

The Details of the course are given below:

| Course | Course Title | Credits | Semester |
|---|--|-----------|----------|
| Core Theory Course (L) | | | |
| EM 101 | Ecology, Ecosystem and Environment Science | 6 | I |
| EM 102 | Global, Regional Issues and Health Concerns | 6 | I |
| EM 103 | Environment Management: Issues and Concept | 6 | I |
| EM 201 | Resource Management and Environment Risks | 6 | II |
| EM 202 | Energy and Waste Management | 6 | II |
| EM 203 | Ecotechnology | 6 | II |
| EM 301 | Environmental Monitoring and Analysis | 6 | III |
| EM 302 | Modern Tools in Environment Management | 6 | III |
| EM 303 | Environment Assessment, Audit and Certification. | 6 | III |
| | TOTAL CREDITS | 54 | |
| Choice Based Generic Elective Theory Courses (L) | | | |
| EM 104 | Environmental Pollution | 6 | I |
| EM 105 | Environment and Conservation | 6 | I |
| EM 106 | Environmental Statistics and Computer Applications | 6 | I |
| EM 107 | Environmental Instrumentation and Techniques | 6 | I |
| | TOTAL CREDITS | 6 | |
| Choice Based Discipline Specific Elective Theory Courses (L) | | | |
| EM 204 | Environmental Chemistry | 6 | II |
| EM 205 | Biogeochemistry | 6 | II |
| EM 206 | Environmental Microbiology | 6 | II |
| EM 207 | Environmental Education and Awareness | 6 | II |
| EM 304 | Environmental Engineering | 6 | III |
| EM 305 | Environmental Toxicology | 6 | III |
| | TOTAL CREDITS | 12 | |
| Laboratory Skill Development Core Courses(P) | | | |
| EM 108 | Practical I | 4 | I |
| EM 208 | Practical II | 4 | II |
| EM 306 | Project Work | 4 | III |
| | TOTAL CREDITS | 12 | |

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| Soft Skill Development Core Courses (FR/S/CW/GD/PP/LA/CP) | | | |
|---|-------------------------------------|--|-----|
| EM 109 | Field Report | 1 | I |
| EM 110 | Seminar/Computer work | 1 | I |
| EM 209 | Survey Report | 1 | II |
| EM 210 | Seminar/Group Discussion | 1 | II |
| EM 307 | Library Assignment /Contact Program | 1 | III |
| EM 308 | Poster presentation/Seminar | 1 | III |
| | TOTAL CREDITS | 6 | |
| On-Site Training (OT) | | | |
| EM 401 | On-site Training | 22 | IV |
| | TOTAL CREDITS | 22 | |
| Comprehensive viva-voce (Virtual Credits) | | | |
| EM 402 | Comprehensive viva-voce | 8 | IV |
| | TOTAL CREDITS | 8 | |
| | GRAND TOTAL | 112 Valid Credits) + 8 (virtual Credits) =120 | |

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SEMESTER I

| S.No. | Course Code | Course Title | Course Type | Marks | | | Credits |
|--------------|--|--|-----------------------|----------------|-----------------|-------------|--------------|
| | | | | Internal Exam | University Exam | Total Marks | |
| 1 | EM- 101 | Ecology, Ecosystem and Environment Science | Core | 10 | 40 | 50 | 6 |
| 2 | EM- 102 | Global, Regional Issues and Health concerns | Core | 10 | 40 | 50 | 6 |
| 3 | EM- 103 | Environment Management: Issues and Concept | Core | 10 | 40 | 50 | 6 |
| 4 * | EM- 104 EM- 105 EM- 106 EM- 107 | Environmental Pollution Environment and Conservation Environmental Statistics and Computer Applications Environmental Instrumentation and Techniques | * Generic Elective | 10 | 40 | 50 | 6 |
| 6 | EM- 108 | Skill Development Courses (Laboratory Skill Development Course) 1. Practical I (Soft Skill Development Course)** 2. Field Report 3. Seminar/Computer Work | Core | 20 (10+5+5) | 80 | 100 | 6 (4+1+1) |
| TOTAL | | | | | | 300 | 30 |

*- Any one of the four Generic Elective to be opted by student; ** - Self study courses under supervision of a teacher.

SEMESTER II

| | | | | | | | |
|--------------|--|---|-----------------------------------|----------------|----|-----|--------------|
| 1 | EM- 201 | Resource Management and Environment Risks | Core | 10 | 40 | 50 | 6 |
| 2 | EM- 202 | Energy and Waste Management | Core | 10 | 40 | 50 | 6 |
| 3 | EM- 203 | Ecotechnology | Core | 10 | 40 | 50 | 6 |
| 4* | EM- 204 EM- 205 EM -206 EM -207 | Environmental Chemistry Biogeochemistry Environmental Microbiology Environmental Education and Awareness | * Discipline Specific Elective | 10 | 40 | 50 | 6 |
| 6 | EM- 208 | Skill Development Courses (Laboratory Skill Development Course) 1. Practical II (Soft Skill Development Course)** 2. Survey Report 3. Group Discussion | Core | 20 (10+5+5) | 80 | 100 | 6 (4+1+1) |
| TOTAL | | | | | | 300 | 30 |

*- Any one of the four Discipline Specific Elective to be opted by student; ** - Self study courses under supervision of a teacher.

