house effect heat budget. 5
3. Temperature measurements and controls, Environmental lapse rate, dry and wet adiabatic lapse rate, inversion of temperature and atmospheric stability. 5
4. Atmospheric pressure and winds: Pressure measurements and distribution; Wind observation, measurement, factors affecting wind; geostrophic wind and gradient wind, local winds, model of general circulation of the atmosphere, Jet stream. 4
5. Atmospheric moisture: Forms of condensation; Precipitation, Hydrological cycle. 3
6. Atmospheric disturbances: Thunderstorms, Cyclones, lightning, flood, and drought. 3
7. **Earth science:** Internal structure of Earth, Geological evolution, Rocks and their classification, minerals and their classification. Weathering and soil formation, soil profile, soil classification, soils of India. 7
8. Water Resources and Environment: Global Water Balance. Ice sheets and fluctuations of sea levels. Origin and composition of seawater. Hydrological cycle. Factors influencing the surface water. Types of water. Resources. Human use of surface ground waters. 6
9. Environmental Geochemistry: Concepts of major, trace and REE. Classification of trace elements, mobility of trace elements, Geochemical cycles. Biochemical factors in environmental health. Human use, trace elements and health. Possible effects of imbalance of some trace elements. Diseases induced by human use of land. 6
10. Geological Hazards and its mitigation measures: Earthquake and Tsunamis, Volcanoes, Landslides 4

References:

1. Valdiya, K.S. 1987, Environmental Geology.
2. Keller, E.A. Environmental Geology & Turk and Turk.

ENV – 102: Environmental Chemistry:

1. Concept and Scope of Environmental Chemistry: Definition and explanation for various terms, segments of environment. Principles and cyclic pathways in the environments
2. Chemistry of Biologically Important Molecules: Chemistry of Water: Unusual physical properties, hydrogen bonding in biological systems, unusual solvent properties, changes in water properties by addition of solute. Protein structure and biological functions, enzymes, enzyme metabolism, biosynthesis of DNA and RNA, mutations and Gene control during embryogenesis.
3. Chemistry of Various Organic and Inorganic Compounds. Carcinogenic compounds and their effects.
4. Hydrocarbons: Chemistry of hydrocarbon decay, environmental effects, effects on macro and microorganisms.
5. Surfactants: Cationic, anionic and nonionic detergents, modified detergents.
6. Pesticides: Classification, degradation, analysis, pollution due to pesticides and DDT problems.
7. Synthetic Polymers: Microbial decomposition, polymer decay, ecological and consideration, Photosensitize additives.
8. Lead and its compounds: Physical and chemical properties, behavior, human exposure, absorption, influence.
9. Aflatoxin occurrence, chemical composition and properties metabolism, acute toxicity, carcinogenicity.
10. Destruction of some hazardous substances: Acid halides and anhydrides, alkali metals, cyanides and cyanogens bromides, chromium, aflotoxins, halogenated compounds.
11. Principle, merits and demerits of the techniques – Neutron Activation Analysis, isotope dilution analysis, calorimetric, colourimetry, Atomic Absorption Spectroscopy, Gas chromatography, HPLC, Ion exchange Chromatography and Polarography. XRF, XRD etc.
12. Stoichiometry, Gibb's energy, Chemical potential, chemical equilibria, acid base reactions, solubility product, solubility of gases in water, the carbonate system, radionuclides.

References :

1. Environmental Chemistry : B.K. Sharma, and H. Kaur.
2. Elements of Environmental Chemistry : H.V. Jadhav.
3. Environmental Chemistry : S. K. Banerjee.
4. Environmental Chemistry : J. W. Moore and E. A. Moore.
5. Destruction of hazards chemicals in the laboratory : G. Lunn and E.B. Sansone.
6. A text book of Environmental Chemistry and Pollution Control : S.S. Dara.
7. Instrumental Methods of Analysis : G. W. Ewing.
8. Instrumental Methods of Analysis : Chatwal and Anand.
9. Essential of Nuclear Chemistry: H. J. Arnikar

10. Principles of Biochemistry : Lehninger.
11. General Biochemistry : J. H. Well.
12. Environmental Pollution Analysis : Khopkar.
13. Environment Chemistry : A. K. de
14. Environmental Chemistry : M. Satake, ., Do, S. Sethi, S.A. Eqbal.
15. Environmental and Man : The Chemical Environmental : J. Lenihan and W.W. Fletcher.

