

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,
CHHATRAPATI SAMBHAJINAGAR.



CIRCULAR NO.SU/PG/College./NEP/19/2024

It is hereby inform to all concerned that, the syllabi prepared by the Board of Studies/ Ad-hoc Boards & recommended by the Dean, Faculty of Science & Technology, **Academic Council at its meeting held on 08 April 2024 has accepted** the following Syllabi under the Faculty of Science & Technology **as per Norms of National Education Policy -2020** run at the Alliliated Colleges, Dr.Babasaheb Ambedkar Marathwada University as appended herewith.

Sr.No.	Courses	Semester
1.	M.Sc.Microbiology	IIIrd & IVth semester
2.	M.Sc.Botany	IIIrd & IVth semester
3.	M.Sc.Environmental Science	IIIrd & IVth semester
4.	M.Sc.Industrial Chemistry	IIIrd & IVth semester
5.	M.Sc.Biochemistry	IIIrd & IVth semester
6.	M.Sc.Chemistry Specialization Analytical Chemistry, Organic Chemistry, Inorganic Chemistry, Polymer Chemistry, Industrial Chemistry.	IIIrd & IVth semester
7.	MCA(Science)	IIIrd & IVth semester
8.	M.Sc (Forensic Science)	Ist to IVth semester
9.	M.Sc.Forensic Cyber	Ist to IVth semester

This is effective from the Academic Year 2024-25 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,
Chhatrapati Sambhajinagar.
431 004.

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*Deputy Registrar,
Academic Section*

REF.NO.SU/2024/244654
Date:- 21.06.2024

Copy forwarded with compliments to :-

- 1] **The Principal of all concerned Colleges,**
Dr. Babasaheb Ambedkar Marathwada University,
- 2] **The Director, University Network & Information Centre, UNIC, with a request to upload this Circular on University Website.**

Copy to :-

- 1] **The Director, Board of Examinations & Evaluation,** Dr Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
- 2] The Section Officer, [M.Sc.Unit] Examination Branch, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
- 3] The Programmer [Computer Unit-1] Examinations, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
- 4] The Programmer [Computer Unit-2] Examinations, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
- 5] The In-charge, [E-Suvidha Kendra], Rajarshi Shahu Maharaj Parkshu Bhavan, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
- 6] The Public Relation Officer, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
- 7] The Record Keeper, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.

**Dr. Babasaheb Ambedkar Marathwada University,
Chhatrapati Sambhajinagar**



FACULTY OF SCIENCE & TECHNOLOGY

2 Years P.G. Programme

For Affiliated Colleges

Course Structure and Curriculum

As per National Education Policy

2020

Subject: Environmental Science

(Effective from 2023-24)

Bomdilla
17/12/2024
Senior Professor & Head
Department of Environmental Science,
Dr. Babasaheb Ambedkar Marathwada University,
Chhatrapati Sambhajinagar

Two-Year Post-graduate Program

Course and Credits Distribution of Two years Master's Degree Program with Entry & Exit Option Faculty of Science & Technology

Year / level	Sem.	Major subject		RM	OJT /FP	RP	Credits	Degree
		DSC Core Mandatory	DSE (Elective)					
First year 6.0	I	3(4)+2=14	4	4			22	PG Diploma (after 3 years degree)
	II	3(4)+2=14	4		4		22	
Cum. Cr. For PG Diploma		28	08	4	4		44	
<i>Exit option with Post-graduate Diploma (44 credits) after first year or two semester with completion of courses equivalent to 44 credits</i>								
Second Year 6.5	III	3(4)+2=14	4			4	22	PG Degree after 3 years UG or PG Degree after 4 years UG
	IV	3(4)=12	4			6	22	
Cum. Cr. For 1 year PG Degree		26	8			10	44	
Cum. Cr. For 2 years PG Degree		54	16	4	4	10	88	
2 Years -4 sem.PG Degree (88 credits) after three year UG Degree								

Note- DSC-is based on specialization

ABBREVIATION:

Major – Comprising Mandatory –is based on specialization

DSE- Discipline Specific Elective

OJT – On-the- Job Training

FP – Field Project (Corresponding to the Major (Core) Subject

RP – Research Project (Corresponding to the Major (Core) Subject

Internship/Apprenticeship - (Corresponding to the Major (Core) Subject

AS PER NEP 2020 (for Colleges)

Illustrative Credit distribution structure for Two Years Post Graduate Programme with Multiple Entry and Exit options –

(Discipline Specific Core in Environmental Science)

Class: M.Sc. First Year Semester: Ist Semester

Subject: Environmental Science

Course type	Course Code	Course Name	Total Hours	Teaching Scheme (week)		Credits Assigned	
				Theory	Pr	Th	Pr
DSC	CENV-MJ-501-T	Basics of Environment	45	Theory	-	3	-
	CENV-MJ-501-P	Lab Course- I	30	-	Practical	-	1
	CENV-MJ-502-T	Environmental Chemistry	45	Theory	-	3	-
	CENV-MJ-502-P	Lab Course –II	30	-	Practical	-	1
	CENV-MJ-503-T	Environmental Pollution Studies	45	Theory	-	3	-
	CENV-MJ-503-P	Lab Course –III	30	-	Practical	-	1
	CENV-MJ-504-T	Waste Monitoring and Quality Measures	30	Theory	-	2	-
DSE	CENV-DSE-505-TA	Restoration Ecology and Watershed Management	45	Theory	-	3	-
	CENV-DSE-505-PA	Lab Course –IV	30	-	Practical	-	1
	CENV-DSE-505-TB	Environmental Metrology and Geosciences	45	Theory	-	3	-
	CENV-DSE-505-PB	Lab Course –IV	30	-	Practical	-	1
RM	CENV-RM-506-T	Research Methodology	45	Theory	-	3	-
	CENV-RM-506-P	Lab Course-V	30	-	Practical	-	1

Total Theory and Practical Credits = (3+3+3+3+3+2)+ (1+1+1+1+1) = 22

Note: Candidate has to select one theory & its related practical Elective Paper from CENV-DSE-505-TA & CENV-DSE-505-PA or CENV-DSE-505-TB & CENV-DSE-505-PB.

Class: M.Sc. First Year Semester: IInd Semester
Subject: Environmental Science

Course type	Course Code	Course Name	Total Hours	Teaching Scheme (week)		Credits Assigned	
				Theory	Practical	Th	Pr
DSC	CENV-MJ-551-T	Environmental Toxicology and Health	45	Theory	-	3	-
	CENV- MJ-551-P	Lab Course- VI	30	-	Practical	-	1
	CENV- MJ-552-T	Solid and Hazardous Waste Management	45	Theory	-	3	-
	CENV- MJ-552-P	Lab Course –VII	30	-	Practical	-	1
	CENV- MJ-553-T	Environmental Instrumentation	45	Theory	-	3	-
	CENV- MJ-553-P	Lab Course –VIII	30	-	Practical	-	1
	CENV-MJ-554-T	Fire and Safety	30	Theory	-	2	-
DSE	CENV-DSE-555-TA	Wildlife Conservation and Management	45	Theory	-	3	-
	CENV- DSE-555-PA	Lab Course –IX	30	-	Practical	-	1
	CENV- DSE-555-TB	Environmental Statistics and Modelling	45	Theory	-	3	-
	CENV- DSE-555-PB	Lab Course –IX	30	-	Practical	-	1
OJT/FP	CENV-OJT-556-P	Lab Course-X - On Job Training (OJT) / Field Project (FP)	120		Practical	-	4

Total Theory and Practical Credits = (3+3+3+3+2) + (1+1+1+1+4) = 22

Note: Candidate has to select one theory & its related practical Elective Paper from CENV-DSE-555-TA, CENV-DSE-555-PA or CENV-DSE-555-TB & CENV-DSE-555-PB.