SEMESTER III

| S.No. | Course Code | Course Title | Course Type | Marks | | | Credits |
|--------------|-------------|---|-----------------------------------|----------------|-----------------|-------------|--------------|
| | | | | Internal Exam | University Exam | Total Marks | |
| 1 | EM- 301 | Environmental Monitoring and Analysis | Core | 10 | 40 | 50 | 6 |
| 2 | EM- 302 | Modern Tools in Environment Management | Core | 10 | 40 | 50 | 6 |
| 3 | EM- 303 | Environment Assessment, Audit and Certification | Core | 10 | 40 | 50 | 6 |
| 4* | EM- 304 | Environmental Engineering | * Discipline Specific Elective | 10 | 40 | 50 | 6 |
| | EM- 305 | Environmental Toxicology | | | | | |
| 6 | EM- 306 | Skill Development Courses (Laboratory Skill Development Course) 1. Project Report (Soft Skill Development Course)** 2. Library Assignment/Contact Program 3. Poster Presentation/Seminar | Core | 20 (10+5+5) | 80 | 100 | 6 (4+1+1) |
| TOTAL | | | | | | 300 | 30 |

* - Any one of the two Discipline Specific Elective to be opted by student; ** - Self study courses under supervision of a teacher.

SEMESTER IV

| | | | | | | | |
|--------------|---------|---|------|----|-----|------------|------------------------|
| 1 | EM- 401 | On-site Training Report Report Presentation and <i>viva-voce</i> | Core | 40 | 160 | 200 | 22 |
| 2 | EM- 402 | Comprehensive <i>viva-voce</i> | Core | - | 100 | 100 | 8 (Virtual Credits) |
| TOTAL | | | | | | 300 | 30 |

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Semester I
EM 101 : Ecology, Ecosystem and Environment Science (Core)
Credit 6

Unit 1:

1. Definition and Scope of Ecology. Ecosystem and Environment Science.
2. Environment- Interrelationship with Organisms.
3. Economic Environment, Political Environment.
4. Critical Theory of Ecology- Ethics, Eco-feminism; India's Psycho- Philosophical Environment.

Unit 2:

1. Ecosystem Components, Organization and function. Type of Ecosystem.
2. Biogeochemical Cycles; C,N,P. Trophic levels.
3. Flow of Energy in Ecosystem. Primary and Secondary Productivity. Productivity of Different Ecosystem.
4. Natural Ecosystem Management.

Unit 3:


1. Basic Issues in Environmental Science.
2. Environmental Geology. General Concepts.
3. Atmosphere- Composition and Stratification.

Unit 4:

1. Environmental Education. Status of Environmental Education in India.
2. Environmental Resources Economics.
3. Environmental Accounting and Tax System. Incentives and Significance.
4. Environmentalism- Activism and its Implementations.

References:

1. Ecology and Ecosystem Conservation By Oswald J. Schmitz
2. Ecology: Basic and Applied By S. C. Santra
3. Environmental Science By Daniel D. Chiras
4. Environmental education by Martha T. Henderson
5. Environmental Geology by Edward A. Keller - 2011 - 596 pages



Semester I

EM 103 : Environment Management: Issues and Concept (Core)

Credit 6

Unit 1:

1. History of Environment Management (EM).
2. Environment Management in India. R & D in India for Environment Science and Technology.
3. Environmental Training- Propositions, Practice and Problems.
4. Total Environmental Quality Management – A New Concept; Its Application and Success.
5. Preparation of Environment Management Plan.

Unit 2:

1. Concepts of Industrial Ecology & Corporate Environment Management.
2. Issues in Industrial Environment Management.
3. Guidelines for Siting of Industries and Projects.
4. Decision Making in Environmental Issues.

Unit 3:

1. Environment Management in Human Settlement Management Response for Metropolis, Small Cities, Slums and Rural Sectors.
2. Disaster Management: Man Made & Natural. Problems and Challenges.
3. Indoor Air Pollution: Growing Crises, Health Effects and Its Management Prospects.

Unit 4:

1. Pollution Control Acts: Water Pollution (1974), Air Pollution Act (1981).
2. Environment Pollution Act, 1986.
3. Wild life Conservation Act.
4. Forest Policy and New forest Acts.
5. Occupational & Safety Regulation Act.
6. International Conventions and Agreements Related to Environment.