ENV – 103: Environmental Biology:

1. Fundamentals of Ecology, Definition, Subdivisions. Ecosystems: concept of ecosystems, energy flow in ecosystems, Nutritional Flux. Development and evolution of the ecosystems. Biogeochemical cycles, Food-chains, ecotone, edge effects, ecological niche, and ecosystem stability.
2. Environmental Microbiology: Microbes – classification and their applications in the environmental sciences. Cultivation and growth of microorganisms. Microorganisms and their association with man, animals and plants. Microbes as anti-microbial agents, Extremophilic microorganisms, Microbial metabolism
3. Biomes and Habitat Diversity: Classification of biomes, major biotic elements of each biome and their characteristics.
4. Biological diversity of India: Definition and nature, India's biogeographically history, physiography, climate and its impact on biodiversity. Indian forest and vegetation types and diversity of flora and fauna.
5. Population and Community Ecology.
6. Wetlands Forests and Semi-arid Habitats of India: Definition and types of wetlands, important wetlands of India and their conservation issues. Forests and semi-arid habitats of India: their distribution in India, ecological status of forests and arid lands, and their conservation.
7. Endangered, Endemic and Extinct Species of India: Threatened species categories of IUCN, threatened species of plants and animals in India and their reasons, Red data books.
8. Environmental biotechnology. Role of biotechnology in conservation of species, *in-situ* and *ex-situ* conservation.
9. Wildlife management and conservation. Protected Areas Network in India: Goals of management, Strategies for planning. Factors influencing wildlife management such as habitats, population, behavior, food-habits, health, etc., tools for data collection and analysis. Human land-use and wildlife management units, important projects for the conservation of wildlife in India, Role of local communities in wildlife management.
10. Marine Biology: biology of coastal and open sea environment, their distribution, adaptation and productivity.
11. Biodiversity conservation: Global agreements and national concerns. RAMSAR sites, CBD, Quarantine Regulations, National Forest Policy, Biodiversity Act., Wild-life Protection Act

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References :

1. Microbes, Man and Animals : The Natural History of Microbial Interactions : Linton, A. H. and Burns, R.G. (1982) John Wiley and Sons.
2. Elements of Microbiology : Pelczar, M.J. and Chan ECS, 1981 McGraw Hill.
3. General Microbiology : Stainer, R.Y., Adelberg, E.A. and Ingraham, J.L. 1977. Macmillan Press.
4. Microbial Methods for Environmental Biotechnology : Grainer, J.M. and Lynch, J.M. 1984. Academic Press.
5. Microbiological Methods for Environmental Scientists and Engineers : Gaudy, A.F. and Gaudy, E.T. 1980, McGraw Hill.

ENV-104: Statistical and Research Methods: Theory and practicals

1. Sampling, Data collection and recording.
2. Central tendency – concept; arithmetic mean, mode, median for ungrouped and grouped data.
3. Measures of dispersion: absolute and relative measures; range, standard deviation (grouped and ungrouped data), variance, quartile deviation, coefficient of variability. Skewness, Kurtosis
4. Probability - normal, poisson and binomial
5. Statistical Methods: Hypothesis testing, significance and correlation. Correlation. Linear models and regressions. Pearson and other correlation coefficients. Multiple regressions.
6. Distribution- Normal, t and chi square test
7. Difference among means: F-test: 1 way ANOVA; F-test: 2 ways ANOVA. Computer applications in environmental modeling. Computer-based modeling: Linear, regression, validation and forecasting. Computer-based modeling for population and population studies.
8. Matrices, simultaneous linear equations; tests of hypothesis and significance.
9. Time series analysis - moving averages (3 and 5 unit cycles)
10. Current development in the subject

References :

1. Zar, Jerrold H. (1998). Biostatistical Analysis. Prentice Hall, N.J.
2. Sokal, Robert and James Rohlf (1997). Biometry, Freeman Press, N.Y.
3. Walpole, R. and R. Myers (1993). Statistics for Engineers and Scientists, 5th edn. MacMillan, N.Y.
4. Wayne, R. Ott (1995). Environmental Statistics and Data Analysis, CRC Press.
5. Manly (2001) Statistics for environmental science and management, Chapman and Hall / CRC.
6. Ramsay and Schafer (1997). The Statistical Sleuth, Duxbury Press.

