

**SCHOOL OF STUDIES IN ENVIRONMENT MANAGEMENT,  
VIKRAM UNIVERSITY**

Syllabus

M. Sc. Environment Management (For UTD)

**Revised Course Structure  
Choice Based Credit System (CBCS)**

2020-2022



## **M.Sc. Environment Management**

### **Program Objectives**

1. To produce skilled experts with a background of Environmental Science employable for positions in the fields like education, industry and government and non-government organizations.
2. To impart knowledge on human environment interaction and provide knowledge on issues related to development and environment.
3. To impart technical/analytical methodologies for environmental analysis.
4. To provide technical methodologies (EIA/EA/Safety management) for sustainable Development
5. To prepare our graduates to become effective scientific communicators/collaborators in multidisciplinary teams providing technical leadership to engage with the challenging environmental problems of local, national and global nature.

### **Program Outcomes**

1. Students will be able to understand and apply the basic concepts of ecosystem and other sciences suitably in environmental science.
2. Students can analyze the relationship between natural resources, animals, plants as well as human being.
3. Students could understand the procedures of Environmental Impact Assessment/Environmental Audit/Industrial Safety.
4. Students could analyze the legal procedure/Compliances required towards sustainable Industrial development.
5. Students will understand the impact of professional engineering solutions in societal and environmental contexts for sustainable development.



The School of Studies in Environment Management will have choice based credit system (CBCS) in M.Sc. Environment Management (For UTD). The student will have to earn 104 actual credits (valid credits) and 16 virtual credits (total 120 credits) in total four semesters (two year duration). The course will comprise of Lectures (L), Seminars (S), Practical (P), Library Assignments (LA), Project work (PW) and Comprehensive viva.

The semester will consist of 16-18 weeks of academic work. One credit is equivalent to one hour (60 minutes) of teaching (lecture) or two hours (120 minutes) of S, P, LA, and PW per week in a semester. The credits for the course have been distributed among the courses under Core, Skill development, Generic Elective and Discipline Specific Elective categories. The credits associated with the courses will be valid credits, while credits associated with Comprehensive viva-voce will be virtual credits.

During the semester, a teacher offering the course will do the continuous evaluation of the student at three points of time by conducting three tests of 20 marks each. Of these, two must be written tests and the third may be written test / Quiz/ Seminar/ Assignment for theoretical courses. Marks obtained in two best tests out of three will be awarded to the student. In each course, there shall be End Semester Exam of 60 marks. Each student has to appear in at least two tests and End Semester Examination; otherwise, the student will be awarded Ab Grade in that course. Examination and evaluation of the courses will be as per ordinance 14 of the Vikram University.

The details of the course are given below:



### Semester I

S.No.	Course code	Title of course	Course type	Marks			
				Internal Examination Marks	University Examination Marks	Total Marks	Credits
1	EM 101	Ecology, Ecosystem and Environment Science	Core	40	60	100	5
2	EM 102	Global, Regional Issues and Health concerns	Core	40	60	100	5
3	EM 103	Environment Management issues and Concept	Core	40	60	100	5
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 *	40	60	100	5
5	ED	Entrepreneurship Development	Skill Development Course **	30	50	80	4
6	EM 108	Practical-I (Laboratory Skill Development) /Review writing/Library Assignment	Core	15	25	40	2
7	EM 109	Comprehensive Viva (Virtual Credits)	Core	-	80	80	4
		Total		205	395	600	30

- Molecular Biology

\* Of the 04 Generic Elective any 01 can be opted by the students.

\*\* Common course offered by the University.

One Credit = 20 Marks.