References:

1. Environmental Law in India By Mohammad Nascem
2. Disaster Management in India: Structure and Challenges by Jyoti Purohit
3. ENVIRONMENTAL SCIENCE : PRINCIPLES & PRACTICE BY R. C. DAS, D. K. BEHERA
4. The Life and Death of International Treaties: Double-Edged Diplomacy and the ...By Jeffrey S. Lantis
5. Introduction to Environmental Management edited by Mary K. Theodore, Louis Theodore
6. Basic Concepts in Environmental Management By Kenneth M. Mackenthun



Semester I

EM 102 : Global Regional Issues and Health Concerns (Core)

Credit 6

Unit 1:

1. Global Environmental Issues, Environment Development Conflicts.
2. Present State of India's Environment and Environmental Priorities of India.
3. Madhya Pradesh State Environment Policy. Non Governmental Organizations, NBA.
4. Environmental Health Concerns; Famine, Malnutrition, Asbestos. Carcinogens, Radon.

Unit 2:

1. Climate Change- Greenhouse Effect, CO₂ Buildup, Other Radioactive Gases.
2. Ozone Depletion, Causes and Consequences, Montreal Protocol.
3. Acidification, Its Impact, Mitigation Strategies.
4. Desertification, Causes, Control Management.

Unit 3:

1. The Rio Declaration, Agenda 21- Full Details.
2. Post Rio Scenes- Implementation.
3. Sustainable Development, Indicators of Sustainable Development.
4. WTO, IPR, Patent Steps.

Unit 4:

1. The Biodiversity- Importance, Loss and Causes, Convention on Biological Diversity, Conservation Effects.
2. Rain Forests- Significance, Present Status.
3. Global and Regional Hotspots of Environment.

References:

1. Global Environmental Issues edited by Frances Harris
2. Environmental Issues By Ron Fridell
3. Ethics and Climate Change: The Greenhouse Effect edited by Harold Coward, Thomas Hurka
4. Greenhouse Effect, Sea Level and Drought edited by R. Paepe, Rhodes W. Fairbridge, Saskia Jelgersma
5. The Age of Sustainable Development By Jeffrey D. Sachs
6. Sustainable Development, Evaluation and Policy-Making: Theory, Practise and .. edited by Anneke von Raggamby, Frieder Rubik



Semester I
EM 104 : Environmental Pollution (Generic Elective)
Credit 6

Unit 1:
Linkage between energy, environment and development. Human population issues. Definition of pollution. Different types of pollution- Air, Water and soil and their local, regional and global aspects. **Unit 2:**
Effects of air pollutants on

Air: Sources of air pollutants, their behavior in the atmosphere. Effects of air pollutants on humans, animals, plants and properties. Control approaches.

Unit 3:
Water: Sources, effects, water pollution treatment.
Soil: Sources and nature of soil pollution and its harmful effects.

Unit 4:
Solid waste: generation, collection, environmental effects and safe disposal practices.
Environmental problems associated with noise pollution, oil pollution and radioactive pollution.

References:

1. Managing Environmental Pollution By Andrew Farmer
2. Fundamentals of Air Pollution By Daniel Vallero
3. Water Pollution: Causes, Effects and Control By P. K. Goel
4. Soil Pollution: From Monitoring to Remediation by Armando C. Duarte, Anabela Cachada, Teresa A.P. Rocha-Santos
5. Pollution Control and Resource Recovery: Municipal Solid Wastes at Landfill By Zhao Youcai, Lou Ziyang



Semester I

EM 105 : Environment and Conservation (Generic Elective)

Credit 6

Unit 1:

Biodiversity concepts and patterns: Microbial diversity, plant diversity, Agro-biodiversity, soil biodiversity and economic value of biodiversity biodiversity. Levels of Biodiversity - Community diversity (alpha, beta and gamma biodiversity), Gradients of Biodiversity (latitudinal, insular)

Unit 2:

Ecosystems diversity: Biomes, mangroves, coral reefs, wetlands and terrestrial diversity (equilibrium mix of G and W.). Species diversity - richness and evenness, loss of species, magnitude of biodiversity. Direct and indirect benefits, Bioprospecting (molecular techniques like RAPD, RFLP, AFLP, DNA sequencing etc). Genetic diversity - sub species, breeds, race, varieties and forms. Variation in genes and alleles at DNA sequence levels (selected case studies). Microbial diversity and useful prokaryotic genes.

Unit 3:

Threats to Biodiversity: Habitat loss and fragmentation, disturbance and pollution; introduction of exotic species; extinction of species. IUCN categorized-endangered, threatened, vulnerable species. Red data book and related documentation. Human intervention and biodiversity loss.