Class: M.Sc. Second Year Semester: IIIrd Semester
Subject: Environmental Science

Course type	Course Code	Course Name	Total Hours	Teaching Scheme (week)		Credits Assigned	
				Theory	Practical	Th	Pr
DSC	CENV-MJ-601-T	Environmental Plan, Policies and Legislation	45	Theory	-	3	-
	CENV- MJ-601-P	Lab Course- XI	30	-	Practical	-	1
	CENV- MJ-602-T	Environmental Microbiology	45	Theory	-	3	-
	CENV- MJ-602-P	Lab Course –XII	30	-	Practical	-	1
	CENV- MJ-603-T	Waste Water Engineering	45	Theory	-	3	-
	CENV- MJ-603-P	Lab Course –XIII	30	-	Practical	-	1
	CENV-MJ-604-T	Environmental Economics and Social Welfares	30	Theory	-	2	-
DSE	CENV-DSE-605-TA	Climate Change and Global Environmental Issues	45	Theory	-	3	-
	CENV- DSE-605-PA	Lab Course –XIV	30	-	Practical	-	1
	CENV- DSE-605-TB	Disaster Management	45	Theory	-	3	-
	CENV- DSE-605-PB	Lab Course –XIV	30	-	Practical	-	1
RP	CENV-RP-649-P	Lab Course-XV- Research Project-I	120		Practical	-	4

Total Theory and Practical Credits = (3+3+3+3+2)+ (1+1+1+1+4) = 22

Note: Candidate has to select one theory & its related practical Elective Paper from CENV-DSE-605-TA & CENV-DSE-605-PA or CENV-DSE-605-TB & CENV-DSE-605-PB.

Class: M.Sc. Second Year Semester: IVth Semester
Subject: Environmental Science

Course type	Course Code	Course Name	Total Hours	Teaching Scheme (week)		Credits Assigned	
				Theory	Practical	Th	Pr
DSC	CENV-MJ-651T	Air, Noise and Radiation Pollution: Management and Mitigation	45	Theory	-	3	-
	CENV- MJ-651P	Lab Course- XVI	30	-	Practical	-	1
	CENV- MJ-652T	Environmental Impact Assessment	45	Theory	-	3	-
	CENV- MJ-652P	Lab Course –XVII	30	-	Practical	-	1
	CENV- MJ-653T	Environment and Sustainable Developmental	45	Theory	-	3	-
	CENV- MJ-653P	Lab Course –XVIII	30	-	Practical	-	1
DSE	CENV-DSE-654TA	Natural Resource Management	45	Theory	-	3	-
	CENV- DSE-654PA	Lab Course –XIX	30	-	Practical	-	1
	CENV- DSE-654TB	Biodiversity Conservation and Management	45	Theory	-	3	-
	CENV- DSE-654PB	Lab Course –XIX	30	-	Practical	-	1
RP	CENV-RP-699-P	Lab Course –XX: Major Project - II	180		Practical	-	6

Total Theory and Practical Credits = (3+3+3+3)+ (1+1+1+1+6) = 22

Note: Candidate has to select one theory & its related practical Elective Paper from CENV-DSE-654-TA , CENV-DSE-654-PA or CENV-DSE-654-TB & CENV-DSE-654-PB.

Name of Course (Subject): **M. Sc. Environmental Science (for Affiliated Collages)**

1. Preamble of the Syllabus –

As enshrined in the National Education Policy-2020 vision of introducing course curriculum for postgraduate studies under Choice Based Credit System (CBCS), the main objective of framing this curriculum of M.Sc. in Environmental Science is to impart the students a holistic understanding of the subject giving substantial weightage to the core contents, skill, value-based and ability enhancement.