## SEMESTER II

S.No.	Course code	Title of Course	Course type	Marks			
				Internal Examination Marks	University Examination Marks	Total Marks	Credits
1	EM 201	Resource Management and Environmental Risks	Core	40	60	100	5
2	EM 202	Energy and Waste Management	Core	40	60	100	5
3	EM 203	Ecotechnology	Core	40	60	100	5
4	EM 204 EM 205 EM 206 EM 207	Environmental Chemistry Biogeochemistry Environmental Microbiology Environmental Education and Awareness	Discipline specific elective*	40	60	100	5
5	CC	Communication Skills	Skill Development Course **	30	50	80	4
6	EM 206	Practical-II (Laboratory Skill Development) / Field Work	Core	15	25	40	2
7	EM 107	Comprehensive Viva (Virtual Credits)	Core	-	80	80	4
		Total		205	395	600	30

\* Of the 04 Discipline specific Elective any 01 can be opted by the students.

\*\* Common course offered by the University.

One Credit = 20 Marks.

### SEMESTER III

S.No.	Course code	Title of Course	Course type	Marks			
				Internal Examination Marks	University Examination Marks	Total Marks	Credits
1	EM301	Environmental Monitoring and Analysis	Core	40	60	100	5
2	EM302	Modern Tools in Environment Management	Core	40	60	100	5
3	EM303	Environment Assessment, Audit and Certification	Core	40	60	100	5
4	EM304 EM305	Environmental Engineering Environmental Toxicology	Discipline specific elective*	40	60	100	5
5	PD	Personality Development	Skill Development Course **	30	50	80	4
6	EM306	Minor Project (Skill Development)/ Survey Work	Core	15	25	40	2
7	EM107	Comprehensive Viva (Virtual Credits)	Core	-	80	80	4
		Total		205	395	600	30

\* Of the 02 Discipline specific Elective any 01 can be opted by the students.

\*\* Common course offered by the University.

One Credit = 20 Marks.



### SEMESTER IV

S. No.	Course code	Title of Course	Course type	Marks			
				Internal Examination Marks	University Examination Marks	Total Marks	Credits
1	EM 401	On site training/ Project Work Report presentation and assessment + ( <i>viva-voce</i> )	Core	100 (Project work Report + Presentation)	140 (Project Report Assessment + <i>viva-voce</i> )	240	12
2	EM 402	Case study/Minor Project/ Industrial or Scientific Institute visit.	Core	30 (Report)	50 ( <i>viva-voce</i> )	80	4
3	EM 403	Review Writing	Core	30 (Report)	50 ( <i>viva-voce</i> )	80	4
4	EM 404	Seminar/Group Discussion	Core	25 (Write up)	35 (Presentation)	60	3
5	EM 405	Poster Presentation	Core	25 (Poster)	35 (Presentation)	60	3
6	EM 406	Comprehensive Viva (Virtual Credits)	Core	-	80	80	4
		Total		210	390	600	30

One Credit = 20 Marks.

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
	<b>TOTAL CREDITS</b>	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
	<b>TOTAL CREDITS</b>	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
	<b>TOTAL CREDITS</b>	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
	<b>TOTAL CREDITS</b>	12	
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
	<b>TOTAL CREDITS</b>	6	
On-Site Training (OT)			
EM 401	On-site Training	22	IV
	<b>TOTAL CREDITS</b>	22	
Comprehensive viva-voce (Virtual Credits)			
EM 402	Comprehensive viva-voce	8	IV
	<b>TOTAL CREDITS</b>	8	
	<b>GRAND TOTAL</b>	<b>112 Valid Credits) + 8 (virtual Credits) =120</b>	



Letter Grades and Grade Points:

The grading will be made on 10-point scale as recommended by UGC:

<b>Letter Grade</b>	<b>Grade Points</b>	<b>Description</b>	<b>Range of Marks (%)</b>
O	10	Outstanding	90-100
A <sup>+</sup>	+9	Excellent	80-89
A	8	Very Good	70-79
B <sup>+</sup>	7	Good	60-69
B	6	Above Average	50-59
C	5	Average	40-49
P	4	Pass	35-39
F	0	Fail	0-34
Ab	0	Absent	Absent



## **SEMESTER I**

### **EM 101: Ecology, Ecosystem and Environment Science (Core)**

**Credit 6**

**Objectives** – To make new students friendly towards subject and let them know the knowledge of interrelation between Ecology and Environment management with the history and future scopes of Environmental Education in India.

