



GUJARAT UNIVERSITY
ENVIRONMENTAL SCIENCE SYLLABUS
M. Sc.

Effective from July 2017

Web site address <http://www.gujaratuniversity.ac.in/web/>

1. There will be Four Papers (Three Hour Duration) and Two Practicals (Six hour Duration) of One Hundred (70 External + 30 Internal) Marks each at Semester Examination.
2. The Field Excursion is highly essential for studying environment in its natural state. There shall be at least one excursion in and outside or within Gujarat State for each year. Tour report submission will be given due weightage.
3. The Candidate shall be required to submit at the time of practical examination at the end of each semester.
 - The laboratory Journal and diary of field work (Tour report) duly signed by the teachers concerned from time to time.

Distribution of Marks

| Semester | Theory | | | Practical | | | Grand |
|----------|--------------|--------------|-------|--------------|--------------|-------|-------------|
| | Internal | External | Total | Internal | External | Total | Total |
| I | 30 X 4 = 120 | 70 X 4 = 280 | 400 | 30 X 2 = 60 | 70 X 2 = 140 | 200 | 600 |
| II | 30 X 4 = 120 | 70 X 4 = 280 | 400 | 30 X 2 = 60 | 70 X 2 = 140 | 200 | 600 |
| III | 30 X 4 = 120 | 70 X 4 = 280 | 400 | 30 X 2 = 60 | 70 X 2 = 140 | 200 | 600 |
| IV | --- | --- | --- | 60 X 3 = 180 | 420 | 600 | 600 |
| | | | | | | | 2400 |

Seminar:

- Topics will be allotted in the beginning of the each semester.
- On due date student has to present the seminar on allotted topic and also have to submit compiled literature.
- Presentation would be evaluated.

Assignment / Submission:

- Student must Prepare / Collect specific literature / Material pertaining to the topics in Environmental Science.
- Student may take up survey work in guidance of the department.
- Assignment / submission would be evaluated.

Project:

- Based on the papers and topics studied, student must select a line of research; prepare a project proposal (comprising introduction, literature survey, problem, target, methodology, probable outcome and reference) and submit the dissertation.
- Project report would be evaluated.

Question Paper Pattern (for External Examination)

Theory:

| Question | Unit | | | Marks |
|----------|-------------------|----|-----|-------|
| Q - 1 | From Unit- I | | | |
| | (a) | OR | (a) | 07 |
| | (b) | OR | (b) | 07 |
| Q - 2 | From Unit- II | | | |
| | (a) | OR | (a) | 07 |
| | (b) | OR | (b) | 07 |
| Q - 3 | From Unit- III | | | |
| | (a) | OR | (a) | 07 |
| | (b) | OR | (b) | 07 |
| Q - 4 | From Unit- IV | | | |
| | (a) | OR | (a) | 07 |
| | (b) | OR | (b) | 07 |
| Q – 5* | From Unit I to IV | | | 14 |

*Objective type questions like Multiple choice / match A & B / fill in the blank / True or false / give one word / expand abbreviations etc.

Practical:

| | |
|--------------------------------|-----------|
| Q – 1. Major experiment | 20 Marks. |
| Q – 2. Minor experiment | 14 Marks. |
| Q – 3. General experiment | 10 Marks. |
| Q – 4. Comment | 16 Marks. |
| Q – 5. Viva – voce and journal | 10 Marks. |

(Pattern may change slightly depending upon the practical topics.)

Environmental Science

| Department Name: Environmental Science, School of Sciences | | | Semester - I | | | | |
|--|----------|---|-----------------------|--------|-----------|-------|--------|
| Course | | Name of Course | No. of Hours per Week | | | | Credit |
| No. | Type | | Lectures | Others | Practical | Total | |
| ENV 401 | CORE | Natural and Biological Environment | 3 | 1 | - | 4 | 4 |
| ENV 402 | CORE | Environmental Issues and Impacts | 3 | 1 | - | 4 | 4 |
| ENV 403 | CORE | Energy and Environment | 3 | 1 | - | 4 | 4 |
| ENV 404 | CORE | Environment and Soil | 3 | 1 | - | 4 | 4 |
| ENV 405 PR | CORE | Practical – 1 Ecological Experiment | - | 1 | 3 | 4 | 4 |
| ENV 406 PR | CORE | Practical – 2 Soil Analysis | - | 1 | 3 | 4 | 4 |
| TOTAL | | | 12 | 06 | 06 | 24 | 24 |
| | | | Semester - II | | | | |
| Course | | Name of Course | No. of Hours per Week | | | | Credit |
| No. | Type | | Lectures | Others | Practical | Total | |
| ENV 407 | CORE | Water Quality and Wastewater Treatment Techniques | 3 | 1 | - | 4 | 4 |
| ENV 408 | CORE | Integrated Solid Waste Management | 3 | 1 | - | 4 | 4 |
| ENV 409 | CORE | Aquatic and Marine Environmental Chemistry | 3 | 1 | - | 4 | 4 |
| ENV 410 | CORE | Air Pollution:Quality and Control Methods | 3 | 1 | - | 4 | 4 |
| ENV 411 PR | CORE | Practical – 3 Water Analysis | - | 1 | 3 | 4 | 4 |
| ENV 412 PR | CORE | Practical – 4 Instrumentation | - | 1 | 3 | 4 | 4 |
| TOTAL | | | 12 | 06 | 06 | 24 | 24 |
| | | | Semester - III | | | | |
| Course | | Name of Course | No. of Hours per Week | | | | Credit |
| No. | Type | | Lectures | Others | Practical | Total | |
| ENV 501 | CORE | Environmental Biotechnology | 3 | 1 | - | 4 | 4 |
| ENV 502 | CORE | Environmental Toxicology and its Impact | 3 | 1 | - | 4 | 4 |
| ENV 503 | CORE | Environmental Rules and Regulations | 3 | 1 | - | 4 | 4 |
| ENV 504 | CORE | Environmental Impact Assessment | 3 | 1 | - | 4 | 4 |
| ENV 505 | CORE | Review Writing | - | 1 | 3 | 4 | 4 |
| ENV 506 S | CORE | Seminars | - | 1 | 3 | 4 | 4 |
| TOTAL | | | 12 | 06 | 06 | 24 | 24 |
| | | | Semester - IV | | | | |
| Course | | Name of Course | No. of Hours per Week | | | | Credit |
| No. | Type | | Lectures | Others | Practical | Total | |
| ENV 507 | CORE | PROJECT | 1 | 1 | 16 | 18 | 18 |
| | | Dissertation / Project Work | 1 | 2 | - | 3 | 3 |
| ENV 508 | ELECTIVE | Assignment / Group Discussion | 1 | 2 | - | 3 | 3 |
| TOTAL | | | 03 | 05 | 16 | 24 | 24 |

