

**DR. BABASABEB AMBEDKAR MARATHWADA UNIVERSITY
AURANGABAD- 431004 (M.S)**

Department of Environmental Science



structure and Curriculum

For

M.Sc. Environmental Science Programme

(Choice Based Credit System)

Academic Autonomy

(Effective from June 2015 onwards)

CC	ENV-502	Remote Sensing and GIS application for Environmental Management	04	04	100
CC	ENV-503	Environmental Toxicology & Biodiversity Assessment	04	04	100
EC	ENV-521A	Environmental Plan, Policies, and legislation	04	04	100
EC	ENV-521B	Ecological footprints and carbon sequestration	04	04	100
SC	ENV-522	Climate Change and Global Environmental Issues	04	04	100
LC	ENV-541	Lab Course- IX	04	02	50
LC	ENV-542	Lab Course- X	04	02	50
LC	ENV-543	Lab Course- XI (Project /Dissertation Part- I)	08	08	100
Total Credits for Semester – III : 32 (Theory:20 ;Lab:04;Research Project :08) (With One Elective Course)					
M.Sc. II Year (Semester-IV)					
Course	Course Code	Paper Titles	Hrs/ week	Credits	Marks
CC	ENV-504	Risk Assessment and Disaster Management	04	04	100
CC	ENV-505	EIA & Environmental Auditing	04	04	100
EC	ENV-523A	Advanced Technologies & CDM	04	04	100
EC	ENV-523B	Ground Water Engineering and Watershed Management	04	04	100
LC	ENV-545	Lab Course-XII	04	02	50
LC	ENV-546	Lab Course – XIII (Field work and In-plant training)	04	02	50
LC	ENV-547	Lab Course- XIV (Seminar / Dissertation Part- II)	08	08	200
Total Credits for Semester – IV : 24 (Theory:12 ;Lab:04;Research Project :08) (With One Elective Course)					
Total Credits : 110 (Sem I : 28 +Sem II : 26 + Sem III : 32 + Sem IV:24)					

COM: Common,
CC: Core Course
LC: Lab Course
SC: Service Course

RM: Research Methodology
EC: Elective Course
LEC: Lab Elective Course
FC: Foundation Course

Introduction :

The Department of Environmental Science was established in June 1985. The department offers M.Sc. and Ph.D. degrees in Environmental Science as a commitment to higher education to rural youth. The department has produced more than 450 post graduate students and more than 60 Ph.D. students so far. The major domains of research activities are in the areas of Environmental monitoring, Environmental Managements, Water Pollution, Waste Water Treatment, Solid and hazardous waste management, under water quality testing, LCA, EIA, Wild life,

522 of 4 Credits of 100 marks from IIIrd semester will be a **Service Course** which needs to opt by the students from the other departments.

During the two years study course students has to earn the total credits from the following manner.

1. Core Courses	:- 40 credits
2. Elective Courses	:- 16 credits
3. Foundation Course	:- 04 credits
4. Service Course	:- 04 credits
5. Lab Courses	:- 40 credits
6. RM Courses	:- 04 credits
7. COM Course	:- 02 credits
Total Credits	:- 110 credits

Above credits includes the credits for Research Methodology /Project /Seminars etc. in the following manner ,04 credits-RMC and 18 credits for Project / Seminars /In-plant training etc, with a total of 22 credits for research project assignment

Courses:

1. **Core Course (C.C)** : Core course is a course that a student admitted to a particular P.G. Program must successfully complete to receive the degree. Normally no theory course shall have more than four credits.
2. **Elective Course (E.C)** : Elective course means an optional course from the basic subject or specialization.
3. **Foundation Course (F.C)**: It includes fundamentals of environment, necessary to the students offering the course from other disciplines.
4. **Service Course (S.C)**: Service course will be offered in IIIrd semester. Students must complete a service course for securing M.Sc degree to acquire 4 credits.
5. **Lab Course (L.C)** : It includes all laboratory assignments related to theory courses.
6. **Research Methodology (R.M)**: This course includes research related components to understand basics in the research and develop the research skill.
7. **Common Course (COM)** : This course is introduced to learn the Great Constitution of India.

- Each course shall include lectures/ tutorials/laboratory or field work/seminar/practical training/assignments /mid-term and term end examination/paper/report writing or review of literature and any other innovative practices to meet effective teaching and learning needs.
- The student will have to register the service course of his interest after the start of semester in the concerned department on official registration form. The teacher in charge of the respective course will be given from the date of admission for completion of registration procedure. The Departmental Committee will follow a selection procedure after counseling to the students etc. to avoid overcrowding to particular course(s) at the expense of some other course.
- The department will decide the maximum number of students in each service course taking into account the teachers and Physical facilities available in the Department.
- No service course will be offered unless a minimum of 10 students are registered.

Choice Based Credit System (CBCS) :

The choice based credit system has been adopted by this department. This provides flexibility to make the system more responsive to the changing needs of our students, the professionals and society. It gives greater freedom to students to determine their own pace of study. The credit based system also facilitates the transfer of credits.

- Students will have to earn 110 credits for the award of M.Sc. (Environmental Science) degree.
- Out of 110 credits, students will have to earn 104 credits from Core courses worth 40 credits, foundation course worth 04 credits, elective courses worth 16 credits, laboratory courses worth 22 credits research project of 22 credits (distributed in all semesters) from Environmental Science Department , 04 credits of open elective (Service course) from any department in the university campus and 02 credits from the course 'Constitution of India'.

Credit-to- contact hour Mapping:

LC	ENV-543	Lab Course- XI (Project /Dissertation Part- I)	08	08	100
Total Credits for Semester – III : 32 (Theory:20 ;Lab:04;Research Project :08)					
M.Sc. II Year (Semester-IV)					
Course	Course Code	Paper Titles	Hrs/ week	Credits	Marks
CC	ENV-504	Risk Assessment and Disaster Management	04	04	100
CC	ENV-505	EIA & Environmental Auditing	04	04	100
EC	ENV-523A	Advanced Technologies & CDM	04	04	100
EC	ENV-523B	Ground Water Engineering and Watershed Management	04	04	100
LC	ENV-545	Lab Course-XII	04	02	50
LC	ENV-546	Lab Course – XIII (Field work and In-plant training)	04	02	50
LC	ENV-547	Lab Course- XIV (Seminar / Dissertation Part- II)	08	08	200
Total Credits for Semester – IV : 24 (Theory:12 ;Lab:04;Research Project :08)					
Total Credits : 110 (Sem I : 28 +Sem II : 26 + Sem III : 32 + Sem IV:24)					

Notes:

- Tutorial, assignments and seminar presentation are integral components of all theory courses. Tutorials consists of conceptual / questions based on the respective theory courses in the semester covering all five (05) units.
- Each course / paper should be taught for 40 to 45 contact hours.
- Teaching duration for LAB COURSES from first to fourth semesters should be of 04 hours per week per batch.
- Teaching duration for research project in third and fourth semesters should be 08 hours per week per batch.
- Each of the course is divided into five units.
- The content of theory course / paper as well as laboratory (practical) course may be modified time to time (with the approval DC) to keep pace with the recent developments and trends in the subject.