#### **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. Tropic 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.

**Outcome** – Understand the basic issues related to Environmental Science with the relation of it with ecology and ecosystem cycles also cleared the composition, chemistry and properties of Atmosphere.

#### **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



## **SEMESTER I**

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

**Credit 6**

**Objectives** – To study the chemistry of atmosphere and the history of environment management in the world. Also study the status of rainforest and biodiversity with its past and present effects.

#### **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, CO<sub>2</sub> 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. W. T. O., I. P. R., 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.

**Outcome** – Understand the past history of conferences and their role in environment management, how patent is done and also the roles of trade in world. Also the composition and clarification of green house gases and layers in atmosphere.

## **REFERENCES**

1. Global Environmental Issues edited by Francis 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 Jeffery D. Sachs
6. Sustainable Development, Evaluation and Policy-Making. Theory, Practise and edited by Anneke von Raggamby, Frieder Rubik.

## **SEMESTER I**

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

**Credit 6**

**Objectives** – To study History of Environment Management, research and development on fields, how an Environment Management Plan is been made, how disaster management is used impact fully with new concepts on Total Environmental Quality Management and how Siting of Industries and Projects is done.

#### **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.

**Outcome** – Cleared concepts of Acts for environment protection, industrial concepts of ecology, anthropogenic disasters and instant Decision Making in Environmental Issues with in-Situ and ex-Situ siting for industries.

## **REFERENCES**

1. Environmental Law in India By Mohammad Naseem
2. Disaster Management in India : Structure and Challenge 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 By Jeffery S. Lantis.
5. Introduction to Environmental Management Mary K. Theodore, Louis Theodore
6. Basic Concept in Environment Management By Kenneth M. Machenthum

## **SEMESTER I**

### **EM 104: Environmental Pollution (Generic Elective)**

**Credit 6**

**Objectives** – To study Linkage between energy, environment and development, to study types of pollutions especially Air, Water, Solid waste and soil pollution with their detailed study.

#### **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:**

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

#### **Unit 3:**

1. Water: Sources, effects, water pollution treatment.
2. 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.

**Outcome** – Understand all types of pollution, how to segregate pollutions, their effects, sources, Control approaches, global effects, aspects and behavior on humans, animals and ecosystem.

## **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**

**Objectives** – To study Biodiversity concepts and patterns, Bio-prospecting, Threats to Biodiversity, Methods of conservation of Biodiversity with laws and actions on it.

#### **Unit 1:**

Biodiversity concepts and patterns: Microbial diversity, plant diversity, Agro-biodiversity, soil biodiversity and economic value of 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, Bio-prospecting (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.

**Outcome** – It cleared the concepts of Biodiversity, In situ & ex situ Biodiversity, documentation of Biodiversity, testing of Biodiversity, and it gets easy as we study various case studies in favor of the objectives also we understand the scope and Aesthetics and cultural benefits of Biodiversity.

#### **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 SahotraSarka
5. A Text book of Environmental Science -PrabhatPatnaik
6. A Textbook of Environmental Sciences-Purohit

## **SEMESTER I**

### **EM 106: Environmental Statistics and Computer Applications (Generic Elective) Credit 6**

**Objectives** – To study the statistics of EM with various computer applications present worldwide, also the paper consist about study of Research Writing and Computer applications in environmental modeling

#### **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. Why not to fudge, tinker, fabricate or falsify data.

#### **Unit 4:**

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

**Outcome** – Computer-based modeling made easy with various software's available working also the knowledge of research and research presentation with Plagiarism and paraphrasing in detail is been grabbed by students.

#### **REFERENCES**

1. Biostatistics: A Guide to Design, Analysis and Discovery, 2nd Edition
2. Environmental Statistics (Handbook of Statistics) - Ganapati P. Patil and C. RadhakrishnaRao
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

## **SEMESTER I**

### **EM 107: Environmental Instrumentation and Techniques (Generic Elective) Credit 6**

**Objectives** – To study the instrumentation analysis for Environment Management also detailed knowledge of pollution sampling, monitoring and control equipments with their calculations and Modeling.