**ENV - 105 – Practical based on ENV-101 – 104 of Semester I
practicals**

1. A visit to aquatic ecosystem and methods for water and plankton collection
2. Plankton identification and quantification from river / lake water samples. 2
3. Vegetation studies by line, quadrates and belt transect methods and their analysis
4. Preparation of media for microbial culture, Isolation and culturing of microbes from soil / water samples.
5. Estimation of halides in water samples by potentiometry
6. Estimation of Co^{2+} and Ni^{2+} by colorimetry/ spectrophotometry
7. Estimation of sulphates by turbidometry
8. Estimation of alkali metals in various samples by flame-photometry
9. Water analysis for physico-chemical characteristics
10. Determination of half-life period of a given radionuclide
11. Classification and identification of minerals and Rocks specimens (Museum specimens)
12. Preparation of a climatic maps and diagrams: hyper map, climographs and water balance diagrams.
13. Study of Topological sheets and use of stereoscope
14. Classification of climate

References:

1. Fundamentals of Ecology: E. P. Odum
2. Modern concepts in Ecology: H. D. Kumar
3. Inorganic Chemistry of Earth: Fergusson J. E.
4. Introduction to Geochemistry: Krauskoph K. B.
5. Environmental Chemistry: Raiswell
6. Environmental Chemistry: S. e. Manahan
7. The Chemistry of Our Environment: R. A. Home
8. Methods in Biotechnology: Hans Peter Schmauder
9. The Chemistry and Microbiology of pollution: I. J. Higgins and R. Burns
10. Global environmental Biotechnology: D. L. Wise
11. The Atmosphere: An Introduction to Meteorology : Frederic K. Lutgen, E.J.Tarbuck
12. Introduction to Weather and Climate: Trewartha
13. Introduction to Climatology for Tropics: Ayoade J. O.
14. General Climatology : Critchfield H. J.
15. Climatology : Fundamentals and Applications : Mater J. R.
16. Climatology, Selected applications : Oiver J. E.
17. Fundamentals of Soil Sciences : Henry D. Forth
18. A. Text-Book of Soil Sciences : T. D. Biswas and S. K. Mukherjee
19. Environmental Science : E. D. Enger and B. F. Smith
20. Groundwater Hydrology : D. K. Tosdd
21. Elementary Seismology : Charles F. Richter
22. Eqrthquakes : Bruce A. Bolt
23. Engineering and General Geology : Parbin Singh.

SEMESTER – II

ENV-201: Environmental Economics

The Economy and the Environment: Two Parts of a Whole – Interlinkages between the economy and the environment.

Micro Foundations of Environmental Economics - Theory of Public goods, Externalities and Market failure – The Problem of Social Cost - Design of Environmental Policy.

Economic Instruments for Environmental Protection: Command & Control versus Incentives and Subsidies - Available Policy Options - Effectiveness of these instruments, International Comparisons.

Economics of Natural Resource Exploitation – Renewable and Non-Renewable Resources – Methods of valuation of Environmental Costs and Benefits.

Economic Growth and the Environment: Environmental Kuznets' curve, Foreign Direct Investment Inflow and the Environmental quality

Sustainable Development: Concept of and issues in Sustainable Development, Strategic Planning for Sustainable Development, Economic reforms and sustainable development.

Climate Change and India: Vulnerability of regions and populations – Adaptation options.

Texts/References:

Hanley, Nick, Jason F. Shogren & Ben White: *Environmental Economics in Theory and Practice*, New Delhi: Macmillan –India, 1997.