Unit 4:

Methods of conservation: In situ (Biosphere reserves, National Parks, Sanctuaries, Sacred groves etc) & ex situ (Botanical gardens, Zoological gardens, Gene banks, Pollen, seed and seedling banks, tissue culture and DNA banks etc) and modes of conservation. Benefits of conservation - biodiversity as a source of food and improved varieties, source of drugs and medicines, Aesthetics and cultural benefits. Biodiversity conservation laws.

References:

1. Biodiversity and Conservation - P. C. Joshi
2. Biodiversity and Conservation - M. P. Singh and Aravind Kumar
3. Biodiversity Conservation - Ghosh Asish
4. Systematic Conservation Planning (Ecology, Biodiversity and Conservation) - Chris Margules and Sahotra Sarka
5. A Text book of Environmental Science -Prabhat Patnaik
6. A Textbook of Environmental Sciences-Purohit



Semester I

EM 106 : Environmental Statistics and Computer Applications (Generic Elective)

Credit 6

Unit 1:

Introduction: Sampling, data collection and recording. Central tendency – concept, arithmetic mean, mode, median for ungrouped and grouped data. Measures of dispersion - absolute and relative measures, range, standard deviation (grouped and ungrouped data), variance, quartile deviation, co-efficient of variability. Probability - normal and binomial

Unit 2:

Statistical Methods: Hypothesis testing, significance and correlation. Correlation - linear models and regressions. Pearson and other correlation coefficients. Multiple regressions, Distribution-Normal, t and chi square test Difference among means: F-test: 1 way ANOVA, F-test: 2 ways ANOVA

Unit 3:

Research Writing: Overall outline and structure of the article/manuscript. Description, value, and development of points/outlines before writing. Screening of Material for inclusion within the structure of the manuscript. Importance of authors & their sequence, importance of clear title, abstract and summary. Introduction, methods, results and discussion. Writing Style - Active or passive, Punctuation, use of commas, apostrophe, semicolon and colon. Avoiding duplication and repetition. Importance of revisions and references. Plagiarism - paraphrasing and copy write violation. Consequences of plagiarism.

Unit 4:

Computer applications in environmental modeling: Computer-based modeling: Linear, regression, validation and forecasting. Computer-based modeling for population and population studies.

References:

1. Biostatistics: A Guide to Design, Analysis and Discovery, 2nd Edition
2. Environmental Statistics (Handbook of Statistics) - Ganapati P. Patil and C. Radhakrishna Rao
3. Environmental Statistics - Books LLC
4. Scientific Writing: A Reader and Writer's Guide - Lebrun, Jean-Luc
5. Scientific Writing - Hall Marian Rose
6. From Research to Manuscript: A Guide to Scientific Writing- Michael J. Katz
7. Computing Research for Sustainability - Committee on Computing Research for Environmental and Societal Sustainability, Computer Science and Telecommunications Board, Division on Engineering and Physical Sciences and National Research Council
8. Statistics for Environmental Science and Management-Manjunatha



Unit 1:

Physics of Dielectrophoresis and its environmental applications, Basics of NMR instrumentations, significance of relaxation time.

Unit 2:

Principle of spectroscopy and its use in environmental field. Raman effect and experimental measurement, Raman Spectroscopy,

Unit 3:

LASER based techniques, LIDAR based methods and techniques, SODAR Radiofrequency measurement and techniques.

Unit 4:

Instrumentation of air pollution sampling, monitoring and control equipments. Instrumentation of water pollution sampling, monitoring and control equipments.

References:

1. Handbook of Analytical Instruments, Second Edition By Dr R.S. Khandpur
2. Industrial Air Pollution Monitoring edited by A.G. Clarke
3. X-Ray Spectroscopy in Environmental Sciences By Vlado Valkovic
4. Nuclear Magnetic Resonance Spectroscopy in Environmental Chemistry edited by Mark A. Nanny, Roger A. Minear, Jerry A. Leenheer
5. Laser in Environmental and Life Sciences: Modern Analytical Methods edited by Peter Hering, Jan Peter Lay, Sandra Stry
6. Environmental Issues in Chemical Perspective By Thomas G. Spiro, William M. Stigliani



Semester II
EM 201 : Resource Management and Environment Risks (Core)

Credit 6

Unit 1:

1. Resource Classification and Status; Concept of Integrated Resource Management
2. Forest: Cover in India; Regeneration, Natural Forest Management vs. Joint Forest Management.
3. Wildlife Protection and Management in India

Unit 2:

1. Mines: Types of Mining, Problems and Issues.
2. Environmental Management in Mining.
3. Mineral Resources of India and Present Available Strategies for Conservation of Minerals.

Unit 3:

1. Land Degradation; Land & Soil Management Practices.
2. Wastelands-Indian Scenario; Types and Restoration.
3. River Management: Key Processes in River, River Engineering in Restoration; Rehabilitation of River Management, Flood Plains Importance.