Attendance:

Students must have 75 % of attendance in each core, foundation, elective, laboratory and research project course for appearing examination otherwise he / she will not be strictly allowed for appearing the examination of each course. However, students having 65 % attendance with medical certificate may request Head of the Department for the condonation of attendance.

Departmental Committee:

The existing Departmental Committee (DC) will monitor the smooth functioning of M. Sc. programme.

Results Grievances / Redressal Committee

Grievances / redressal committee will be constituted in the department to resolve all grievances relating to the evaluation. The committee shall consist of Head of the department, the concerned teacher of a particular course and senior faculty member of Department of Committee. The decision of Grievances / redressal committee will have to be approved by Department committee.

Evaluation Methods:

- The assessment will be based on 50: 50 ratio of continuous internal assessment (CIA) and semester end examination (SEE) with separate passing.

- Part B will carry 7 questions. Therefore, students will have to attempt any five questions each of 8 marks.
- Number of sub questions (with allotment of marks) in a question may be decided by the examiner.
- Semester end practical examination (for laboratory courses) will be of 25 marks each (semester end examination only). Student must perform at least three experiments from each lab course. The final practical examination will be conducted at the end of each semester along with the theory examination.
- Semester end examination for project will be carried out in the respective semester.
- At the end of each semester the result will be forwarded to the Controller of the Examination through Departmental Committee in university departments and through Principal in colleges.
- The Head of the Department/ Principal shall send all results to the Controller of Examination for further processing.
- Every student will have privilege for revaluation of answer sheets or recounting of marks for each semester end examination. However, students will have to submit an application within 15 days from the date of declaration of results.
- Applications received for revaluation / recounting will be discussed in the Departmental Committee and examiners will be appointed accordingly.
- The results of revaluation / recounting will be approved by Departmental Committee/ Principal and forwarded to Controller of Examination for further processing.

Earning Credits:

At the end of every semester, a letter grade will be awarded in each course for which a student had registered. A student's performance will be measured by the number of credits that he/she earned by the weighted Grade Point Average (GPA). The SGPA (Semester Grade Point Average) will be awarded after completion of respective semester and the CGPA (Cumulative Grade Point Average) will be awarded at the end of the 4th semester.

Grading System:

- The grading reflects a student-own proficiency in the course. A ten point rating scale shall be used for the evaluation of the performance of the students to provide letter grade for each course and overall grade for the Master Programme. Grade points are based on the total number of marks obtained by him / her in all heads of the examination of the course. The grade points and their equivalent range of marks are shown in Table-I.

Table – I : Ten point grade and grade description

Marks Obtained (%)	Grade Point	Letter Grade	Description
90-100	9.00- 10	O	Outstanding
80-89	8.00-8.90	A ⁺⁺	Exceptional
70-79	7.00-7.90	A ⁺	Excellent
60-69	6.00-6.90	A	Very Good
55-59	5.50-5.90	B ⁺	Good
50-54	5.00-5.40	B	Fair
45-49	4.50-4.90	C ⁺⁺	Average (Above)
41-44	4.1-4.49	C	Average
40	4.0	P	Pass
< 40	0.0	F	Fail (Unsatisfactory
	0.0	AB	Absent

- Non appearance in any examination / assessment shall be treated as the students have secured zero marks in that subject examination / assessment.

Semester - I

RM (ENV- 001:- Research Methodology – Part-I)

(Theory Course with 02 Credits)

Course Objectives

1. Student will know the different research approaches, scientific methods, criteria for good research and innovation.
2. Student will get knowledge of problems encountered while working on research plan , trouble shooting mechanism and field and laboratory problems.
3. Students will get the knowledge of data collection, presentation of data, data analysis and presentation of samples.

Teaching Scheme

Lectures	:-	2 hr/week
Tutorials	:-	1 hr/ week
Test	:-	1 hr/week
Total Credit	:-	02

Evaluation Scheme

Test	:-	10 Marks
Teacher Assessment	:-	15 Marks
Sem-End Examination	:-	25 Marks
Total Marks	:-	50 Marks

Unit-I:

Definition of research, Objectives of research, Research approaches, Significance of research, Research and scientific methods, Innovation and research, Research process, Criteria of good research, Defining the research problem, Technique involved in defining a problem, Research design, Important components and concepts related to research design, Developing a perspective research plan. 10+2

Unit-II:

Problems encountered during working of research plan, Trouble shooting mechanisms for encountering, Field and laboratory problems , Data collection-by survey method and by experimentation, Types of data, Data presentation methods, Data analysis, process of data analysis, Sampling -Collection of samples, Preservation of samples (soil, water, or live specimen or live samples), Selection of representative samples, Populations and samples. 10+2

Current developments in the subject.

Course Outcome

Students should able to:

1. Explain the different research approaches, scientific methods, criteria for good researches.
2. Describe the problems encountered while working on research plan, trouble shooting mechanism, field and laboratory problems.
3. Acquire knowledge of data collection, presentation of data, data analysis and presentation of samples.

Semester – I

FC (Env-401:- Foundation Course on Environment)

(Theory Core Course with 04 credits)

Course Objectives

Students will be able to know

1. Dynamics of ecosystems, energy flow in ecological system, nature of a biotic and biotic components and stability concept of ecosystem.
2. Various types of degraded ecosystems, ecological succession, concept of climax and role of pioneer's species in restoration of ecosystems.
3. Population dynamics, prey predator relationship, concept of community, community competition and ecological sustainability.
4. Nature and status of renewable and non-renewable resources, mineral resources, fishery resources, energy resources and recycle, reuse and recovery of these resources.