ENVIRONMENTAL SCIENCE SYLLABUS

M.Sc. SEMESTER – I July – December 2017

| Course | Title of the Paper | Course Credit |
|---------------|---|----------------------|
| ENV 401 | NATURAL AND BIOLOGICAL ENVIRONMENT | 4 |
| ENV 402 | ENVIRONMENTAL ISSUES AND IMPACTS | 4 |
| ENV 403 | ENERGY AND ENVIRONMENT | 4 |
| ENV 404 | ENVIRONMENT AND SOIL | 4 |
| ENV 405 PR | ECOLOGICAL EXPERIMENTS | 4 |
| ENV 406 PR | SOIL ANALYSIS | 4 |

M.Sc. SEMESTER – I

ENV 401 NATURAL AND BIOLOGICAL ENVIRONMENT

UNIT-1 Biological Communities and Ecosystem

Introduction, Interactions between species, Natural selection, Species richness, Ecological succession, Food chains and food webs, Primary production, Energy flow in ecosystems, Secondary productivity, Decomposition, Ecosystem stability.

UNIT-2 Terrestrial Biomes and Forest Resources

Introduction, Tundra and Taiga, Temperate deciduous forest, Mediterranean vegetation, Temperate and tropical grasslands, Desert and tropical rainforest, Forest Resources-Uses, Forest Type and Management, World Forest Cover, Forest Resources of India, Deforestation, Effect of Deforestation on Tribal People, Effect of Dams on Forest, Forest Degradation in India, Sustainable Forest Management.

UNIT-3 Mineral and Food Resources

Introduction, Exhaustibility, Localized Occurrence, Uses and Exploration of Mineral Resources, Environmental Effects of Mineral Exploration and Usage, World Food Problems and Production, Pesticides in Modern Agriculture and Environmental Problems, Environmental Limits for Increasing Food Production, Solutions : Sustainable Agriculture, Impact of Irrigation on Environmental Quality.

UNIT-4 Conservation of Natural Resources and Environmental Management

Conservation of Natural Resources, Role of Individuals in Sustainable Environmental Management, Value System and Equitable Resources Use for Sustainable Life System, Role of Individuals in Conservation and Prevention of Pollution

M.Sc. SEMESTER – I

ENV 401 NATURAL AND BIOLOGICAL ENVIRONMENTAL

REFERENCES

- 1) Y. Anjaneyulu, "*Introduction to Environmental Science*", BS Publications, Hyderabad, India, 2004.
- 2) H. Kaur, "*Environmental Studies*", Pragati Prakashan, 2006.
- 3) Andrew R.W., Jackson & Julie M. Jackson, "*Environmental Science – The Natural Environment and Human Impact*", Addison Wesley Longman Limited, 1996.
- 4) S.C. Santra, "*Environmental Science*", 2nd Edition, New Central Book Agency (P) Ltd, Kolkata, India, 2005.
- 5) Richard T. Wright, "*Environmental Chemistry*", Pearson Education Inc., South Asia, 2007.
- 6) Sharma B.K., "*Environmental Chemistry*", Goel Publ. House, Meerut, 2001.
- 7) Wanger K.D., "*Environmental Management*", W.B. Saunders Co. Philadelphia, USA, 1998.
- 8) Krebs J.R., Davies N.B., "*Behavioral Ecology : An Evolutionary Approach*", 3rd Edition, Oxford : Blackwell Scientific, 1991.
- 9) Ricklifs R.E., "*Ecology*", 3rd Edition, W.H. Ereeman, New York, 1990.
- 10) O' Neill P., "*Environmental Chemistry*", 2nd Edition, Chapman & Hall, London, 1993.
- 11) Bunce N. J., "*Environmental Chemistry*", Wuerz, Winnipeg, 1990.

M.Sc. SEMESTER – I

ENV 402

ENVIRONMENTAL ISSUES AND IMPACTS

UNIT-1 The Atmosphere and Acid Rain

Composition of the atmosphere, Residence times, sources and sinks, Evolution of the primitive atmosphere, Temperature profile of the atmosphere, Atmospheres around the other planets, Nature and Development of Acid Rain, Acid Rain and its impacts on geological Environment, Terrestrial Environment, and Build Environment, Impact of Acid Rain on Human Health and Mitigation of its problems.

UNIT-2 Stratospheric Ozone and Tropospheric Chemistry

The ozone layer, Formation and destruction of ozone, Chlorofluorocarbons, The Montreal Protocol, CFC replacement compounds, Nitrogen oxides as ozone depleters, The hydroxyl radical as an oxidant, Oxidation of carbon monoxide by OH, Oxidation of methane, Photochemical smog, Tropospheric concentration of OH, Particles in the atmosphere, London smog, Particles and climate, Control of particles.