Unit 4:

1. Environmental Risks- Concept.
2. Risks Associated with- Population Explosion, Extinction of Species, Altering Hydrological Regime of Large Dams, Forest Ecosystem Disturbances, Highways and Radioactive Materials.
3. Industrial Risks: Preparedness and Management .Site and on Site Emergency Management Plans.

References:

1. Energy Resources: Availability, Management, and Environmental Impacts By Kenneth J. Skipka, Louis Theodore
2. Assessment and Management of Environmental Risks: Cost-efficient Methods and ... edited by Igor Linkov, José Palma-Oliveira
3. Corporate Strategies for Managing Environmental Risk by Bernard Sinclair-Desgagné Ashgate,
4. Progress in Resource Management and Environmental Planning vy Timothy O'Riordan, Ralph C. D'Arge.
5. Land Degradation edited by A.J. Conacher
6. Wasteland management and environment by S.K. Karma, A. K. Roy, U.R. Biswas



Semester II

EM 202 : Energy and Waste Management (Core)

Credit 6

Unit 1:

1. Energy Scenario; Fossil Fuels- Coal, Oil Gas; Renewable Energy; Solar, Hydro, Wind, Geothermal & Tidal; Nuclear Energy.
2. Conventional Vs. Non Conventional Energy Resources; Environmental Impacts.
3. Energy Conservation Practices and Strategies.

Unit 2:

1. Classification and Characteristics of Solid Wastes.
2. Bio Waste Treatment and Recycling; Energy and Phosphorus Recovery from Animal Wastes and Sewage.
3. Hospital Waste Management; Medical Incinerator- Design & Operation.

Unit 3:

1. Hazardous Waste: sources, Classification, Characteristics. Disposal Options; Basel Convention.
2. Hazardous Waste Management; Role, Structure & Operation of Landfill and Incineration.
3. Dioxin; Sources, Health Effects, Disposal.

Unit 4:

1. Green Productivity (Cleaner Production Technology): Concept of Green Development in the technology, Eco-labeling.
2. Cleaner Technology in Four Target Industries: Chemical, Pulp and Paper, Textile, Electroplating; Environmental Impact.
3. Zero Effluent Discharge System- Concept & Case Study.

References:

1. Hazardous Waste Management By Gaynor W. Dawson, Basil W. Mercer
2. Hazardous Waste Management: Second Edition By Michael D. LaGrega, Phillip L. Buckingham, Jeffrey C. Evans
3. Industrial Water Management: A Systems Approach By William Byers, Glen Lindgren, Calvin Noling, Dennis Peters
4. Green Productivity In Small And Medium Enterprises (in 2 Vols.) By M. Soundarapandian
5. Energy Resources By Laura McDonald
6. Energy Resources: Availability, Management, and Environmental Impacts By Kenneth J. Skipka, Louis Theodore
7. Solid Waste Management: Principles and Practice By Ramesha Chandrappa, Diganta Bhusan Das



Semester II
EM 203 : Ecotechnology (Core)
Credit 6

Unit 1:

1. Eco-Technology: The Concept and Application; Ecological Engineering.
2. Environmental Biotechnology & Microbiology. Introduction; Role of Bugs/Super Bugs for Toxic Cleanup Environment, Microbiology of Activated Sludge.
3. Genetically Engineered Products- Plants, Seeds, Insects, Animals, Foods, Microbes and Their Hazards; Threats and Soil Fertility.

Unit 2:

1. Bioremediation: Concept and Applications.
2. Protozoa and Metazoa, Grazing Food Chain, Contamination Removal.
3. Vermitechnology: Concept, Role in Bio-solid Recycling and Sludge Treatment.

Unit 3:

1. Green Belt Technology: Development and Designing, Modern Ecological Inputs.
2. Microcosm: Concept, Construction and Application.
3. Mesocosm: Concept, Essential Elements, Applications.

Unit 4:

1. Constructed Wetland Technology (Root zone): Concept, Types of Constructed Wetlands, Basic Mechanisms, Waste Water Treatments Advantages.
2. Ecological Restoration: Concept, Restoring Original Habitats- Aquatic Ecosystem / Forest / Mines.
3. Watershed and Rain Water Harvesting Technology: Concept, Technology Details.