Teaching Scheme

Lectures	:-	4 hr/week
Tutorials	:-	1 hr/ week
Test	:-	1 hr/week
Total Credit	:-	04

	Evaluation Scheme	
Test	:-	20 Marks
Teacher Assessment	:-	30 Marks
Sem-End Examination	:-	50 Marks
Total Marks	:-	100 Marks

Unit-I: - Ecosystem Dynamics:

Concept of ecosystem, A biotic and biotic components, Energy in ecological system, Concept of productivity, Energy flow in ecosystem, Food chain, Food web, Ecological pyramids, Cybernetic nature and stability of ecosystem, Concept of habitat, Ecological niche, Guild, concept of ecotone, Edge effect, Ecological succession, Mechanism of succession, Concept of climax, Concept of Gaia hypothesis. **10+2**

Unit-II:- Restoration of Degraded Ecosystems:

Degraded ecosystems such as, Forest, grassland, Desert ecosystem, Lentic and Lotic ecosystems, Coastal ecosystems, etc., Role of pioneer species in restoration, Major biomes of world. **10+2**

Unit-III :- Population and Community Ecology:

Concept of population ecology, Population dynamics, Characteristics of population: Natality, Mortality, Fecundity, Density, Age distribution, Prey predator Relationship, Population explosion: Concept of community, Interspecific and intraspecific competition, Concept of carrying capacity, Ecological sustainability. **10+2**

Unit-IV :- Natural Resources :

Renewable and non-renewable resources, Wild life resources, Water resources, Water use, Water conservation, Rain water harvesting, fishery resources, Mineral resources, Impact of over exploitation of mineral resources, Exploitation of metallic ores, Energy resources, Conventional and non-conventional energy resources, Natural resource conservation practices, Recycle, reuse and recovery of resources through 3 R principles. **10+2**

Unit-V : Environmental Pollution:

Air pollution	:-	Sources, Air pollution episodes and disasters, Industrial pollution, Major effects of air pollution, Control measures. 10+2
Water pollution	:-	Sources, Types, Water pollution episodes and disasters, Major effects, Monitoring and preventive measures.
Noise pollution	:-	Sources, Vibration and impact isolation, Monitoring of noise, Noise pollution control equipments, Noise standard and control measures.
Soil pollution	:-	Sources, Effects, Methods of soil reclamation, Soil conservation measures.
Radiation	:-	Major sources, Nuclear fusion and fission effects, Use of nuclear weapons and their consequences, Impact, Radioactive risk assessment and waste disposal practices.

Current development in the subject.

Course Outcome

Students should able to:

1. define ecological systems and its functionality along with stability concept of ecosystem
2. Describe various types of pioneer species and their role in restoration of ecosystems.
3. Recognize ecological succession, concept of climax and degraded ecosystem.
4. Examine nature and status of renewable and non renewable energy resources, mineral resources and energy resources.

Semester – I
CC (Env-402 :- Environmental Chemistry)
(Theory Core Course with 04 credits)

Course Objectives

Students will be able to know

1. Understand the basics of Environmental Chemistry
2. Acquire the knowledge of composition of Air, Water & Soil
3. Identify the chemical contamination in Environment.
4. Analyze process for Air, Water & Soil
- 5.

Teaching Scheme

Lectures	:-	4 hr/week
Tutorials	:-	1 hr/ week
Test	:-	1 hr/week
Total Credit	:-	04

Evaluation Scheme

Test	:-	20 Marks
Teacher Assessment	:-	30 Marks
Sem-End Examination	:-	50 Marks
Total Marks	:-	100 Marks

Unit-I :- Basic Concepts of Environmental Chemistry :

Energy-definition, types (kinetic and potential), Forms of energy : Laws of thermodynamics (First & Second), Stoichiometry , Gibbs energy, Chemical potential, Chemical equilibrium, Acid-base reactions. Solubility product, Solubility of gases in water, The Carbonate system, Unsaturated and Saturated hydrocarbons, Radionuclide. 10+2

Unit-II :- Chemical Agents in Environment:

Introduction, definition, Scope, Importance , Role of chemical agents in environment, Basic water chemistry, Chemical bonding, Solubilization, and ionization , Impurities, Basic principles and sources, Gases solubility in water, Heat influencing chemical reactions, Solubility of impurities, Characteristics of sanitary spent water, Concentration, Normality, Molarity, concept of dilution , Serial dilution, Single step and multiple step dilution, Sample collection guidelines, Sample preservation , Sample order, Data collection and record keeping. 10+2

Unit –III :- Chemistry of Air :

Classification of elements, Composition of air, Chemical speciation, particles, Ions and radicals in the atmosphere, Chemical processes for formation of inorganic and organic particulate matter, Toxic chemicals in environment, Pesticides, Insecticides, Arsenic, Cadmium, Lead, Mercury, Carbon monoxide and Ozone, MIC and other carcinogens in air and water. 10+2

Unit –IV :- Chemistry of Water and Soil:

Chemistry of water, Structure of water molecule, Solubility of compounds in water, Dissociating constant, Water quality parameters and standards, Chemistry of soil, Composition of soil, Biogeochemical cycles (nitrogen, oxygen, carbon, sulphur, phosphorus etc), Micronutrients of soil, Factors effecting the soil quality, Adsorption of contaminant in soil, Toxic chemicals present in soil. 10+2

Unit – V :-Global warming and green house gases :

Global warming, Effects, Control of global warming, Carbon sequestration, International agreements, Green house gases , Impact on global climate, Consequences of green house effects, Impact of global warming, Formation of ozone, Mechanism of ozone depletion , CFC and ozone layer depletion, Chemistry of photochemical smog, HCFC, NO₂, HC and PAN, Chemistry of cleaning agents, Soap, Detergents and bleaching agents, Chemistry of colloids, Gasoline and additives antiknock compounds, Lubricants and greases, Biogases. 10+2

Current development in the subject

Course Outcome

Students should able to:

- Define basics of environmental chemistry
- Explain chemical contamination in environment
- Apply the knowledge of chemistry to analyze air, water and soil quality
- Evaluate the level of contamination in environment

Semester – I
CC (Env-403:- Environmental Instrumentation and Analysis)
 (Theory Core Course with 04 credits)

Course Objectives

Students will be able to

1. Study different sampling techniques, sampling equipments, sample preservation and processing of air, water and soil samples.
2. Use instruments for Studies.
3. Know analytical Instrumentation.
4. Apply Knowledge of instruments in Environmental Fields.

Teaching Scheme

Lectures	:-	4 hr/week
Tutorials	:-	1 hr/ week
Test	:-	1 hr/week
Total Credit	:-	04

Evaluation Scheme

Test	:-	20 Marks
Teacher Assessment	:-	30 Marks
Sem-End Examination	:-	50 Marks
Total Marks	:-	100 Marks

Unit-I: - Introduction and sampling techniques:

10+2

Samples preparation, preservation and processing of air, water and soil samples, sampling equipments, separation and sampling techniques, precipitation, fractional crystallization, fractional distillation, solvent extraction, accuracy and precision, types of errors, trouble shooting of instruments.

Unit – II: - Chromatography:

10+2

Theory, Principles , working, methods and application of Thin Layer Chromatography (TLC) , Gas Chromatography (GC) , High Performance Liquid Chromatography (HPCL), Gas Liquid Chromatography (GLC), Ion Exchange Chromatography

Unit-III: - Spectrophotometry :

10+2

Theory , principles, working methods, and application of colorimeter and spectrophotometer, ultra violet (UV) spectrophotometer, Infra Red (IR) spectrophotometer, Nuclear Magnetic Resonance (NMR), Atomic Absorption Spectrophotometers (AAS), flame photometer , fluoride meter, Conductivity meter, Nephelometer turbidity meter , pH meter .