UNIT-3 Global Warming and Climate Change

Introduction, Greenhouse Gases and Global Climate Changes, Global Warming Potential, Possible Impact of Global Warming, Greenhouse Effect – Policy Response, Kyoto Protocol, El Niño-Climate Cycle, Ozone in the Atmosphere, Ozone Hole, Worldwide Ozone Trends, Consequence of Ozone Depletion, Consequences of global CO₂ changes, Strategies for Conservation of Environmental Changes Induced by CO₂ Rise.

UNIT-4 Radiation Hazardous and Environmental Degradation

Introduction, Radiation: Atomic and Natural Background, Measurement of Radio Activity, Nuclear Winter, Radioactive Waste, Ionizing Radiation, Anthropogenic Sources and Effects of Radioactive Pollution, Preventive Measurements.

M.Sc. SEMESTER – I

ENV 402

ENVIRONMENTAL ISSUES AND IMPACTS

REFERENCES

- 1) Nigel J. Bunce, "*Environmental Chemistry*", Wuerz Publishing Ltd, Winnipeg, Canada, 1991.
- 2) S.C. Santra, "*Environmental Science*", 2nd Edition, New Central Book Agency (P) Ltd, Kolkata, India, 2005.
- 3) H. Kaur, "*Environmental Studies*", Pragati Prakashan, 2006.
- 4) Joner J.AA., "*Global Hydrology : Processes, Resources and Environment*", Longman, Essenx, England, 1997.
- 5) Wilson E.O., "*Biodiversity*", National Academy Press, Washinton, DC, 1988.
- 6) Tudge, Colin, "*Global Ecology*", Oup, New York, 1991.
- 7) Mauahan S.E., "*Environmental Chemistry*", Willaw Grant Press, Beston, USA, 1983.
- 8) Moeller, Dave W., "*Environmental Health*", Mass : Harvard University Press, Cambridge, 1992.
- 9) R.P. Wayne, "*Chemistry of Atmospheres*", Oxford University Press, Oxford, England, 1985.
- 10) Eds. J.D. Coyle, R.R. Hill and D.R. Roberts, "*Light, Chemical Change and Life*", Open University press, Milton Keynes, England, 1982.
- 11) B.J. Finlayson-Pitts and J.N. Pitts, "*Atmospheric Chemistry*", Wiley-Interscience, New York, 1986.
- 12) T.C. Elliott and R.C. Schwieger, "*The Acid Rain Sourcebook*", McGraw Hill, New York, 1984.

M.Sc. SEMESTER – I

ENV 403

ENERGY AND ENVIRONMENT

UNIT-1 **Energy Flow and Equilibrium**

Introduction, The laws of energy flow, Dynamic equilibrium and spontaneous change, Chemical kinetics, Atoms and elements, Molecules and covalent compounds, Valency and periodic table of the elements, Oxidation states, Compound mixtures, Chemical species and chemical reactions, The atomic nucleus and nuclear reactions.

UNIT-2 **Energy Production and Management**

Introduction, Energy Production and Consumption, Sources of Energy, Renewable Energy, Energy Conservation, Solar Energy Input, Conventional Fuels, Natural Gas, Uranium, Nuclear Energy and Nuclear Reactions, The Risk of Nuclear Accidents.

UNIT-3 **Non-Conventional and Biological Energy**

Introduction, Photovoltaics, Solar Heating, Wind Energy, Tidal Power, Biomass and Biofuels, Natural Vegetation, Energy Tree Plantations, Specific Energy Crops, Power From Biomass, Biomass Programs, Biomass and the Environment.

UNIT-4 **Energy from Wastes**

Introduction, Water-Based Biomass, Energy from Wastes, Solid Wastes, Research and Development, Biogas Plants in India and its use, Utilization of Effluent, Cost of Installation and Annual Savings, Financial Assistance from Government, Organization of the Biogas Sector, Potential for Biogas Generation and Digester Construction, Future Energy Scenario of the World.

M.Sc. SEMESTER – I

ENV 403

ENERGY AND ENVIRONMENT

REFERENCES

- 1) Andrew R.W., Jackson & Julie, M. Jackson, “*Environmental Science – The Natural Environment and Human Impact*”, Addison Wesley Longman Limited, 1996.
- 2) S.C. Santra, “*Environmental Science*”, 2nd Edition, New Central Book Agency (P) Ltd, Kolkata, India, 2005.
- 3) Fowler, John M., “*Energy and the Environment*”, 2nd Edition, McGraw Hill, New York, 1984.
- 4) Atkins P.W. and J.A. Beran, “*General Chemistry*”, 2nd Edition, W.H. Ereeman, New York, 1992.
- 5) Weast R.C., “*Handbook of Chemistry and Physics*”, CRC Press, 1994.
- 6) Ebbing, D.D., “*General Chemistry*”, (International 4th Edition) MA : Houghton Mifflin, Boston, 1993.
- 7) Carless, Jennifer, “*Renewable Energy : A Concise Guide to Green Alternative*”, Walker, New York, 1993.
- 8) Gray, N.E., “*Biology of Wastewater Treatment*”, Oxford University Press, New York, 1992.

M.Sc. SEMESTER – I

ENV 404

ENVIRONMENT AND SOIL

UNIT-1 Soil Composition, Formation and Morphology

Preview and Historical Perspectives, Weathering of Soil Minerals, Soil Formation and the factors, Land, Development and Horizons, Degradation and Destruction, Quality Assessment, Soil Individual and Mapping Units, GIS and GPS for Soil.