#### **Unit1:**

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.

**Outcome** – To get detailed knowledge of Instrumentation of pollution sampling, monitoring and control equipments with their modelling and engineering aspects.

## **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 Environment Sciences By Vlado Valkovic
4. Nuclear Magnetic Resonance Spectroscopy in Environmental Chemistry  
by Mark A Nanny, Roger A. Minear, Jerry A Leecheer
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**

**Objective** – To study Mining, its effects on environment, Forest Management, Land degradation, River Management, Rehabilitation of River Management, Flood Plains with Environmental Risk and Industrial Risk with Emergency Plans.

#### **Unit1:**

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

#### **Unit2:**

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.

#### **Unit3:**

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.

#### **Unit4:**

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 off Site and on Site Emergency Management Plans.

**Outcome** – Understand the risk factors, off Site and on Site Emergency Management Plans, River management, Environmental Management in Mining and Wildlife Protection and Management in India

## **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, Jose Palma- Oliveira
3. Corporate Strategies for Managing Environmental Risk by Bernard Sinclair- Desgagne Ashgate
4. Progress in Resource Management and Environmental Planning by 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**

**Objectives** – Classification of Energy and than its management, Solid Waste Management, Hazardous Waste Management with Cleaner Production Technology, Labeling and Zero Discharge systems.

#### **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.

**Outcome** – Understand the effects of Energy management in industries, change of strategies with type and nature of industry, Cleaner Production Technology, and Solid Waste Management in industry as well as town. Also understand the function of government in environment labels

## **REFERENCES**

1. Hazardous Waste Management by Gaynor W. Dawson, Basil W. Mercer
2. Hazardous Waste Management : Second Edition by Michael D. Lagrega., Philip L. Buckingham, Jeffery C. Evans
3. Industrial Water Management : A System Approach by William Byers, Glen Lindgren, Calvin Noling, Dennis Peters
4. Green Productivity in Small and Medium Enterprises (in 2 Volumes) by M. Soundarapandian
5. Energy Resource 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, Dignta Bhushan Das

**SEMESTER II**  
**EM 203 :Ecotechnology(Core)**

**Credit 6**

**Objectives** – To study Ecological Engineering and Environmental Biotechnology & Microbiology with Green Belt Technology, Concept, Types of Constructed Wetlands and Watershed and Rain Water Harvesting Technology.

**Unit1:**

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.

**Unit2:**

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.

**Unit3:**

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

**Unit4:**

1. Constructed Wetland Technology (Rootzone): 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.

**Outcome** – Understood the Ecological Restoration, Watershed management, Vermitechnology, Green Belt Technology and other various in them useful for industries as well as human beings.

**REFERENCES**

1. Ecological Engineering: An Introduction to Eco-Technology 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, Elian Fontes
5. Environmental Microbiology edited by Ian L. Pepper, Charles P. Gerba, Terry J. Gentry
6. Progress in Environmental Microbiology edited by Myung-Bo Kin



## **SEMESTER II**

### **EM 204 :Environmental Chemistry (Discipline Specific Elective)**

**Credit 6**

**Objectives** – To study the Chemistry affects of Environment Management with various laws and equations. Chemical composition of Air and Water including marine environment also study in detail present existing Environmental Instrumentation and its analysis.

#### **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.

**Outcome** – The students will be benefitted in Environmental Instrumentation their working and industrial marking of chemist. Also they will understand the aspects and Fundamentals of Environmental Chemistry with Chemical composition of Air and Water and their classifications.