References:

1. Ecological Engineering: An Introduction to Ecotechnology William J. Mitsch, Sven Erik Jørgensen
2. Constructed Wetlands for Water Quality Improvement By Gerald A. Moshiri
3. Constructed Wetlands and Sustainable Development By Gary Austin, Kongjian Yu
4. Environmental Risk Assessment of Genetically Modified Organisms edited by Angelika Hilbeck, David Alan Andow, Eliana Fontes
5. Environmental Microbiology edited by Ian L. Pepper, Charles P. Gerba, Terry J. Gentry
6. Progress in Environmental Microbiology edited by Myung-Bo Kim



Semester II

EM 204 : Environmental Chemistry (Discipline Specific Elective)

Credit 6

Unit 1:

Fundamentals of Environmental Chemistry: Stoichiometry, Gibbs energy, chemical potential, chemical equilibria, acid-base reactions, solubility product, solubility of gases in water, the carbonate system, unsaturated and saturated hydrocarbons, radionuclides.

Unit 2:

Soil Chemistry: Inorganic and organic components of soil, chemical properties of soil-saline. Acidic and alkaline soils, micro and macro nutrients of soil, nitrogen, phosphorus and Potassium Pathways in the soil.

Unit 3:

Chemical composition of Air and Water: Classification of elements, chemical speciation, ions and radicals in the atmosphere. Chemical processes for formation of inorganic and organic particulate matters. Thermochemical and photochemical reactions in the atmosphere. Toxic chemicals in the environment. Properties of water, water pollutants - sources & types, heavy metals, metalloids, types of reactions in various water bodies including marine environment.

Unit 4:

Environmental Instrumentation: Spectrometry, UV-Vis and IR spectrophotometer and AAS, flame spectrometry and fluorimetry; Chromatographic techniques: Paper, Thin Layer, Gas and Gas – Liquid Chromatography, HPLC, X-ray fluorescence, x-ray diffraction, Electrophoresis, NMR and Mass Spectrometry.

References:

1. A Text book of Environmental Science - Prabhat Patnaik
2. A Textbook of Environmental Sciences - Purohit
3. Elements of Environmental Chemistry – J. Hussain
4. Environmental Instrumentation and Analysis Handbook – R.D. Down and J.H. Lehr
5. Environmental Analysis and Instrumentation - N. Rajvaldya and D. K. Markande
6. Environmental Monitoring and Analysis - Dr. Aradhana Salpekar



Semester II

EM 205 : Biogeochemistry (Discipline Specific Elective)

Credit 6

Unit 1:

Introduction- Biogeochemical provinces- Atmosphere- Lithosphere: weathering process, soil biogeochemistry- Terrestrial systems: photosynthesis respiration- Wetlands: vegetation adaptations- **Unit 2:**

Freshwater and Marine Biogeochemistry: Lakes, ponds, rivers, mangroves, salt marsh and estuaries- Oceans: productivity and limiting nutrient role, carbon chemistry-

Unit 3:

Global biogeochemical cycles: Nutrient cycles-Advances in biogeochemistry- Sediment biogeochemistry, stable isotopes in Biogeochemistry and their application to various environmental problems.

Unit 4:

Nutrient dynamic in the atmosphere, hydrosphere, and Lithosphere. Nutrient budgeting and modeling

References:

1. Biogeochemistry: An Analysis of Global Change By William H. Schlesinger, Emily S. Bernhardt
2. Biogeochemistry in Mineral Exploration By Colin E. Dunn
3. The Biogeochemistry of Submerged Soils By Guy Kirk
4. Biogeochemistry, Volume 8 edited by William H. Schlesinger
5. Biogeochemistry of Inland Waters edited by Gene E. Likens



Semester II

EM 206 : Environmental Microbiology (Discipline Specific Elective)

Credit 6

Unit 1:

Introduction: Prokaryotes versus eukaryotes - eukaryotic and prokaryotic cell structure, three domains of life. General characters of a) Protozoa b) algae, c) fungi, d) bacteria and e) virus. General concepts of microbial taxonomy, morphology, physiological, biochemical, genetic and molecular characterization, classification and identification schemes.

Unit 2:

Effects and microbial adaptations to environmental conditions: Temperature, oxygen, desiccation, extreme cold, ionic effect, osmotic pressures, radiant energy, hydrostatic pressures.

Microbial control: General concepts, Inhibition of growth and killing, sterilization and disinfection, antiseptics, and sanitation, desirable characteristics and mode of action physical agents (moist and dry heat, radiation and filtration), chemical agents, classes of disinfectants: Factors affecting sterilization and disinfection (moisture, organic matter, temperature, pH). Evaluation of antimicrobial activity

Unit 3:

Bio-indicators: What are bio indicators? Plankton community as indicators of water pollution; use of diversity index in evaluation of water quality. Determination of microbiological quality of recreational and potable waters, indicator organisms, coliforms and E.coli, fecal streptococci, clostridia, and heterotrophic plate counts etc. lichens as air pollution indicators.

Biosensor: What is a biosensor? Components, advantages and limitations, biocatalyst based, ion-affinity based and microorganism based biosensors; Applications of biosensors in environmental monitoring.