James, D.E., *Economic Approaches to Environmental Problems: Techniques and Results of Empirical Analysis*, Elsevier Scientific Publishing Co., 1978.

Nash, R.F., *The Rights of Nature: A History of Environmental Ethics*, University of Wisconsin, 1989.

Whytte, Anne, V. and Ian Burton (eds), *Environmental Risk Assessment*, John Wiley & Sons, 1980.

Arrow, K.J. and Scitovsky, T., *Readings in Welfare Economics* Part III, 1969.

Coase, R.H., The Problem of Social Cost in *Readings in Micro Economics* by Breit and Hochman, 1951

Allen V. Kneese and James L. Sweeney, eds. *Handbook of Natural Resource and Energy Economics*, Chapters 2,12,14,17, North Holland,1985.

Cropper, M.L. and W.E. Oates, 'The Environment Economics: A Survey', *Journal of Economic Literature*, 1992.

Fisher, A.C., Environment and Resource Economics, Selected readings, *New Horizon in Environmental Economics*, Ed. W.E. Oates, 1995.

Oates, W.E., *Economics of the Environment*, 1992.

Field, B.C., *Environmental Economics: An Introduction*, McGraw Hill, 1994

Baumol, W.J. and W.E. Oates, '*The Theory of Environmental Policy*', Cambridge University Press, 1988.

Bohm, P. and Russell, C., 'Comparative Analysis of Alternative Policy Instruments', Chap. 10 in *Handbook of Natural Resource and Energy Economics*, Vol.I Ed. A.V. Kneese and J.L. Sweeney, 1985.

Mehta, S., S. Mundle and U. Sankar, '*Incentives and Regulation for Pollution Control*', Sage, 1997.

Sankar, U. (ed.) Environmental Economics, New Delhi: Oxford University Press, 2001.

ENV-202: Water and Wastewater Engineering:

1. Water engineering:

Water Requirements for Domestic Consumption. Population forecasting by the following methods. Demographic method, Arithmetical progression method, Geometrical progression method, Logistic methods, Graphical projection method, Final prediction.

Quality of water required for followings.(a) Domestic, (b) Institutional (Schools, Hostels, Hospitals), (c) Fire fighting, (d) Commercial (Shopping complex, Hotels, Restaurant),(e) Industrial (Dairy, Sugar, Pulp and Paper, etc.) (f) Specific requirement at pilgrimage place and recreation activities.

2. Impact of future growth and development and change in quality of life on water requirement.

3. Types of solid in water and their impact on water quality.

4. Need of water quality standards for domestic & industrial purpose.

5. Specifications for drinking water (physical, chemical & bacteriological) by Bureau of Indian Standards & World Health Organization. Packaged drinking water.

6. Water Sources – Availability & quality of Surface water (River, stream lake, dam) & Ground water (Open well & Bore well)

7. Water Treatment – Principal, Application & Designing of following Unit Operation in water treatment. a. Collection & pumping, b. Aeration, c. flocculation, d. Sedimentation, e. Filtration, f. Disinfections (Chlorination, UV, Ozonization), g. water softening Advance treatment methods e.g. a. Demineralization, b. Ultra filtration, c. Reverse osmosis, d. Color & odor removal by activated carbon, e. Iron removal.

8. Inter-relations between water source, quality of raw water, solids in water & treatment process.

9. Selection of appropriate unit operations for the treatment and flow chart of water treatment plant.

10. Wastewater engineering for Preliminary & Primary Treatment:

Quantity & Quality of sewage generated, Impact of Future growth & development & change in quality of life on sewage quality & quantity.

11. Specification of treated wastewater for disposal into surface water, on land & for treatment. a. Collection & pumping, b. Screen chamber, c. Grit chamber, d. Oil & grease removal, e. Dissolve air floatation.

12. Wastewater engineering for Biological Treatment : Principal, role of microorganisms, ecosystem & designing of following biological Unit Operation in waste water treatment. a. Stabilization pond, b. Aerated lagoon, c. Activated sludge process, d. Trickling filter, e. Anaerobic treatment.