Unit-IV: - Air Sampling Equipments:

10+2

Theory and applications of High Volume Air Sampler (HVAS), Respirable Suspended Particulate Matter (RSPM) measurement and its scope, Suspended Particulate Matter (SPM) analytical significance, its measurement and practical importance , Anderson Sampler, Tilak air sampler, non-dispersive infrared analyzer (NDIR) Pulsed fluorescent analyzers and chemiluminescent analyzer .

Unit-V :- Microbiological instruments and Equipments:

10+2

Theory, principles, working and application of Colony Counter, Autoclave, Oven, Incubator, Laminar air flow and BOD incubator

Current developments in the subject

Course Outcome

Students should be able to:

1. Describe sampling techniques, instrumental operations and trouble shooting
2. Categorize analytical instruments used for environmental problems.
3. Illustrate application of specific analytic instrument for pollution studies.

Semester – I

EC (Env-421 A :- Wildlife Conservation and Management)

(Theory Elective Course with 04 credits)

Course Objectives

Students will be able to

1. To understand the value of wildlife, its ecological importance and its scientific, commercial and ethical value.
2. Explain the threats and causes of loss of wild life and extinctions of wild species from India.
3. Illustrate different wild life conservation methods, and importance of protected areas conservations such as national parks, biosphere reserves, zoos, botanical gardens and gene banks.
4. Know the importance of wildlife management, management of forest fires, water resources, shelters and corridors management for wild life protection.

Teaching Scheme

Lectures	:-	4 hr/week
Tutorials	:-	1 hr/ week
Test	:-	1 hr/week
Total Credit	:-	04

Evaluation Scheme

Test	:-	20 Marks
Teacher Assessment	:-	30 Marks
Sem-End Examination	:-	50 Marks
Total Marks	:-	100 Marks

Unit-I :- Introduction to wildlife :

Definition and concept of wildlife, Value of wildlife- ecological importance, Commercial value, Scientific value, Game value, Recreational value, and Ethical value, Status of wildlife-abundant, Threatened, Endangered, Greatly endangered, Extinction-prone, Extinct, and vermin, Wildlife distribution in India-Himalayan mountain system (north east and north west), Peninsular India, Tropical rainforest region of Indian, Indian desert.

10+2

Unit- II :- Threats and causes of loss of wildlife :

Pollution, Hunting, Superstitions, Over exploitation, Developmental activities, Mining, Destruction of forest, Habitat degradation, Trade in wildlife-history of trade in wildlife, Trade in live animals, Trade in wildlife products, Wildlife trade in India, CITES.

10+2

Unit- III :- Endangered Fauna of India :

Causes of extinction of wild species, Endemic wild species from India, Endangered wild animals from India-Mammals, Birds, Reptiles, Amphibians.

10+2

Unit – IV :- Wildlife Conservation :

Need of wildlife conservation, Types conservation-In-situ conservation, Ex-situ conservation, Wildlife conservation methods, Species specific conservation methods, Crocodile breeding project, Musk deer breeding project, Project Hangul , Project elephant, project tiger etc., Community conservation methods, Protected areas such as sanctuaries, National parks, Biosphere reserves, Zoo's, Botanical gardens & gene banks.

10+2

Unit- V:- Wildlife Management:

Need of wild life management, Wildlife management principles, Wildlife management techniques, Control hunting technique, Ecosystem management for wildlife, Sanctuary and national park management , Management of forest fires, Management of water resources, Shelters, Habitats, roads, Corridors management for wildlife.

10+2

Current developments in the subject.

Course Outcome

Students should be able to:

1. Identify the value of wildlife, its ecological importance and its scientific, commercial and ethical values.
2. Examine the threats and causes of loss of wildlife, extension of wildlife species from India.
3. Assess different wildlife conservation methods and importance of protected area such as national parks, biosphere reservoirs, zoo, botanical gardens and gene bank.
4. Evaluate importance of wildlife management, management of forest fires, water resources, shelters and corridors management for wildlife protection.

Semester – I
EC (Env-421-B:- Environmental Meteorology & Geosciences)
 (Theory Elective Course with 04 credits)

Course Objectives

Students will be able to

1. Know different climatic regions of the world, distribution of vegetation and condition of climate in India.
2. Know the various seasons in India distribution of rainfall, forecast of monsoon and climatic considerations in Agriculture and Industrial sector.
3. Identify meteorological parameters to forecast the weather, scale of meteorology and to establish ambient and emission standards.
4. To assess different earths process, natural cycles and risk of geological hazards, like earth quake, floods, landslides, volcanism etc.

Teaching Scheme

Lectures	:-	4 hr/week
Tutorials	:-	1 hr/ week
Test	:-	1 hr/week
Total Credit	:-	04

Evaluation Scheme

Test	:-	20 Marks
Teacher Assessment	:-	30 Marks
Sem-End Examination	:-	50 Marks
Total Marks	:-	100 Marks

Unit-I: - Climate:

Weather, Climate, Physiographic and geological homogeneity of India, Geo-economic significance, Major climatic regions of the world based on latitude and distribution of vegetation, Condition of climate, Classification of climates, Criteria for classification, Thornthwaites and Koppens classification. 10+2

Unit –II: - Climates of India:

Climates of India, Indian monsoon, Jet streams general circulation, The seasons mechanism of monsoon, Forecast of monsoon various seasons, Distribution of rainfall, Drought prone areas, Flood prone areas, Climate change, Causes and consequences of global warming, Ozone hole, Sea level rise in climate, Climatic considerations in industrial locations, (El-Nino, droughts, tropical cyclones and western disturbances, IPCC, UNFCCC, Kyoto protocol) 10+2

Unit – III: - Meteorology:

Scale of meteorology, Meteorological fundamentals, Primary and secondary meteorological parameters, Temperature, Pressure, wind, Humidity, Adiabatic lapse rate, Miringhighs, Wind velocity, Wind roses, Turbulence, Plume behavior, Weather forecasting, Establishing ambient and emission standards, Application of meteorological principles to transport and diffusion of pollutants. 10+2

Unit – IV: - Environmental Geosciences :

Fundamental concepts, Earth system and biosphere, Conservation of matter in various geosphere, lithosphere, Hydrosphere, Atmosphere and biosphere, Energy budget of the earth, Earths thermal environment and seasons, Mineral structures and their compositions, Trace elements and their partitioning during mineral formation. 10+2

Unit – V: - Earths Processes and Geological hazards :

Earths processes, Concept to residence time and rates of natural cycles, Catastrophic geological hazards, Study of earthquakes, Volcanism, floods, Landslides, Avalanche etc. prediction and perception of hazards, Adjustment to hazardous activities, Assessment of geological hazards and risks. 10+2

Current developments in the subject.

Course Outcome

Students should be able to:

1. Classify different climatic regions of the world, distribution of vegetations and climatic conditions in India.
2. Compare the various seasons in India, distribution of rainfall, monsoon forecast and climatic conditions, in agricultural and industrial sectors.
3. Identify the meteorological parameters to forecast the weather, scale of meteorology and establish ambient and emission standards.
4. Evaluate different earth process, natural cycles and risk of geological hazards.