Unit 4:

Quality Control and Quality Assurance: What is quality control and quality assurance? Standard operating procedures, quality assurance of pre-analytical, analytical and post analytical stages of microbiological procedures. Staff & qualifications, quality control of culture medium.
References:

1. Environmental Microbiology - Ralph Mitchell and Ji-Dong Gu
2. Environmental Microbiology: A Laboratory Manual - Ian L. Pepper and Charles P. Gerba
3. Environmental Microbiology - Alan H. Varnam and Malcolm G. Evans
4. Environmental Microbiology - Annette Bolger
5. Environmental Microbiology - Purnima Sethi and V.S. Kulkarni
6. Environmental Microbiology: Methods and Protocols - Spencer
7. Environmental Microbiology- Banwari Lal



Semester II

EM 207 : Environmental Education and Awareness (Discipline Specific Elective)

Credit 6

Unit 1:

Introduction to environmental education: Significance and concept. Fundamentals of integration of knowledge, application to human society, peoples biodiversity register and Role of NGO in environmental awareness

Unit 2:

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.

Unit 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

Unit 4:

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 and cost benefit analysis. Introduction of ecological growth factor similar to economical growth factor for sustainable development.

References:

1. Environmental Education and Management -Dr.Avinash Chiranjeev
2. Environmental Education - Babita Verma
3. Environmental Education - Pachuri and S C & P Kumar
4. Environmental Education - Dr. Rajeev Saxena
5. Environmental Education - Archana Tomar
6. Environmental Education - Sukla Bhattacharya



Semester III

EM 301 : Environmental Monitoring and Analysis (Core)

Credit 6

Unit 1:

1. Sampling Methods for Environmental Parameters- Protocol Development.
2. Indian and International Standards for Air, Waste and Drinking Water Quality.
3. Measurement Techniques for Middle Atmosphere: Ground based, Balloon, Rocket and Satellite Techniques for Stratospheric Ozone Chemistry, Stratospheric Warming and Aerosol.

Unit 2:

1. Monitoring and Analysis of Air for Gaseous Pollutants: e.g. SO_x, NO_x and Ozone.
2. Monitoring & Analysis of Greenhouse Gases: e.g. CO₂, CH₄, N₂O
3. Monitoring & Analysis of Particulate Pollutants: Respirable and Non-Respirable; And Odorous Gases.

Unit 3:

1. Physico-Chemical and Biological Analysis of Municipal Waste Water.
2. Physico-Chemical and Microbiological Quality of Drinking Water.
3. Ground Water Analysis for Fluoride, Arsenic, Nitrate, Organic Trace Pollutants and Metal Ions.

Unit 4:

1. Ecotoxicology- Scope, Methodology and Does Response Studies. LC/LD/EC 50.
2. Bioassay Methods, Test Protocols and Organisms Employed as Tools.
3. Biomonitoring of the Environment- Theory and Practice and Problems; Biosensors- Perspectives and Concept.

References :

1. Measuring the natural environment by Ian Strangeways
2. Basic Environmental Technology by Jerry A. Nathanson; Richard A. Schneider
3. Environmental Monitoring by G. Bruce Wiersma
4. Monitoring of Water Quality: The Contribution of Advanced Technologies By F. Colin, Ph. Quevauller
5. Industrial Air Pollution Monitoring by AG Clarke



Semester III
EM 302 : Modern Tools In Environment Management (Core)
Credit 6

Unit 1:

1. Application of Mathematics and Statistics in Environmental Studies, System Analysis, Mathematical Modeling- Application and Advantages.
2. Statistical Parameters- Standard Deviation, Error, Students "t" test, Chi square test, Analysis of Variance.
3. Correlations and Regressions- Simple, Multiple and Polynomial Regression, Their Significance.

Unit 2:

1. Introduction to Computers, Structure and Functional Aspects of Computers, Operational Guidelines.
2. Various languages, Commonly Used Program, Packages, Internet.
3. Software Related To Environment Management and Their Application- Case Studies.

Unit 3:

1. Remote Sensing, Its Physical Basis and Evolution With Reference To India.
2. Application of Remote Sensing in Managing Environment.

Unit 4:

1. Geographical Information System- Concepts, GIS Use of Environment Management Applications.
2. GIS- Ground Water, Watershed Wetland, Water Quality Applications.
3. High Tech Monitoring Tools: Mass spectrometers, Lidar.