The syllabus has given due importance on the main streams of the body of knowledge on 'Environment' with due recognition of its wide spectrum. The ultimate goal of the syllabus is to enable the students to have an in-depth knowledge and acquire the technical skill on the Environmental Science subject and enhance their scope of employment at every level of exit. Adequate emphasis has been given on the new and emerging techniques and understanding of the subject under the changing regime and global context

Environmental Sciences are necessarily to be taught in an inter-disciplinary curriculum. There is need to strengthen the students to understand essential aspects of environmental sciences in diverse subject areas such as chemistry, biology, pollution, geosciences, atmospheric sciences, biodiversity, natural resources management and wildlife management. There is also an additional emphasis in providing opportunities to understand the integration of modern sciences such as geographical information systems (GIS) and remote sensing applications to environmental sciences. This integration has been enabled in the syllabus.

Students would be encouraged to go beyond the classroom and conduct active action-research research projects with subject experts and institutions in different fields. Lectures and classroom sessions are accompanied by on-field visits, laboratory experiments and in-plant training. These interventions are compulsory and essential aspects of the curriculum. There are optional subject areas that can be chosen by the students as per their desire about their future professional areas. The Masters in Environmental Sciences being offered by Dr. Babasaheb Ambedkar Marathwada University, Aurangabad for college PG centers and which will allow the student to access a broad spectrum of environmental disciplines and would naturally extend well beyond the boundaries of any single subject area.

The independent research areas and acquisition of subject-specific skills within an interdisciplinary group of subjects would help the student to proceed to conduct Ph.D.-level research in the future in Environmental Sciences. Interface with research, industry, government and society is an important convergence paradigm that would be brought about by the Masters Program. Understanding the importance of crucial wildlife management and biodiversity conservation perspectives would help protect our ecosystems and the fragile wildlife sanctuaries and national parks in Maharashtra and India.

The course of M.Sc. Environmental Science is designed as per the present needs of industrial and professional consultancy services, development of administrative, management and academic skills and at par with NET/SET syllabi. The content of syllabus is modified and reframed from time to time considering the need of time and demand from industries to incorporate recent developments and new trends in the subject. Apart from the academic curricula the students are assigned field visits, excursions, and industrial visits and special in-plant training in industries. The students are encouraged for research through the projects as a part of partial fulfillment of the M.Sc. course. The students are also given exposure to seminars, short-term trainings and guests lecture by eminent environmentalist. The course promotes the interest in the students to enrich their knowledge and involvement in the environmental protection.

Eligibility conditions:

Those who have completed B.Sc. with Environmental Science, Botany, Zoology, Physics, Chemistry, Microbiology, Biochemistry, Bio-Technology, Earth Science etc., B.E. Civil Engineering, B.Sc. Agriculture and Forensic Science, shall be held eligible for the admission to M.Sc. in Environmental Science.

The weightage of 1% will be given to the candidates who offered Environmental Science as one of the optional subjects at the B.Sc. level for seeking the admission to the M.Sc. Environmental Science.

Admission / Promotion Process:

In response to the advertisement for registration, interested students will have to register themselves. Admission will be done on the basis of merit in their degree score or Common Entrance Test (CET) and performance of students at their qualifying graduate level examination. The weightage of 1% will be given to the candidates who offered Environmental Science as one of the optional subjects at the B.Sc. level for seeking the admission to the M.Sc. Environmental Science.

Course structure:

The M.Sc. Course is of two years period with 88 Credits of 2200 marks. The course is divided in to four semesters, and every semester there will be 22 credits with 550 marks.

Choice Based Credit System (CBCS):

The principle of 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 and they can select one theory and its related practical paper as elective paper in each semester.

➤ **Students will have to earn 88 credits for the award of M.Sc. (Environmental Science) degree.**

Credit-to- contact hour Mapping:

One contact hour per week is assigned 01 credit for theory and 0.5 credits for laboratory courses/ research project. Thus a 03 - credit theory course corresponds to 03 contact hours per week and same analogy will be applicable for laboratory courses / research project, containing 03 contact hours per week for 01 credits practical course. Overall, one credit equal to 15 hours for theory and 30 hours for practical.

Note:

- Tutorial, assignments and seminar presentation are integral components of all theory courses. Tutorials consist of conceptual / questions based on the respective theory courses in the semester covering all units of paper.
- Each theory paper of 03 credits should be taught about 45 contact hours in one semester.
- Teaching duration for LAB COURSES from first to fourth semesters should be of 03 hours per week per batch per paper of 01 credit.