LC: ENV 441:Lab Course – I
(Based on CC Env. 401)

Lab Course	:- 4 hr/week		
Assignment / field work/ outreach activities	:- 2 hr/week	Teacher Assignment	:- 15 Marks
Total Credit	:- 02	Sem-End Examination	:- 25 Marks
		Total Marks	:- 50 Marks

Evaluation Scheme

1. Determination of primary production as GPP & NPP by light and dark bottle technique.
2. Identification and enumeration of phytoplankton in water body.
3. Identification and enumeration of zooplanktons in water body
4. Ecological adaption of hydrophytes, mesophytes and xerophytes.
5. Quantitative analysis of planktons by Sedgwick rafter cell method.
6. Estimation of biomass from grassland by harvest method.
7. Productivity study of grassland ecosystem by harvest method.
8. Determination of relative density relative frequency and relative abundance of species by using simulation.
9. Profile study of natural pond/lake and manmade reservoir.
10. To study fresh water resources water quality parameters like pH, EC, total acidity , total alkalinity, DO, CO₂, TS, TDS, TSS, BOD, Colifom, MPN, etc.
11. To study the cover and based area study of tree species
12. To study the light intensity by sunshine record.

Field activities:

1. Visit to aquatic ecosystem for collection of water and plankton samples.
2. Visit to terrestrial ecosystem for productivity studies.
3. Study of wetland Flora and fauna and the status study.

LC: ENV 443:Lab Course – III
(Based on CC Env. 403)

Lab Course	:- 4 hr/week		
Assignment / field work/ outreach activities	:- 2 hr/week	Test :-	10 Marks
		Teacher Assignment :-	15 Marks
Total Credit	:- 02	Sem-End Examination :-	25 Marks
		Total Marks :-	50 Marks

1. Study on the principle, component and working operation of Flame photometer and its applications.
2. Determination of turbidity by nephelometer/ turbidity meter from water /sewage.
3. Calibration of pH and conductivity meter and their applications.
4. Studies on the principle, components and working operations of calorimeter and spectrophotometer.
5. Demonstration of HPLC for pesticide analysis.
6. Determination of dissolved oxygen content from sewage samples by using DO meter.
7. Study of color of water /sewage sample by using tintometer.
8. Determination of fluorescent compound by using photofluorometer.
9. Separation of chlorophyll pigments of green leaf by using thin layer chromatographic technique.
10. Separation of a mixture of amino acid by using paper chromatography.
11. Separation of geometric isomer compounds by using column chromatography.
12. Demonstration atomic absorption spectroscopy (AAS) for heavy metal analysis.
13. Study of Tilak Air Sampler / Anderson air sampler for biomonitoring .

Activities :- Field visits to various industries and research institutes to learn various instrumental techniques its operation and maintenance studies.

LEC (ENV 444-B :Lab Course – IV)
(Based on EC Env. 421-B)

Lab Course	:- 4 hr/week		
Assignment / field work/ outreach activities	:- 2 hr/week	Teacher Assignment	:- 15 Marks
Total Credit	:- 02	Sem-End Examination	:- 25 Marks
		Total Marks	:- 50 Marks

1. **Collection techniques and sampling devices for gaseous pollutants**
 - i) Absorption sampling, ii) Adsorption sampling, iii) Freeze out or condensation sampling, iv) Grab sampling.
2. Study of micrometeorological equipments.
3. Determination of relative humidity of air .
4. Determination of atmospheric pressure by using Barometer.
5. Determination of wind speed by using Anemometer.
6. Determination of wind direction by using wind vane.
7. Interpretation of wind rose diagram.
8. Determination of Air pollution index.
9. Determination at carbon dioxide from air by using Lungs Zincondroff apparatus.
10. Determination of NO_x in ambient air by high volume sampler (HVS).
11. Measurement of SO_x by high volume sampler (HVS).
12. Measurement of SPM by using high volume sampler (HVS).
13. Measurement of RSPM by using Respirable Dust Sampler.
14. Determination of atmospheric lead & other metals by using impinger techniques and AAS.
15. Identification of minerals on the basis of physical properties (10 minerals specimens).
16. Identification of rocks: Igneous rock, sedimentary rock and metamorphic rocks.
17. Smoke monitoring by ring chart.
18. Determination of polynuclear aromatic hydrocarbon from air.

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LC: ENV 446:Lab Course – VI
(Based on CC Env. 405)

Lab Course	:- 4 hr/week		
Assignment / field work/ outreach activities	:- 2 hr/week	Test	:- 10 Marks
		Teacher Assignment	:- 15 Marks
Total Credit	:- 02	Sem-End Examination	:- 25 Marks
		Total Marks	:- 50 Marks

1. To assess the lifecycle of different industrial product from cradle to grave.
2. To study the recycling, reuse and disposal practices of different industrial wastes.
3. To study zero waste technology of any two industrial units.
4. To study in detail on the provisions of ISO 14000, with respect to green product design .
5. To study on ecolabelling from pharmaceuticals, foods, cosmetics, automobiles and electronic industry.
6. To assess the impact of materials on biodiversity, resources and ecosystems.
7. To study bio-fuel production methods and characterization for biodiesel and bio-ethanol.
8. To study the application of green chemistry concept in industries.
9. To study application of green chemistry concept in agricultural related practices and food processing units.
10. To study in detail the concept of green building in urban areas.
11. To study the chemical reactive involve in green nanotechnology, nano-particle production and characterization.

LEC: ENV 448- A :Lab Course – VIII
(Based on EC Env. 422 -A)

Lab Course	:- 4 hr/week		
Assignment / field work/ outreach activities	:- 2 hr/week		
Total Credit	:- 02		
		Evaluation Scheme	
		Test	:- 10 Marks
		Teacher Assignment	:- 15 Marks
		Sem-End Examination	:- 25 Marks
		Total Marks	:- 50 Marks

1. Study on International and National standard of Air, Water and Soil
2. Study in detail on Environmental accounts and auditing, green funding and taxes trade and environmental management in any two industrial units.
3. To evaluate the adverse effect of lack of environmental planning in industries (any two)
4. To prepare base line data on water, soil , air, natural assets, demography , and heritage of any two project areas.
5. Study of rural and urban environmental planning at regional level.
6. Study on resource planning at regional and national level.
7. Study on Gandhian concept of self relied villages.
8. Study of ISO: 14000 and OSHAS 18000
9. Studies on LCA of pulp and paper industry , food industry and crop plants.
10. To study the Ramsar Convention on wetlands with few case studies.
11. To study the application of Vienna Convention Montreal protocol and kyoto protocol in India.
12. To study trade and commerce practice and fair environmental practice at national and international level.