UNIT-2 Physical Properties of Soil

Soil Texture, Rock Fragments, Soil Structure, Particle Density and Bulk Density, Soil Porosity and Permeability, Soil Air, Rhizotrons, Soil Consistence, Soil Color, Soil Temperature, Other Soil Physical Properties.

UNIT-3 Soil Water Properties

Water and its Relation to Soil, Terminology and Classifications for Soil Water, Soil as Water Reservoirs, Soil Water Content, Instruments for determining Water Content or Potential, Water Flow into and through Soils, Water Uptake by Plants, Consumptive Use and Water Efficiency, Reducing Water Loss.

UNIT-4 Chemical and Acidic Properties of Soil

Soil Clays, Organic Colloids, Cation/Anion Exchange and Adsorption, Reactions and Buffering in Soils, Ecological Relation of Soil Acidity, Composition and Reactions of Lime, Crops, Lime and Soil, Lime Balance Sheet, Acidifying Soils.

M.Sc. SEMESTER – I

ENV 404

ENVIRONMENT AND SOIL

REFERENCES

- 1) Raymond W. Miller, Duane T. Gardiner, “*Soil in our Environment*”, 8th Edition, Upper Saddle River, New Jersey, 1998.
- 2) Dr. H. Kaur, “*Environmental Chemistry*”, 2nd Edition, Pragati Prakashan, Meerut, 2007.
- 3) E.A. FitzPatrick, “*Soils : Their Formation, Classification and Distribution*”, Longman Publishers, 1980.
- 4) Karl Terzaghi, Ralph B. Peck and Gholamreza Mesri, “*Soil Mechanics in Engineering Practice*”, 3rd Edition, John Wiley & Sons, New York, 1996.
- 5) R.G.Burns, “*Soil Enzymes*”, Academic Press, New York, 1978.
- 6) S.L. Tisdale, W.L. Nelson, J.P. Beaton and John L. Havlin, “*Soil Fertility and Fertilizers*”, 5th Edition, Macmillan, New York, 1993.
- 7) F.R. Troch, J.A. Hobbs, and R.L. Donahue, “*Soil and Water Conservation*”, 2nd Edition, Prentice-Hall Englewood Cliffs, NJ, 1991.

M.Sc. SEMESTER – I

ENV 405 PR

Ecological Experiments

1. Determination of minimum size quadrat by the Species Curve method.
2. Determination of minimum no. of quadrat to be laid down in the field under the study.
3. Study of vegetation using line transect method.
4. Study of vegetation using belt transect method.
5. Study of vegetation using chart quadrat method.
6. Determination of important value index (IVI).

M.Sc. SEMESTER – I

ENV 406 PR

Soil Analysis

1. Soil moisture measurement.
2. Determination of soil pH.
3. Determination of salt in soil.
4. Determination of calcium and magnesium in soil.
5. Determination of chloride in soil.
6. Determination of carbonate and bicarbonate in soil.
7. Determination of total phosphorus.

ENVIRONMENTAL SCIENCE SYLLABUS

M. Sc. SEMESTER – II 2017

| Course | Title of the Paper | Course Credit |
|---------------|--|----------------------|
| ENV 407 | WATER QUALITY AND WASTEWATER TREATMENT TECHNIQUES | 4 |
| ENV 408 | INTEGRATED SOLID WASTE MANAGEMENT | 4 |
| ENV 409 | AQUATIC AND MARINE ENVIRONMENTAL CHEMISTRY | 4 |
| ENV 410 | AIR POLLUTION:QUALITY AND CONTROL METHODS | 4 |
| ENV 411 PR | WATER ANALYSIS | 4 |
| ENV 412 | INSTRUMENTATION | 4 |

M.Sc. SEMESTER – II

ENV 407 WATER QUALITY AND WASTEWATER TREATMENT TECHNIQUES

UNIT-1 **Water Resources and Classification of Water Pollutants**

Introduction, Hydrological Cycle, Surface Water, Ground Water, Natural Conditions That Influence Water Quality, Methods for Managing Water Resources, Utilization of water, Origin of Wastewater, Types of Water Pollutants and their Effects.

UNIT-2 **Wastewater Sampling and Analysis Methods**

Sampling, Methods of Analysis, Determination of Organic Matter, Determination of Inorganic Substances, Physical Characteristics, Bacteriological Measurement.

UNIT-3 **Wastewater Treatment Techniques**

Basic Process of Water Treatment, Primary Treatment, Secondary (Biological) Treatment, Advanced Wastewater Treatment, Recovery of Materials from Process Effluents.

UNIT-4 **Industrial Chemical Processes and Water Quality Regulations**

Sugar Industry and Distillery, Pesticides, Drugs and Pharmaceuticals, Pulp and Paper Industry, Tanneries, Dye and Dye Intermediates, Paints and Synthetic Resins, Fertilizer Industry, Dairy Industry, Water Quality Regulations.