Attendance:

Students must have 75 % of attendance in each course for appearing examination otherwise he / she will not be 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.

Pattern:

The 60:40 patterns for external and internal assessment will be implemented with continuous assessment and there shall be separate passing for external and internal assessment.

Results Grievances

Grievances related to assessment in examination will be resolved as per the provisions of university rules and regulations.

Evaluation Methods:

The assessment will be based on 60:40 ratios for external and internal pattern. In the continuous internal assessment (CIA) and semester end examination (SEE), there is separate passing.

Continuous Internal Assessment (CIA):

- For the theory paper of 75 marks: The Continuous Internal Assessment (CIA) of the students, containing 20 marks for two midterm tests (10 marks per test), 10 marks for two tutorials (05 marks per tutorial), 10 marks for one seminar (08 marks for giving seminar and 02 marks for submission of hard copy of seminar) and 10 marks for attendance and overall performance of the students. The marks secured out of 50 will be scale down to 30 as internal marks secured out of 30.
- For theory paper of 50 marks: The Continuous Internal Assessment (CIA) containing 20 marks for two midterm tests (10 marks per test), 10 marks for two tutorial (05 marks per tutorial), 10 marks for one seminar (08 marks for giving seminar and 02 marks for submission of hard copy of seminar) and 10 marks for attendance and overall performance of the student. The marks secured out of 50 will be scale down to 20 as internal marks secured out of 20.
- The first midterm exam will be taken after completion of 40 percent syllabus and second midterm exam will be taken after completion of 80 percent syllabus. The continuous internal assessment will be done by concern teacher, who is teaching that paper. The obtained score in Continuous Internal Assessment (CIA) will be considered as internal score.
- There will be 10 marks for Continuous Internal Assessment (CIA) of lab course / practical paper of 25 marks, containing 10 marks for one practical test, 10 marks for record book submission, 10 marks field work / assignments / viva on practical's and 10 marks for attendance, discipline & overall performance of student. The marks secured out of 40 will be scale down to 10 as internal marks secured out of 10.

- There will be separate passing for internal and external examination. The students have to earn minimum 40% marks for passing.

Semester End Examination (SEE):

- The semester end theory and practical examination will be conducted after completion teaching. The total marks shall be 75 for 3 credit theory courses, 50 marks for 02 credits theory course and 25 marks for 01 credits lab course / practical course. The semester end exam of 45 marks will be taken for 03 credits theory course and 30 marks for 02 credits theory course along with 15 marks lab course of 01 credits.
- Semester end examination (SEE) time table will be declared as per the university annual calendar. The paper setting and assessment of theory courses, laboratory courses and project dissertation will be done by external / internal appointed examiners.

A. Structure for theory course for Internal Assessment.

- Theory paper of 75 marks

Test-I	Test-II	Two Tutorials/ Assignments	One Seminar	Attendance, Discipline & Overall performance etc.	Total Marks secured out of	Marks scale down to 30 as internal score
10 Marks	10 Marks	10 Marks	10 Marks	10 Marks	50 Marks	

- Theory paper of 50 marks

Test-I	Test-II	Two Tutorials/ Assignments	One Seminar	Attendance, Discipline & Overall performance etc.	Total Marks secured out of	Marks scale down to 20 as internal score
10 Marks	10	10 Marks	10 Marks	10 Marks	50 Marks	

B. Structure for lab course of 25 marks for Internal Assessment.

Practical Test-I	Record Book	Field work / Assignments / Viva	Attendance, Discipline & Overall performance etc	Total Marks secured out of	Marks scale down to 10 as internal score
10 Marks	10	10 Marks	10 Marks	40 Marks	

The theory and practical examinations will be held at the end of each semester. There will be separate passing for continuous internal assessment marks and for semester end examination assessed by external / internal appointed examiner center wise after getting at least minimum 40 % marks in each paper.