Activities : - Field visit to various industries, major project areas and National management Institutes to study in detail on Environmental management systems.

Semester – III
CC (Env-501 :- Municipal & Hazardous waste Management)
(Theory Core Course with 04 credits)

Course Objectives

Students will be able to know

1. Current Scenario of MSW, Model's for appropriate waste collection.
2. Management & Handling Rules of MSW.
3. Identification of Hazardous Waste sources & Characteristics.
4. Designing & Operation facilities for Hazardous waste.
5. Bio-Medical Handling & Management Rule's 2008

Teaching Scheme

Lectures	:-	4 hr/week
Tutorials	:-	1 hr/ week
Test	:-	1 hr/week
Total Credit	:-	04

Evaluation Scheme

Test	:-	20 Marks
Teacher Assessment	:-	30 Marks
Sem-End Examination	:-	50 Marks
Total Marks	:-	100 Marks

Unit I- Introduction

Introduction to MSW, Composition and Waste characteristics of MSW, Collection, Segregation and Transfer Operation, Waste system, current scenario, MSW generation in India, Model for appropriate waste collection and segregation, reference model, mode of collection, micro-route planning and maps, transfer stations, Management and Handling Rules of MSW.

Unit II- Treatment Method for MSW

1. Anaerobic Digestion, 2. Aerobic Digestion, 3. Vermi composting, 4. Incineration, 4) Mass Burn and Refuse-Derived Fuel, 5. Waste To Energy (WTE), Dioxin and furans, heavy metals, 6. Landfill (Basic Landfill Constructions and operations, Decomposition and phases in Landfill) Types landfills (Secured Landfill, Sanitary Landfill).

Unit III- Integrated Solid Waste Management

Source Reduction, Green Product Design Strategies, Material Selection, Product System Life Extension, Material Life Extension, Reduced Material Intensiveness, Process Management, Efficient Distribution, Eco-labels, Lifecycle Assessment, The 5 R's-Reduce, Recycle(Paper & Paperboard, Plastics, Glass Containers, Aluminium), Reuse , Remanufacture, Recover(Energy Recovery & Material Recovery) Case Study (Polystyrene Cups, Soft-Drink Containers).

Unit- IV- Hazardous Sources and Management

Hazardous Waste Management: Definition and identification of hazardous wastes-sources and characteristics – hazardous wastes in Municipal Waste – Hazardous waste regulations –minimization of Hazardous Waste-compatibility, handling and storage of hazardous waste-collection and transport, e- waste -sources, collection, treatment and reuse management.

Unit-V- Hazardous treatment Methods

Hazardous waste treatment and Design: Hazardous waste treatment technologies - Design and operation of facilities for physical, chemical and thermal treatment of hazardous waste –Solidification, chemical fixation and encapsulation, incineration. Hazardous waste landfills: Site selection, design and operation –remediation of hazardous waste disposal sites. Biomedical Waste management: Biomedical (Handling and Management) Rules 2008, sources, treatment and disposal.

Current development in the subject.

Course Outcome

Students should be able to:

1. Discuss current scenario of MSW, models for appropriate waste collection.
2. Apply management and handling rule of MSW
3. Differentiates of hazardous waste sources and characteristics
4. Create designing and operation facilities for hazardous waste
5. Evaluate biomedical handling and management rule 2008

CC (Env-502 :- Remote Sensing and GIS Application for Environmental Management)
(Theory Core Course with 04 credits)

Course Objectives

Students will be able to know

1. Types of Aerial Photography, Photo Interpretation & Mapping of Objects.
2. Scope of Remote Sensing & there Application.
3. Scope of GIS, Advance's in GIS & the application of GPS.
4. Applications of RS & GIS for soil erosion, flood Mapping, wildlife, grassland status.
5. Wildlife conservation & Management, urban planning & GIS in Disaster Management.

Teaching Scheme

Lectures	:-	4 hr/week
Tutorials	:-	1 hr/ week
Test	:-	1 hr/week
Total Credit	:-	04

Evaluation Scheme

Test	:-	20 Marks
Teacher Assessment	:-	30 Marks
Sem-End Examination	:-	50 Marks
Total Marks	:-	100 Marks

Unit-I: Aerial Photography and Photogrammetry:

Sensory organ eye and camera, Working principle of camera, Camera types, cameras used in aerial photography, Aerial photography- history of aerial photography, Platforms used in aerial photography, Methods of aerial photography, Types of Aerial photographs (vertical & oblique photographs), Geometry of aerial photographs, Scale of aerial photographs; Stereoscopic vision, Stereoscopes, stereoscopic photographs, Parallax bar, Photogrammetry – Photo interpretation, mapping of objects from aerial photographs.

Unit-II: Remote Sensing:

Introduction and scope of remote sensing, Stages in remote sensing, Fundamental principle of remote sensing- Electromagnetic spectrum, Transmission, Absorption, Reflection, atmospheric scattering, emissivity, Radiant energy and its interaction with matter and earth surface and atmosphere, spectral signature, Platforms in remote sensing, Active and passive remote sensing, Remote sensing sensors.

Unit-III: Satellite Remote Sensing:

Polar and geostationary satellites, Meteorological satellites and non-meteorological remote sensing satellites, Landsat, Spot, IRS, ERS, JERS, Quickbird; Sensors-Pushbroom and Whiskbroom types, Data reception, Archiving and distribution of data, Radar and LIDAR as Active Remote Sensing Systems, Working of Radar, Satellite images, Radar Images.

UNIT-IV: Geographic Information System (GIS):

Definition, Scope of Geographic Information System, Capabilities and advances of GIS, Use of GIS in spatial and temporal analysis, Components of GIS system, GIS software's; Digital Image processing- Image structure, Raster and Vector data types, Image enhancement and rectification, Band combination, Geo referencing the data, Image classification, image interpretation. Geographical Positioning System, Applications of GPS.

UNIT-V: Application of RS and GIS:

Application of RS& GIS - in Environmental Systems, soil erosion study, flood mapping and flood damage study, Agricultural study, Natural resources study such as Water, soil, wildlife, Grassland, minerals & Metals etc. ;Use of RS &GIS in Environmental Audit. Use of RS&GIS in Environmental Management study- in soil Conservation and Management, in Water Shade Management, in forest conservation & management, in wildlife conservation and management, in Urban Planning. Use of RS and GIS in Disaster management

Current development in the subject.

Course Outcome

Students should be able to:

1. Define and discuss the concepts and components of aerial photographs
2. Summarize the principle and procedure of remote sensing
3. Identify and use the different types of satellite images and aerial photographs
4. Illustrate the use of GIS software for extraction of information and interpretation
5. Demonstrate the use of RS and GIS in environmental study and management

Semester – III
CC (Env-503 :- Environmental Toxicology and Biodiversity Assessment)
 (Theory Core Course with 04 credits)

Course Objectives

Students will be able to know

1. Scope of Toxicology, Source's of Toxicants in Atmospheres, Hydrosphere & Soil.
2. Recent Trend's in pesticides, factors affecting metabolism of Xenobiotics.
3. Bio-assay Test, Protocol of Toxicity Evaluation.
4. Important of Biodiversity, Causes of Loss of Biodiversity.
5. Need of Biodiversity Assessment, Biodiversity Measurements & Extinct Species.