13. Industrial Wastewater: Selection of appropriate unit operations for the treatment and flow chart of wastewater treatment plant for a. Dairy, b. Pulp & Paper, c. Galvanizing.

14. Biotechnology & Waste Management: Application of biotechnology for the Treatment of followings:a. High strength waste e.g. whey & spent wash, b. Primary & secondary sludge, c. Phenol & cyanide removal.

15. Different model of anaerobic digestion by combination of attached & suspended growth.

References :

1. Manual on water supply & sewerage.

2. Manual on sewerage & sewage treatment, Ministry of works & housing, New Delhi.
3. Waste water engineering, Met Calf & Eddy ;INC, Tata mc Graw Hill.
4. Physico-chemical; Process of water quality control, W. J. Webber, Wiley inter-science.
5. Waste water treatment for pollution control, Dr. Arceivala, Tata Mc Graw Hill.
6. Indian standard for drinking water, BSI, New Delhi.
7. Disposal of municipal waste, House report no. 2012, Report by sub committee on Govt. Operation, House of representative, March, 24 1965, UK.
8. Water supply & sanitary engineering, Birdie G. S., Dhanpat Rai & Sons, New Delhi.
9. House waste management in Europe, A Bridgestone H Lidgren, Van Nostard Reinfold Co. London.
10. Principal of water quality control, T H Y Tebbut, Pergamon press.
11. Waste water treatment plant design, 1977, A manual of practice, Water pollution control federation

ENV-203: Environmental Pollution-I: Water and Soil

Freshwater Pollution: Types and sources. Sampling Methods. a. Water Quality Parameters, b. Types and sources of water pollution, Various pollutants responsible for water pollution: Biological pollutants; Inorganic; Organic; Heavy metals; Pesticides; Radioactive pollutants, etc. c. Various sources Effluent standards, Drinking water standards, Characteristics of Domestic Waste, Characteristics of agricultural Waste, e. Consequences of water Pollution: Effect on health on biosphere and on economy, f. Sampling methods: Purpose of sampling, different types of samples, collection methods and various instruments used for it. g. Methods involved in estimation of parameter for pollution levels.

2. Marine Water Pollution: Types, sources and consequences. Specifications for disposal of sewage and industrial waste into sea. Disposal of sewage & wash water from MV cargo & ships

3. Soil Pollution: Types, sources and consequences. Sampling Methods. Specifications for disposal of sewage & effluent on land for irrigation & ground water recharge. Methodology of wastewater disposal on land in India. Impact of usage of land for solid waste disposal both municipal solid waste & industrial solid wastes (fly ash from thermal power station, lime sludge from pulp & paper mills). Disposal of hazardous solid waste (heavy metals, toxic organic compounds) on land & its impact on soil pollution. Deterioration of soil due to mining activities Case study of restoration of land due to a. disposal to fly ash, b. dumping overburden & tailing in iron ore extraction.

4. Solid-waste Pollution: Types, sources and consequences. Classification of wastes – (Domestic, Industrial, Municipal, Hospital, Nuclear, Agriculture), Transfer and transport, Recycle, Reuse, Recovery, Conversion of solid wastes energy / Manure, Disposal methods – Generation, Sea disposal, Land disposal, Waste disposal on farm crops for irrigation purpose.

5. Radioactive Pollution: Types, sources and consequences. Sampling methods. Models of radioactive decay, Detection of nuclear radiation's: G. M. Counter, Scintillation counter, semiconductor detector; Interaction of radiation's with matter: Biological effects of ionizing radiation's: ICRP recommendations;

References:

1. Source book on atomic energy - S. Glasstone, D. Van Nastrand & Germany.
2. Environmental radioactivity – M. Eisendbud, Academic press.
3. Essentials of nuclear chemistry – II, T. Arnikar, Wiley easter.
4. Nuclear chemistry through problems – II, T. Arnikar & N. S. Rajurkar, New age Int. (P) Ltd.
5. Environmental Science – A study of Inter relationships, E. D. Enger, B. E. Smith, 5th ed., W C B publication.