#### **REFERENCES:**

1. A Text book of Environmental Science - PrabhatPatnaik
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. Rajvaidya and D. K. Markande
6. Environmental Monitoring and Analysis - Dr. AradhanaSalpekar

## **SEMESTER II**

### **EM 205: Biogeochemistry (Discipline Specific Elective)**

**Credit 6**

**Objectives** – To study the biogeochemical provinces, fresh and marine lakes, marking of the Global biogeochemical cycles with atmosphere composition of which detailed study of Lithosphere with Nutrient dynamic in the atmosphere.

#### **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-

#### **Unit3:**

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

#### **Unit4:**

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

**Outcome** – Understood the Nutrient dynamic in the atmosphere, hydrosphere, and Lithosphere also a detailed study of Lithosphere: weathering process, Freshwater and Marine Biogeochemistry with all types of cycles their modeling and environmental problems.

#### **REFERENCES:**

1. Biogeochemistry : An analysis of global Change by Williams 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

**Objective** – To study the microbial aspects of Environment Management, Microbial control, Bio-indicators, Quality Control and Quality Assurance with diversity index and its aspects.

#### Unit 1:

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

#### Unit 2:

1. Effects and microbial adaptations to environmental conditions: Temperature, oxygen, desiccation, extreme cold, ionic effect, osmotic pressures, radiant energy, hydrostatic pressures.
2. Microbial control: General concepts, Inhibition of growth and killing, sterilization and disinfection, antisepsis, and sanitation, desirable characteristics and mode of action physical agents (moist and dry heat, radiation and filtration), chemical agents, classes of disinfectants:
3. Factors affecting sterilization and disinfection (moisture, organic matter, temperature, pH). Evaluation of antimicrobial activity

#### Unit 3:

1. Bio-indicators: What are bio indicators? Plankton community as indicators of water pollution; use of diversity index in evaluation of water quality.
2. 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.
3. 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:

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

**Outcome** – The students will understand the concept of Microbiology its use in Environment management, diversity index its use and patterns also biosensors and bioindicators how they are helpful to us

## 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**

**Objective** – To study Role of NGO in environmental awareness, environmental education, International Environmental Laws, Equity Environment versus Development and Definition and concepts of sustainable development, Stockholm Conference.

#### **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:**

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.
2. Global environmental issues and International laws: to control Global warming, Ozone depletion, Acid rains, hazardous waste, CITES etc.
3. Role of UN authorities in protection of Global Environment, Multinational authorities and agreements, future of International laws.

#### **Unit 3:**

1. 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:**

1. Definition and concepts of sustainable development: Integration of:
  - a. Economic, Social and Environmental sustainability,
  - b. Biodiversity and
  - c. Availability of natural resources in development.
2. Critical review of drawbacks in traditional (base on economics) evaluation of development and cost benefit analysis.
3. Introduction of ecological growth factor similar to economical growth factor for sustainable development.

**Outcome** – Understand the – To study Role of NGO in environmental awareness, environmental education, International Environmental Laws, Equity Environment versus Development, concept of Introduction of ecological growth and Education.

## **REFERENCES**

1. Environmental Education and Management -Dr.AvinashChiranjeev
2. Environmental Education - BabitaVerma
3. Environmental Education - Pachuri and S C & P Kumar
4. Environmental Education - Dr. Rajeev Saxena
5. Environmental Education - ArchanaTomar
6. Environmental Education - Sukla Bhattacharya

## **SEMESTER III**

### **EM 301: Environmental Monitoring and Analysis (Core)**

**Credit 6**

**Objective** – To study the Sampling, Monitoring and Analysis Methods, Eco-toxicology, Bio-monitoring of the Environment and Measurement Techniques for Atmosphere with Physico-Chemical and Biological Analysis of water, noise, Solid, Soil and Air pollution.

#### **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. SOX, NOX and Ozone.
2. Monitoring & Analysis of Greenhouse Gases: e.g. CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O
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. Eco-toxicology- Scope, Methodology and Dose Response Studies. LC/LD/EC 50.
2. Bioassay Methods, Test Protocols and Organisms Employed as Tools.
3. Bio-monitoring of the Environment- Theory and Practice and Problems; Biosensors- Perspectives and Concept.