Teaching Scheme

Lectures	:-	4 hr/week
Tutorials	:-	1 hr/ week
Test	:-	1 hr/week
Total Credit	:-	04

Evaluation Scheme

Test	:-	20 Marks
Teacher Assessment	:-	30 Marks
Sem-End Examination	:-	50 Marks
Total Marks	:-	100 Marks

UNIT- I : Introduction to Toxicology:

Scope of toxicology and eco-toxicology, Branches of toxicology - clinical, environmental, economic, forensic, industrial, genetic, systemic and behavioral; Environmental toxicology- environmental toxicants - toxicant in atmosphere, toxicants in hydrosphere, toxicant in soil; Source of toxicants / poisons in atmosphere, hydrosphere and soil; Acute toxicity, Chronic toxicity and Safe concentration; Neurotoxicity, carcinogenicity and mutagenicity.

UNIT-II: Classification of toxicants:

Natural and synthetic, Pesticides- classification of pesticides, mode of action of pesticides; Recent trends in the use of pesticides; Plant toxins- Aflatoxins, ergots, pyrethroids; Heavy metal toxicants and their toxicity - lead, arsenic, mercury, cadmium and chromium, copper; Zinc; Xenobiotic components- Factors affecting metabolism of xenobiotics; Exposure of toxicants- Routes and sites of exposure, types of exposure - acute and chronic, Dose- response relationship, Dose response curve; Translocation of toxicants - absorption, distribution and extraction; Mechanism of action of toxicants; Selective toxicity; bioaccumulation of toxicants.

UNIT-III: Bio-assay:

Bio-assay tests, Concept of lethal concentration and lethal dose, Protocol of toxicity evaluation of toxicants, Determination of LC_{10} , LC_{50} & LC_{90} for exposure period, Tests for assessing carcinogenicity and mutatoxicity of toxic compounds, TLC techniques for determination of toxicants in water and vegetables samples

Unit-IV: Introduction to biodiversity:

Importance of biodiversity; value of biodiversity; Types of biodiversity- alpha and beta biodiversity; genetic diversity, species diversity and ecosystem diversity; causes of loss of biodiversity; measurements of biodiversity; listing of threatened biodiversity;

Unit-V: Biodiversity Assessment :

Need of biodiversity assessment, Qualitative and quantitative assessment, Biodiversity measurement methods, Diversity indices – Species richness indices, Species evenness indices, Wildlife status- Abundant, Threatened, Endangered, Greatly endangered, Extinction prone and Extinct species.

Current development in the subject.

Course Outcome

Students should able to:

1. Describe the basic principle of environmental toxicity.
2. Apply the different toxicity tests and protocols of toxicity.
3. Categorize toxicants and biodiversity.
4. Assess the biodiversity.

Semester – III
EC (Env-521-A :- Environmental Plan, Policies and Legislation)
(Theory Core Course with 04 credits)

Course Objectives

Students will be able to know

1. Environmental Management Plan (EMP).
2. Need & Law, Importance of Environmental Legislation.
3. Prevention & Control Rules & Regulations.
4. Government Policies for Protection & Development of Environment, Concept of Green Building.

Teaching Scheme

Lectures	:-	4 hr/week
Tutorials	:-	1 hr/ week
Test	:-	1 hr/week
Total Credit	:-	04

Evaluation Scheme

Test	:-	20 Marks
Teacher Assessment	:-	30 Marks
Sem-End Examination	:-	50 Marks
Total Marks	:-	100 Marks

Unit- I: Environmental Management Plans (EMP):

- Conceptualization: preliminary environmental assessment
- Planning: detailed studies of environmental impacts and design of safeguards
- Execution: implementation of environmental safety measures
- Operation: monitoring of effectiveness of built-in safeguards

Unit-II:

General: Need of laws, Importance of environmental legislation, National Environmental Policy Act (NEPA), History of environmental laws in India- Laws about environment in historic period, Laws about environmental component adopted during British rule – The Indian Forest Act, 1927.

Environment: -Environmental (Protection) Act, 1986; Environmental (Protection) Rules, 1986; The Hazardous Waste (Management and Handling) Rule, 1989; The Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996; The Bio-Medical Waste (Management and Handling) Rules, 1998; The Recycled Plastics Manufacture and Usage Rules, 1999; The Noise Pollution (Regulation and Control) Rules, 2000; The Municipal Solid Wastes (Management and Handling) Rules, 2000. CRZ Notification of 2011.

Unit- III:

A] Air: - The Air (Prevention and Control of Pollution) Act, 1981; The Air (Prevention and Control) Rules, 1982.
B] Water: - The Water (Prevention and Control of Pollution) Act, 1974; The Water (Prevention and Control of Pollution) Rules, 1975. C] Forest: - The Forest Conservation Act, 1980; The Forest (Conservation); Rules, 1981; The National Forest Policy, 1988. D] Wildlife: - The Wildlife (Protection) Act, 1972; The Wildlife (Protection) Rules, 1995; The Recognition of Zoo, Rules, 1992.

Land acquisition Act, Land Acquisition R&R bill, state laws / Policies on R& R

Unit IV: Environmental policy:

Government policies in the protection and development of environment – environmental considerations in economic planning and development in India. Public policy strategies in pollution control. Environmental policy resolution. NCEP and district environmental status report preparation. Environmental forest clearance processes, National Green Tribunals (NGT). Concept of Green building, criteria and component in green building design.

Unit V:

A) Stockholm Conference; Earth Summit, Johannesburg Summit, Rio Declaration, Agenda 21; United Nations Environment Programme (UNEP), International Union For Conservation of Nature and Natural Resources (IUCN), World Water Council (WWC), World Health Organization (WHO), World Wide Fund for Nature (WWF).IPCC.

Current development in the subject.

Course Outcome

Students should be able to:

1. Describe environmental management plan (EMP), environmental rules, laws and policies.
2. Explain need of laws, importance of environmental legislations, governmental policies for protection and development of environment.
3. Rearrange prevention and control rooms, regulations and governmental policies.
4. Design various strategies of pollution control techniques, green buildings, NCEP and environmental policies resolutions.

Semester – III
EC (Env-521-B: - Ecological Foot Prints & Carbon Sequestration)
 (Theory Core Course with 04 credits)

Course Objectives

Students will be able to know

1. Concepts of Ecological Footprint, Carbon capturing for sustainable future.
2. Carbon Emission and Global issues and remedial measures.
3. Types of carbon sequestration, Carbon sequestration as green house mitigation policy.
4. Pattern of energy use, carbon credit, trading and tax.