M.Sc. SEMESTER – II

ENV 407 WATER QUALITY AND WASTEWATER TREATMENT TECHNIQUES

REFERENCES

- 1) Y. Anjaneyulu, “*Introduction to Environmental Science*”, BS Publications, Hyderabad, India, 2004.
- 2) K. Vigil, “*Clean Water- An Introduction To Water Quality And Water Pollution Control*”, 2nd Edition, Oregon State University Press, USA, 2003.
- 3) C.S. Rao, “*Environmental Pollution Control Engineering*”, Wiley Eastern Limited, New Delhi, India, 1995.
- 4) S.C. Bhatia., “*Solid and Hazardous Waste Management*”, Atlantic Publishers and Distributors (P) Ltd., 2007.
- 5) Brown, R.L., “*Treatment of Water and Solid Wastes*”, Springer Field, New York.
- 6) S.C. Santra, “*Environmental Science*”, 2nd Edition, New Central Book Agency (P) Ltd, Kolkata, India, 2005.
- 7) S.N. Kaul., Arvind Kumar., “*Waste Water Engineering*”, APH Publishing Corporation, New Delhi, India, 2006.
- 8) G.S.Sodhi., “*Fundamental Concepts of Environment Chemistry*”, (3rd Edition), Narosa Publishing House Pvt. Ltd., New Delhi, India, 2009.
- 9) Mark M. Benjamin., “*Water Chemiatry*”, McGraw-Hill, New York, 2002.
- 10) J.C. Currie, and A.T. Pepper, “*Water and The Environment*”, Ellis Horwood Limited, England, 1993.

M.Sc. SEMESTER – II

ENV 408 INTEGRATED SOLID WASTE MANAGEMENT

UNIT-1 Basic Concepts of Solid Waste Management and Volume Reduction Technologies

Introduction, Types of Solid Waste, Solid Waste Collection, Factors in Planning, Reducing the Amount of Garbage, Hierarchy of Waste Management, Source Reduction Policy: Goals and measurement methodology, initiatives, government programmes, Cost of Environmental Management, Concentrating Methods: vacuum filtration, rotary drum precoat filter, pressure filtration, centrifuge dewatering, Incineration of Municipal Sludge.

UNIT-2 Recycling of Solid Waste

Introduction, Ways to Recycle, Collection of Recyclables, Processing Equipment for Recycling Facilities: Baling, magnetic separation, screening, Size Reduction, Air classification, Processing Recyclables: source separated recyclables, glass, plastics, can and metal processing, Recycling of PVC and related products, Automotive and Household Batteries.

UNIT-3 Composting and Landfilling of Municipal Solid Waste

Introduction, Definition, Classification of Compost Process, Compost Phases, Environmental Factors and Operational parameters affecting Composting, Classification of Compost system, Classification of Landfills, Landfilling Methods, Generation And Composition Of Landfill Gases, Formation and Composition of Leachate.

UNIT-4 Hazardous Waste

Introduction, Definition of various Hazardous Waste, Transportation of Hazardous Waste, Treatment, Storage and Disposal, Site Remediation, Hazardous Waste Minimization, Medical and Hospital Wastes, Nuclear Pollution and Radio-active Wastes.

M.Sc. SEMESTER – II

ENV 408 INTEGRATED SOLID WASTE MANAGEMENT

REFERENCES

- 1) S.C. Bhatia., ***“Solid and Hazardous Waste Management”***, Atlantic Publishers and Distributors (P) Ltd., 2007.
- 2) Curds, C.R. and Hawkes, H.A., ***“Basic Hazardous Waste Management”***, Academic Pres, London.
- 3) Goldberg, E.D., ***“Hazardous Waste Management”***, Gordon and Breach, Science Publishers, New York.
- 4) Odum, E.P., ***“Integrated Solid Waste Management”***, John Wiley & Sons, New York.
- 5) Lehr, J.H., Tyler, E.G., Wayne, A.P. and Jack, D., ***“Handbook of Solid Waste Management”***, McGraw-Hill, New York.
- 6) Nemerow, N.L., ***“Industrial Waste Management”***, Addison-Wesley Publishing Company, Philippines.
- 7) James, A. and Evison, L., ***“Treatment of Industrial Wastes”***, John Wiley & Sons, New York.

M.Sc. SEMESTER – II

ENV 409 AQUATIC AND MARINE ENVIRONMENTAL CHEMISTRY

UNIT-1 **Fundamentals of Aquatic and Marine Chemistry**

The Aquatic Environment, The Acidity of Water, Metal Complexes in Solution, Oxidation and Reduction, Deposition Dissolution and Processes, Pharmaceuticals from the Sea.

UNIT-2 **Contamination and Pollutants in the Marine Environment**

Introduction, Pollution of Marine Environment, Sources and Nature of pollutants, Oil Pollution and Marine Biota, Microbial Degradation of Oil and Petrochemical in the Sea, Metallic Pollutant and Aquatic Biota of the Sea, Status of Coastal and Estuarine Pollution in India, Mitigation of Marine Pollution.

UNIT-3 **The Oceans and Climate**

Introduction, The Complex Medium Called Seawater, Spatial Scales and the Potential for Change, Oceanic Gases and the Carbon Cycle, Oceanic Gases and Cloud Physics, Feedback Processes Involving Marine Chemistry and Climate, Future Prospects.

UNIT-4 **Remote Sensing and Geographical Information and Positioning System**

Principles of Remote Sensing, Types of Remote Sensing, System Overview in Remote Sensing, Application of Remote Sensing, GIS and GPS.

M.Sc. SEMESTER – II

ENV 409 AQUATIC AND MARINE ENVIRONMENTAL CHEMISTRY

REFERENCES

- 1) Alan, G. Howard, "*Aquatic Environmental Chemistry*", Oxford University Press, Oxford, New York, 1997.
- 2) R.E. Hester and R.M. Harrison, "*Chemistry in the Marine Environment*", Published by The Royal Society of the Chemistry, Cambridge, UK, 2000.
- 3) S.C. Santra, "*Environmental Science*", 2nd Edition, New Central Book Agency (P) Ltd, Kolkata, India, 2005.
- 4) Manahan, S.E., "*Environmental Chemistry*", Lewis Publishers, Chelsea Michigan, 1995.
- 5) Ward, R.C., and Robinson, M., "*Principles of Hydrology*", 3rd Edition, McGraw-Hill, Maidenhead, 1989.
- 6) J.A. Knauss, "*An Introduction to Physical Oceanography*", Prentice Hall, Englewood, NJ, 1978.
- 7) G.R. Bigg., "*The Oceans and Climate*", Cambridge University Press, Cambridge, 1996.
- 8) J.T. Houghton, L.G. Meira Filho, B.A. Callander, N. Harris, "*Climate Change*", Cambridge University, Cambridge, 1996.
- 9) S. Grabley and R. Thiericke, "*Drug Discovery from Nature*", Springer, Berlin, 1999.