References:

1. An Introduction to Statistical Learning Textbook by Robert Tibshirani and Trevor Hastie
2. Fundamentals of Statistics Book by Michael Sullivan, III
3. Remote Sensing and GIS Book by Basudeb Bhattacharya
4. Fundamentals of Remote Sensing Book by George Joseph
5. Field Guide to Lidar Book by Paul F. McManamon
6. Advances in Remote Sensing and GIS Analysis Editor: Peter M. Atkinson

Atkinson

Semester III

EM 304 : Environmental Engineering (Discipline Specific Elective)
Credit 6

Unit 1:

1. Primary and Conventional Wastewater Treatment Processes and Systems.
2. Key Processes and Mechanisms in Primary Secondary and Tertiary Treatment.
3. Anaerobic Wastewater Treatment Emphasizing Up flow Anaerobic Sludge Blanket (UASB), Advantages.

Unit 2:

1. Design and Flow Chart Preparation of ETP and STP; Operation and Maintenance.
2. Performance Evaluation of ETP and STP- Steps and Guidelines.
3. Drinking Water Treatment- Concept, Treatment Regulations, Treatment Technologies- Filtration, Disinfections, Treating Organic and Inorganic Contaminants

Unit 3:

1. Air Pollution- Characteristics of Emissions.
2. Air Pollution: Plumè Rise Characteristics and Dispersion.
3. Air Pollution Meteorology and Wind roses.

Unit 4:

1. Air Pollution Control Mechanisms & Technologies.
2. Control of Gaseous and Particulates in Industries.
3. Structural Design and Operation of ESP, Cyclones and Bag Houses.

References:

1. Fundamentals of Air Pollution - 5th Edition- by Daniel Vallero- Academic Press.
2. Air Pollution Control By Cooper C.D
3. Fundamentals of Air Pollution Engineering by Richard C. Flagan
4. Air Pollution Control Engineering by Noel De Nevers
5. Air Pollution by Rao,M and HVN Rao.



Semester III

EM 303 : Environment Assessment, Audit and Certification (Core)

Credit 6

Unit 1:

1. Environment Impact Assessment (EIA) and Statements: *Scope, Needs and Justification, Checklists and Protocol*
2. Predictions & Assessment of Impacts on Environments of Air, Water, Noise, Biological, Cultural & Socio-economical.
3. Public Participation in Environmental Decision Making, Public Hearing of EIA.

Unit 2:

1. Environmental Audit (EA): Needs, Approaches, Procedures, Activities, Benefits.
2. Questionnaire for EA.
3. Case Study: Cement, Beer, Leather Manufacturer.

Unit 3:

1. ISO, ISO 14000: International Environmental Management Standards.
2. ISO Organization and Overview.

Unit 4:

1. What Are Other ISO 14000.
2. Action Plan for Implementation, Training & Awareness.
3. Compliance of Certification Protocol, EMS Documentation.

References:

1. Social Life Cycle Assessment (Environmental Footprints and Eco-design of Products and Processes) by Subramanian Senthilkannan Muthu
2. Environmental Impact Assessment: A Guide to Best Professional Practices. by Charles H. Eccleston
3. Methods of Environmental Impact Assessment by Peter Morris
4. ISO 14001 Environmental Certification Step-by-Step Book by Arthur Edwards
5. Environmental Health and Safety Audits Book by Lawrence B. Cahill
6. International Environmental Auditing Book by David D. Nelson



Semester III
EM 305 : Environmental Toxicology (Discipline Specific Elective)

Credit 6

Unit 1:

Toxicology: Definition and scope, acute and chronic toxicity, selective toxicity, does synergism and antagonism. Toxic chemicals in the environment and biochemical aspects of As Cd, Pb, Hg, CO, O₃, PAN, pesticides and carcinogens in air.

Unit 2:

Does-Response relationships: Graded response, quantal response, time action curves threshold limit value (TLV), margin of safety, toxicity curves; cumulative toxicity and LD₅₀ & CTF.

Unit 3:

Toxicity testing: Bioassay – Definition, purpose, criteria for selection of test organism methodology, estimation of LC₅₀, limitation and importance of bioassay, acute toxicity (single), Sub acute toxicity, chronic toxicity, teratogenicity, carcinogenicity and mutagenicity.

Unit 4:

Bio-transformation, bio-accumulation and bio-magnification: Principles, receptor sites absorption and storage of xenobiotics, types of bio- transformations, toxico-genomics and pharmacogenomics. Influence of ecological factors on the effects of toxicity, concept of green chemistry. Pollution of the ecosphere by industries, global dispersion of toxic substance, dispersion and circulating mechanisms of pollutants, degradable and non-degradable toxic substances and food chain.

References:

1. Environmental Toxicology set of 3 volumes- Peter Gomes
2. Aquatic Environment and Toxicology-Pawan Kumar Bhart
3. Toxicology: Principles and Methods-Second Revised Edition - M A Subramanian
4. Toxicology: A Manual for Students and Practitioners. - Edwin Welles Dwigh
5. Toxicology: The Nature, Effects and Detection of Poisons, with the Diagnosis and Treatment of Poisoning - Cassius M Riley
6. Toxicology - Vijayan Kannampilly