ENV-204: Environmental Law, Ethic and Policy

1. International Environmental Laws: Evolution and development of International Environmental laws with reference to Stockholm Conference, Nairobi Declaration, Rio Conference, Rio+5 and the Rio+10, etc.
Global environmental issues and International laws: to control Global warming, Ozone depletion, Acid rains, hazardous waste, CITES etc. Role of UN authorities in protection of Global Environment, Multinational authorities and agreements, future of International laws.
2. Environmental laws in India: Environmental Policy and laws. Constitutional and statutory laws in India: Doctrine Principles of State Policy, Fundamental Duties and Fundamental Rights and Panchayat Raj System.
Statutory protection of the Human Environment: such as Indian Penal Code, Factories Act, Motor Vehicle Act, Hazardous Waste legislation for pollution abatement.
Anti Pollution Acts: The water Act. 1974. The Air Act 1981. The Environment Protection Act 1986
Objectives of the Anti-pollution Acts. Institutional mechanism created under these acts and role and contribution in combating environmental pollution. The role of courts
3. Equity Environment versus Development: Importance of critical review of plan with respect to local, regional & immediate & long term gains & Effect of Development.
Comparison between a. Exploitation and safe guard for conservation, b. Rate of utilization and regeneration, c. Natural and manmade growth, d. Survival need of mankind and protection of environment
Integration of development with carrying capacity of Environment,
Case study of current issue
Requirements of Rule 14 for Environmental Audit under Environmental protection Act 1986
Rule & regulations & guidelines given for disposal of hazardous waste, municipal solid waste & bio-medical waste
5. National Environmental Policy: National Policy on EIA and Regulatory Framework: Rule & regulations of central & state Government and Central & State pollution control boards for Safeguard for Environmental Protection
6. Sustainable Development: Definition and concepts of sustainable development, Integration of: a. Economic, Social and Environmental sustainability, b. Biodiversity and c. Availability of natural resources in development.
Critical review of drawbacks in traditional (base on economics) evaluation of development, Cost benefit analysis. Introduction of Ecological growth factor similar to economical growth factor for sustainable development.

References :

1. Declaration of: The Stockholm Conference, Rio, Rio+5 and Rio+10.
2. Anti – Pollution Acts (3) and Commentaries published thereon.

3. Constitution of India [Referred articles from Part-III, Part-IV and Part-IV-A].
4. Pares Distn. Environmental Laws in India (Deep. Deep, Lated edn.)
5. P. Leelakrishnan, Environmental and the last (Bullorthworths, Latold, edn.).
6. Basic environmental technology: Jerry; A. Nathanson.
7. Handbook of environmental management and technology: Gwendolyn Holmes, Ben Ramnarine Singh, and Louis Theodore.
8. The ISO 14000 Handbook: Joseph Cascio.
9. ISO 14004 – Environmental management systems: General guidelines on principles, systems and supporting techniques (ISO 14004: 1996 (E)).
10. ISO 14001: Environmental management systems: Specification with guidance for use (ISO 14001: 1996b (E)). (International organization for standardization – Switzerland).

[Note: Declarations, comments, cases and research articles published from time to time will be recommended by the concerned teachers].

ENV-205: Practicals based on ENV – 201 to 204 of Semester II

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| 1. Comparative analysis of air sampling from clean and polluted area using key parameters. | 6 |
| 2. Collection and Interpretation of weather data. | 6 |
| 3. Field visit to river/lake and water and wastewater treatment plants. One day tour | |
| 4. CDM case studies | 4 |
| 5. Measurement of sounds by DB meter in silent, industrial, residential and commercial zones. | 3 |
| 6. Radio active beta-decay. | 1 |
| 7. Energy of beta particles | 1 |
| 8. Neutron activation. | 1 |
| 9. Physico chemical analysis soil. | 6 |
| 10. Physico chemical analysis water. | 6 |

References :

1. Wasteland Development – Khan, *et al.*,
2. Forestry – Segreiya : Champion and Seth.
- . Wasteland News : Periodical.