M.Sc. SEMESTER – II

ENV 410 AIR POLLUTION: QUALITY AND CONTROL METHODS

UNIT-1 Sources and Effects of Air Pollution

Definition, Classification and Properties of Air Pollutants, Emission Sources, Behavior and Fate of Air Pollutants, Photochemical Smog, Effects of Air Pollution: human health, vegetation and materials, Air (Prevention and Control of Pollution) Act 1981.

UNIT-2 Sampling and Measurement of Air Pollutants

Types of Pollutant Sampling and Measurement, Ambient Air Sampling, Collection of Gaseous Air Pollutants: grab sampling, absorption in liquids, adsorption on solids, freeze out sampling, Collection of Particulate Pollutants, Stack Sampling: sampling system, particulate and gaseous sampling, Analysis of Air Pollutants.

UNIT-3 Air Pollution Control Methods and Equipment

Introduction, Source Correction Methods, Particulate Emission Control Equipments: gravitational settling chambers, cyclone separators, fabric filters, electrostatic precipitators, wet collectors, Control of Gaseous Pollutants: Control of Sulphur, Dioxide Emission, Nitrogen Oxides, Carbon Monoxide, Hydrocarbons, Mobile Sources.

UNIT-4 Indoor Air Quality

Nature, Sources and Toxicity of Indoor Air Pollutants, Syndromes related to indoor air quality: Sick building syndrome, building related illness, multiple chemical sensitivity or chemical hypersensitivity syndrome, Sources and Sinks in the Indoor Environment.

M.Sc. SEMESTER – II

ENV 410 AIR POLLUTION, QUALITY AND CONTROL METHODS

REFERENCES

- 1) C.S. Rao, “*Environmental Pollution Control Engineering*”, Wiley Eastern Limited, New Delhi, India, 1995.
- 2) M. Marconi, B. Seifert and T. Limdwall, “*Indoor Air Quality*”, Elsevier Science B.V., Netherland, 1995.
- 3) S.H. Stoker, and S.L. Seager, “*Environmental Chemistry : Air and Water Pollution*”, Scott Foresman & Co., New York, 1976.
- 4) P.O. Warner, “*Analysis of Air Pollutants*”, John Wiley & Sons, New York, 1976.
- 5) J.D. Butler, “*Air Pollution Chemistry*”, Academic Press, London, 1979.
- 6) S.C. Santra, “*Environmental Science*”, 2nd Edition, New Central Book Agency (P) Ltd, Kolkata, India, 2005.
- 7) Y. Anjaneyulu, “*Introduction to Environmental Science*”, BS Publications, Hyderabad, India, 2004.
- 8) Trivedi, R.K. and P.K. Goal, “*Introduction to Air Pollution*”, Techno-Science Publications.

M.Sc. SEMESTER – II

ENV 411 PR

WATER ANALYSIS

1. Determination of pH, Conductivity.
2. Determination of Total Hardness.
3. Determination of Chloride, Acidity and Alkalinity.
4. Determination of DO, BOD and COD.
5. Determination of Phosphate, Iron, Sulphate, Fluoride.
6. Determination of Oil and Grease.

M.Sc. SEMESTER – II

ENV 412 INSTRUMENTATION

1. Spectroscopy: UV–Visible, Atomic absorption, Infrared, ICPMS.
2. Microscopy: Scanning and Transmission Electron Microscopy.
3. Basics of NMR instrumentations.
4. Screening: GC, HPLC.
5. Thermal analysis: Thermogravimetric Analysis, Differential Scanning Calorimetry, Differential Thermal Analysis.

ENVIRONMENTAL SCIENCE SYLLABUS

M.Sc. SEMESTER – III 2017

| Course | Title of the Paper | Course Credit |
|---------------|--|----------------------|
| ENV 501 | ENVIRONMENTAL BIOTECHNOLOGY | 4 |
| ENV 502 | ENVIRONMENTAL TOXICOLOGY AND ITS IMPACT | 4 |
| ENV 503 | ENVIRONMENTAL RULES AND REGULATIONS | 4 |
| ENV 504 | ENVIRONMENTAL IMPACT ASSESSMENT | 4 |
| ENV 505 | REVIEW WRITING | 4 |
| ENV 506 S | SEMINARS | 4 |

M.Sc. SEMESTER – III

ENV 501 ENVIRONMENTAL BIOTECHNOLOGY

UNIT-1 General Aspects and Case Studies

Cleaner Bioprocesses and Sustainable Development, Environmental Impact of Nitrogen Fertilizers, Impermeable Barrier Liners in Containment Type Landfills, Control of Submicron Air Toxin Particles after Coal Combustion Utilizing Calcium Magnesium Acetate.

UNIT-2 Recycling and Treatment of Organic Wastes

Duckweed-Based Wastewater Treatment for Rational Resource Recovery and Reuse, Anaerobic Treatment of Tequila Vinasse, Immobilization of Living Microalgae and their Use for Inorganic Nitrogen and Phosphorus Removal from Water, Engineered Reed Bed Systems for the Treatment of Dirty Waters.