**Outcome** – Understood the concepts of Eco-toxicology, Measuring the Natural Environment, sampling, monitoring and Physico-Chemical and Biological Analysis of water, noise, Solid, Soil and Air pollution

## **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 Advances Technologies by F. Colin, Ph. Quevauviller
5. Industrial Air Pollution Monitoring by AG Clarke



## **SEMESTER III**

### **EM 302: Modern Tools in Environment Management (Core)**

**Credit 6**

**Objective** – To study the Most latest aspects of application for environment Management, Application of Mathematics and Statistics in Environmental Studies, Various Computer languages, Statistical Parameters, Remote Sensing and GIS applications.

#### **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.

**Outcome** – Understood the concepts in GIS, Statistical Parameters of Remote Sensing, and Mathematical Modeling with modeling and calculations of High Tech Monitoring Tools and software’s related to Environment Management.

## **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



## **SEMESTER III**

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

**Credit 6**

**Objectives** – To Study EIA, International Laws related to ISO certification, Environmental Audit and making of EMP in circumstances of ISO and audit rules.

#### **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.

**Outcome** – Understanding the concepts of Environment Management Plans, How its implemented, Environmental Audit study become easy with case studies. Detailed study of ISO from 9000 to 50000 and ISO 14000 in detail.

## **REFERENCES**

1. Social Life Cycle Assessment ( Environmental Footprints and Eco-design of Products and Processes) by Subramaniam Senthilkannam 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 304: Environmental Engineering (Discipline Specific Elective)

Credit 6

**Objective** – To study the engineering of water treatment technology, Design and construction of ETP and STP, Modelling of Drinking Water Treatment techniques, Air Pollution Control Mechanisms & Technologies with Structural Design of Air pollution removal Techniques.

#### 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: Plume 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.

**Outcome** – Understand the Modelling techniques of Conventional Wastewater Treatments, Design and construction of ETP and STP, Flow Chart Preparation of ETP and STP with Operation and Maintenance of ETP and STP. Drinking water filtration techniques and its engineering too.

#### REFERENCES

1. Fundamentals of Air Pollution – 5<sup>th</sup> 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 305: Environmental Toxicology (Discipline Specific Elective)**

**Credit 6**

**Objectives** – To study Eco- Toxicology, Toxicology with environment and biochemical aspects, Dose-Response relationships of toxicity, Toxicity testing also Bio-transformation, bio-accumulation and bio-magnification of Toxicity

#### **Unit 1:**

1. Toxicology: Definition and scope, acute and chronic toxicity, selective toxicity, does synergism and antagonism.
2. Toxic chemicals in the environment and biochemical aspects of As Cd, Pb, Hg, CO, O<sub>3</sub>, PAN, pesticides and carcinogens in air.

#### **Unit 2:**

Dose-Response relationships: Graded response, quantal response, time action curves threshold limit value (TLV), margin of safety, toxicity curves; cumulative toxicity and LD<sub>50</sub>& CTF.

#### **Unit 3:**

Toxicity testing: Bioassay – Definition, purpose, criteria for selection of test organism methodology, estimation of LC<sub>50</sub>, limitation and importance of bioassay, acute toxicity (single), Sub acute toxicity, chronic toxicity, teratogenicity, carcinogenicity and mutagenicity.

#### **Unit 4:**

1. Bio-transformation, bio-accumulation and bio-magnification: Principles, receptor sites absorption and storage of xenobiotics, types of bio- transformations, toxicogenomics and pharmacogenomics.
2. 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.

**Outcome** – Understand the concepts of Sub acute toxicity, chronic toxicity, teratogenicity, carcinogenicity and muta-ge-ni-city, Graded response, quantal response, time action curves, Toxic chemicals in the environment and biochemical aspects with natural toxicity.

## **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 Dwig
5. Toxicology: The Nature, Effects and Detection of Poisons, with the Diagnosis and Treatment of Poisoning - Cassius M Riley
6. Toxicology – Vijayan Kannampilly