Teaching Scheme

Lectures	:-	4 hr/week
Tutorials	:-	1 hr/ week
Test	:-	1 hr/week
Total Credit	:-	04

Evaluation Scheme

Test	:-	20 Marks
Teacher Assessment	:-	30 Marks
Sem-End Examination	:-	50 Marks
Total Marks	:-	100 Marks

Unit I: Carbon footprints and Sustainability:

Concept of ecological footprints, origin of ecological footprints, ecological footprint and policy development, ecological foot print and sustainability indicators, Environmental ethics, consumerism and carbon emission trends, comparison of rural and urban consumerism, sources of carbon emission, carbon footprints and ecological stability India's ecological footprint, concept of sustainable human society, carbon capturing for sustainable future.

Unit II: Carbon emission and Global Issues:

Nature of environmental problems, intensity, general causes, and impacts of global, regional and local environmental problems, population explosion and carbon emission trends, carbon emission and global warming, carbon emission and climate change, ozone layer depletion, acid rain, loss of biodiversity, environmental degradation, pollution of air, water and soil, mitigation and remedial measures.

Unit III: Carbon Sequestrations:

Carbon sequestration concept, introduction, types of carbon sequestration, terrestrial carbon sequestration, geological sequestration, ocean sequestration, National Energy Technology Laboratory (NETL), Concept of carbon sequestration in plants, animals and soil, carbon sequestration in food chain, food web, carbon storage in plant and soil, carbon sequestration as greenhouse mitigation policy, role of trees, vegetation and forest in carbon sequestration, monitoring and measurement of wood and soil carbon.

Unit IV: Carbon credits:

Pattern of energy use, energy technologies and environmental impacts, need of carbon trading, Concept and theme of Kyoto protocol, role of international agencies, obligation on nations for carbon emission reduction, Kyoto declaration, Economics of carbon sequestration, legal and institutional issues, carbon credit evaluation mechanics, carbon credit-trading and tax.

Unit V: Energy Conservation and Carbon Trading:

Domestic energy needs, social energy utilization pattern, energy use and carbon emission in industrial and commercial sectors, energy utilization pattern of global, national and local levels, methods for the conservation of energy, Concept of carbon trading, Carbon marketing potential, carbon credits and agriculture, Scope of carbon trading in India.

Current development in the subject.

Course Outcome

Students should be able to:

1. Identify the concepts of ecological footprint
2. Interpret carbon capturing for sustainable future
3. Apply carbon sequestration as green house mitigation policy
4. Create own consultancies

LC: ENV 541: Lab Course – IX
(Based on CC Env. 501 & 502)

Lab Course	:- 4 hr/week		
Assignment / field work/ outreach activities	:- 2 hr/week	Test	:- 10 Marks
		Teacher Assignment	:- 15 Marks
Total Credit	:- 02	Sem-End Examination	:- 25 Marks
		Total Marks	:- 50 Marks

1. Determination pH & Electrical Conductance of Municipal Solid Waste.
2. Determination of Total water soluble solids of Municipal Solid Waste.
3. Determination of Moisture content of Municipal Solid Waste.
4. Determination of Loss on Ignition of municipal Solid Waste.
5. Determination of Organic Carbon from Municipal Solid waste.
6. Determination of Total Kjeldahl Nitrogen from Municipal Solid waste.
7. Determination of Total Phosphorous in Municipal Solid waste.
8. Determination of Potassium of Municipal Solid Waste.
9. To study the percentage composition of degradable and non degradable material from solid waste.
10. To study the percentage of potential recycling material from municipal solid waste.
11. To study and list the laboratory safety and industrial safety principles and practices.
12. To study the impact of solid hazardous waste (toxic substance) on germination and growth of crop plants.
13. To study the conventional signs and symbols used in hazardous waste study.
14. Geological investigation and identification of landfill sites for solid waste management.
15. To study the leachable calcium and magnesium content from vermicompost prepared from municipal solid waste.
16. Developing appropriate microbial consortium for land applied effluents. (Bioremediation)
17. Methods for the Determination of Hazardous Characteristics of Wastes.
18. Determination of Ignitability of Hazardous waste by Setflash closed Cup Method/ Pen sky closed cup method.
19. Marginal information of toposheet and indexing of toposheet.
20. To study the conventional signs and symbols from toposheet
21. Interpretation of toposheet for specific objects.
22. To study the principle and application of: a) Pocket Stereoscopes, b) Mirror stereoscope, c) Parallax Bar.
23. Stereoscopic vision test by using pocket stereoscope.
24. Determination of scale of aerial photograph and satellite image.
25. Identification of features on vertical aerial photograph.
26. Land use and land cover study / mapping of objects from aerial photograph.
27. Orientation of stereo- model under mirror stereoscope and detection of objects from stereopairs.
28. Determination of GPS coordinates of selected area and confirmation of objects from satellite image /toposheet / ground truthing of objects.
29. GIS software's browsing of satellite data.
30. To study the land use and land cover visually by using satellite images tone texture and pattern etc.
31. Digital image processing- image registration , rectification and image enhancement.
32. Image interpretation- unsupervised and supervised classification.

**LC: ENV 543: Lab Course – XI
Project / Dissertation Part-I**

[Core course with 08 credits]

Total Marks -100

1. Project work -70 Marks (External Assessment)- Survey, Environmental Audit, Field Visit, Emergency Management Plan, EIA, EMP etc.
2. Project work -20 Marks (Internal Assessment)
3. Tour Report - 10 Marks (Internal Assessment) – Visit to Industry / Eco-Village etc.

Note: I) the project work is to be allotted after the end of the IInd semester.

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5. The Immanent Disaster A vision on Climate change by Sampooran Singh
6. Natural Resources of Himalaya by K.S.Gupta/
7. Fly Ash Amendment and plant Growth by Dr. S.M. Mohan
8. Environmental Education by Archana Tomar
9. Disaster management by S.Narayan
10. Biodiversity and Ecosystem Conservation by Ashish Dutta
11. Corporate governance for sustainable environment by Ramesh Chandra and Ritu Aneja
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**LC: ENV 546: Lab Course – XIII
Field Work and In-plant Training**

Lab Course	:- 4 hr/week
Assignment / field work/ outreach activities	:- 2 hr/week
Total Credit	:- 02

[Core course with 02 credits]

Total Marks: 50

In-Plant training -30 Marks (External Assessment)

In-Plant training -05 Marks (Internal Assessment)

Field work - 15 Marks (Internal Assessment)

(Garden Development and Maintenance / Lab. Cleaning & Maintenance, Chemical Preparation etc.)

Note: - In-Plant Training only for 15 Days in Industries/ Consultancy Lab/ Pollution Boards/ ETP, STP/ Research Institute/ R&D, NGO's/ Government Labs/ Sugar Factory/ etc.