UNIT-3 Removal of Recalcitrant Compounds

Immobilization of Non-viable Cyanobacteria and their use for Heavy Metal Adsorption from Water, Bioremediation: Clean-up Biotechnologies for Soils and Aquifers, Increasing Bioavailability of Recalcitrant Molecules in Contaminated Soils, Bioremediation of Contaminated Soils, Environmental Oil Biocatalysis.

UNIT-4 Cleaner Bioprocesses

Clean Biological Bleaching Processes in the Pulp and Paper Industry, Clean Technologies through Microbial Processes for Economic Benefits and Sustainability, Cleaner Biotechnologies and the Oil Agroindustry, Cleaner Production Activities.

M. Sc. SEMESTER – III

ENV 501

ENVIRONMENTAL BIOTECHNOLOGY

REFERENCES

- 1) Eugenia J. Olguin, Gloria Sanchez, and Elizabeth Hernandez, “*Environmental Biotechnology and Cleaner Bioprocesses*”, Taylor & Francis Publishing House, London, 2000.
- 2) Anderson, J.M., and Ingram, J.S.I., “*Tropical Soil Biology and Fertility, A Handbook of Methods*”, 2nd Edn., Oxford CAB International, 1993.
- 3) Arceivala, S.J., “*Wastewater Treatment for Pollution Control*”, Tata McGraw-Hill, New Delhi, India, 1986.
- 4) Ehrlich, H.L., and Brierley, C.L., “*Microbial Mineral Recovery*”, McGraw-Hill, New York, 1990.
- 5) Alexander, M., “*Biodegradation and Bioremediation*”, Academic Press Inc., San Diego, California, 1994.
- 6) Wise, L.D., “*Global Environmental Biotechnology*”, Elsevier, Amsterdam, 1997.
- 7) R.M. Atlas, “*Microbiology : Fundamental and Applications*”, 2nd Edition, Macmillan, New York, 1988.

M.Sc. SEMESTER – III

ENV 502 ENVIRONMENTAL TOXICOLOGY AND ITS IMPACT

UNIT-1 Toxicology Chemistry

Introduction to Toxicology and Toxicological Chemistry, Dose – Response Relationships, Relative Toxicities, Reversibility and Sensitivity, Xenobiotic and Endogenous Substances, Kinetic Phase and Dynamic Phase, Teratogenesis, Mutagenesis, Carcinogenesis, and Effects on the Immune and Reproductive Systems, Health Hazards.

UNIT-2 Toxicology of Chemical Substances

Introduction, Toxic elements and elemental forms, Ozone, White Phosphorus, Elemental Halogens, Heavy metals, Cadmium, Lead, Arsenic, Toxic Inorganic Compounds, Cyanide, Carbon Monoxide, Nitrogen Oxides, Hydrogen Halides, Hydrogen Fluorides, Hydrogen Chlorides, Interhalogen Compounds and Halogen Oxides, Inorganic Compounds of Silicon, Asbestos, Inorganic Phosphorus Compounds, Phosphine, Tetraphosphorus decoxide, Inorganic Compounds of Sulphur, Organometallic Compounds, Organolead Compounds, Organotin Compounds, Carbonyls, Toxicology of Organic Compounds.

UNIT-3 Heavy Metals in Environment

Arsenic: Biochemical Effects of Arsenic, Transformation.

Cadmium: Emissions to the Environment, Toxicity, Emission Control and Other Measures, Biochemical Effects of Cadmium.

Lead: Emissions, Toxicity, Transformation, Biochemical Effects of Lead.

Mercury: Biochemical Effects of Mercury, Toxic Effect, Biological Methylation, Remedial Measures.

Chromium: Sources, Toxicity.

UNIT-4 Environmental Impact of Pesticides

Introduction, Historical Aspects, Classification, Application Potential, Limitation of Pesticides Uses, Toxicology of Major Pesticides, Pesticide Persistence, Bioaccumulation and Biomagnification.

M.Sc. SEMESTER – III

ENV 502

ENVIRONMENTAL TOXICOLOGY AND ITS IMPACT

REFERENCES

- 1) Stanley, E. Manahan, “*Environmental Chemistry*”, 7th Edn, Lewis Publishers, New York, 2000.
- 2) S.C. Santra, “*Environmental Science*”, New Central Book Agency (P) Ltd., 2006.
- 3) Cockerham, Lerris, G., and Barbara, S. Shane, “*Basic Environmental Toxicology*”, CRC Press/Lewis Publishers, Boca Raton, FL, 1994.
- 4) Bridggs, SHirley, and The Rachel Carson Council, “*Basic Guide to Pesticides : Their Characteristics & Hazards*”, Taylor& Francis, Washington, 1992.
- 5) S.A. Abbasi, N.Abbasi, R. Soni, “*Heavy Metals in The Environment*”, Mittal Publications, New Delhi, India, 1997.
- 6) A Wallace Hayes, “*Principles and Method of Toxicology*”, Published by Raven Press, New York.
- 7) Perry G., “*Introduction of Environmental Toxicology*”, Elsevier, Netherland, 1980.

M.Sc. SEMESTER – III

ENV 503

ENVIRONMENTAL RULES AND REGULATIONS

UNIT-1 Environmental Laws and Acts

Introduction, Environmental Legislation : Status in India, Some Indian Environmental Laws (i) The Water (Prevention and Control of Pollution) Act, 1974, (ii) The Air (Prevention and Control of Pollution) Act, 1981, (iii) The Environment (Protection) Act, 1986, (iv) The Biological Diversity Act, 2002, Environmental Legislation in USA, Introduction and Schedule of the factories Act, 1948, Protection of Specified Plants in the Wildlife Act, Sanctuaries, National Parks and Closed Areas, Sanctuaries or National Parks Declared by Central Government.

UNIT-2 National Conservation Strategy and Policy Statement on Environment and Development

Environmental Problems: Nature and Dimensions, Actions Taken, Legal, Institutions, Prevention and Control of Pollution, Conservation of Forests and Wildlife, Land and Soil, Environmental Impact Assessment, Other Activities, Constraints and Agenda for Action, Priorities and Strategies for Action, Development Policies from Environmental Perspectives, Energy Generation and Use, Industrial Development, Mining and Quarrying, Tourism, Transportation, Human Settlements, International Cooperation, Support Policies and Systems.

UNIT-3 Policy Statement for Abatement of Pollution

Future Directions and Objectives, Critically Polluted Areas, Assistance for Adoption of Clean Technologies by Small-Scale Industries, Standards, Fiscal Measures, Integration, Environmental Audit, Environmental Statistics, Public Partnership.

UNIT-4 The National Environment Tribunal Bill, 1992

Introduction, Preliminary, Compensation for Death of, or Injury to a Person and Damage to Property and Environment, Establishment of National Environment Tribunal and Benches thereof, Jurisdiction and Proceedings of the Tribunal, Miscellaneous.

M.Sc. SEMESTER – IV

ENV 503

ENVIRONMENTAL RULES AND REGULATIONS

REFERENCES

- 1) S.C. Santra, “*Environmental Science*”, New Central Book Agency (P) Ltd, India, 2006.
- 2) Hunter, Malcolm L. Jr., “*Wildlife, Forests and Forestry: Principles of Managing Forests for Biodiversity*”, Englewood Cliffs N.J., Prentice Hall, 1990.
- 3) S.K. Mohanty, “*Environment and Pollution Laws*”, Universal Law Publishing Co.Pvt. Ltd., New Delhi, 2008.
- 4) P.W. Birnie and A.E. Boyle, “*International Law and The Environment*”, 2nd Edition, Oxford University Press, 2004.
- 5) Cassese, “*International Law in a Divided World*”, Oxford, 1986.
- 6) Caldwell, “*International Environmental Policy and Law*”, 1st Edition, Durham, NC, 1980.
- 7) H.M. Tiwari, “*Environmental Law*”, 2008.

M.Sc. SEMESTER – III

ENV 504 ENVIRONMENTAL IMPACT ASSESSMENT

UNIT-1 Fundamental Approach and Methodology of EIA

Basic Concept, EIA as Planning Tool for Major Project Activities, Comparative Evaluation from EIA Studies, Criteria for Selection of EIA Methodology, EIA Method, Predictive Models for Impact Assessment.

UNIT-2 Prediction and Assessment of Impacts

Prediction and Assessment of Impacts : Noise, Transport, Landscape, Archaeological and other materials as well as Cultural Assets, Air Quality and Climate, Soil , geology and geomorphology, Water, Ecology, Freshwater ecology, Coastal ecology Noise Environment, Socio-Economic and Human Health.

UNIT-3 Environmental Risk Assessment (ERA) and Risk Management in EIA

Introduction, Definition and Concept, Legislative and policy background, Key-steps in Performing an ERA, Different levels of risk analysis, Parallels between ERA and EIA, Opportunities and Challenges in ERA .

UNIT-4 Environmental Remote Sensing (RS), Geographical Information System (GIS) and EIA

Introduction, Definition and concepts, Sources of remote sensing information, software, data, Application of Remote Sensing with particular reference to EIA, GIS and Environment impact assessment, GIS in screening, scoping, baseline studies, impact prediction, mitigation, and monitoring, EIA Case Studies.

M.Sc. SEMESTER – III

ENV 504

ENVIRONMENTAL IMPACT ASSESSMENT

REFERENCES

- 1) P. Morris, and R. Therivel, "*Methods of Environmental Impact Assessment*", 2nd Edition, Spon Press, Newyork, 2001.
- 2) Y. Anjaneyulu and V. Manickam, "*Environmental Impact Assessment*", 2nd Edition, B.S. Publication, Hyderabad, 2007.
- 3) S.C. Santra, "*Environmental Science*", 2nd Edition, New Central Book Agency (P) Ltd, Kolkata, India, 2005.
- 4) P. Calow, "*Handbook of Environmental Risk Management*", Blackwell Publishing Ltd., Australia, 1998.
- 5) J. Glasson, R. Therivel and A. Chadwick, "*Introduction to Environmental Impact Assessment*", 3rd Edition, Routledge, Newyork, 2009.
- 6) H. Abaza, R. Bisset, B. Sadler, "*Environmental Impact Assessment and Strategic Environmental Assessment: Towards an Integrated Approach*", 1st Edition, 2004.
- 7) P. Wathern, "*Environmental Impact Assessment: Theory and Practice*", Routledge, London and Newyork, 1998.

M.Sc. SEMESTER – III

ENV 505 REVIEW WRITING

- 1) Energy and Environment/ Energy and Electricity
- 2) Wildlife Conservation and Species Extinction
- 3) Water Pollution
- 4) Air Pollution
- 5) Nuclear power, waste and pollution
- 6) Waste Disposal
- 7) Loss of Biodiversity
- 8) Urban Sprawl
- 9) Sustainable Development
- 10) Climate Change

M.Sc. SEMESTER – III

ENV 506 S

SEMINARS

The seminars will be related to various topics mentioned in the papers 501 to 504.

ENVIRONMENTAL SCIENCE SYLLABUS

M.Sc. SEMESTER – IV 2017

| Course | Title of the Paper | Course Credit |
|---------------|--------------------------------------|----------------------|
| ENV 507 | DISSERTATION / PROJECT WORK | 16 |
| ENV 508 | ASSIGNMENT / GROUP DISCUSSION | 08 |