M. Sc. I Year, Semester I
(CENV-MJ-501-T: Basics of Environment)
 (Theory Course with 03 credits)

Teaching Scheme	Evaluation Scheme
Lectures :- 3 hr/week	Continuous Internal Assessment :- 30 Marks by teacher
Tutorials :- 2 per/ semester	Sem-End Examination :- 45Marks
Internal Test :- 2 Tests /semester	
Seminar :- 1 Seminar / semester	
Total Credit :- 03	Total Marks :- 75 Marks

Course Objectives

1. Students will be able to know will know the basic concept of environment, its scope.
2. Students will be able to know different types of theories of Ecology and its applications.
3. Examine different measures to remediate ecosystems by natural recovery.
4. Students will be able to assess the role of individuals in prevention of pollution.
5. Student will be able to know the Study of population and community and recognize environmental issues associated with it.

Unit-I: Introduction:

(09)

Definition, principle and scope of environmental science, man & environment, media and people, decision making and applications in environmental science, environmental ethics, environmental consciousness.

Unit -II: Components of Environment:

(09)

Atmosphere: structure and composition atmosphere. Lithosphere: structure and composition of lithosphere, soil: composition of soil, soil formation: physical, chemical, biological weathering, soil profile, properties of soil: physical, chemical and biological soil erosion. Hydrosphere: Hydrological cycle, structure and composition of hydrosphere, global water balance, types of water, factors influencing the surface water, ground water exploration, rain water harvesting. Biosphere: Concept of biosphere, physical, chemical and biological factors of environment.

Unit -III: Ecosystem dynamics

(09)

Concept of ecosystem, abiotic 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.

Unit IV: Restoration of Degraded ecosystems

(09)

Ecological restoration of 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.

Unit- V: Population and community ecology

(09)

Concepts of population ecology, population dynamics, characteristics of population: natality, mortality, fecundity, density, age distribution, prey predator relationship, population explosion; Concept of community, interspecific and interspecific competition, concept of carrying capacity ecological sustainability.

Course Outcome

Students should be 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.
5. To understand the concept of carrying capacity ecological sustainability.

References:

1. Fundamentals of Ecology – E.P. Odum, Revised Edition 1995-96
2. Principles of Ecology – P.S. Verma, V.K. Agarwal, S. Chand and Co. Delhi.
3. Principles of Environmental Science – Watt K.E.F. (1973) McGraw Hill Book Company.
4. Ecology – M.P. Arora
5. Basic Ecology – E.P. Odum
6. Concept of Ecology – E.J. Koromondy, 1996, concept of modern biology series, prentice Hall.
7. Modern Concepts of Ecology – H.D. Kumar
8. Principles of Environmental Biology – P.K.G. Nair, Himalaya pub. House, Delhi
9. Environmental Biology – P.D. Sharma, Rastogi Publication, Meerut.
10. Ecology and Environment - P.D. Sharma, Rastogi Publication, Meerut.
11. Basic concepts of soil science – A.K. Kolay, Willey estern ltd., New Delhi.
12. Environmental Science – Enger, Smith, Smith, W.M.C. Brown company publishing
13. Principles of soil environmental science – Watt, K.E.F. (1973), McGraw Hill Book Company, New Delhi.
14. Practical Method in Ecology – R.K. Trivedi, P.K. Goel and Trisal.,Enviro Publication, Karad.
15. Chemical methods for Environmental Analysis Water and sediments – R.Ramesh, M. Anbu. Macmillan India Ltd. New Delhi.
16. Fundamental of Ecology – Dash M.C. Tata McGraw Hill Pub. Co. Ltd. New Delhi.
17. Concepts of Ecology (Fourth Edition)- Edward J. Kormondy, Prentice Hall of India Pvt. Ltd. New Delhi.
18. Environment forest, ecology and man – Dixit R.K. Rastogi Publication, New Delhi.
19. Physical geography – Dasgupta
20. Environment, energy, health planning for conservation – V. Vidyanath, Gyan Publishing House, New Delhi.

M. Sc. I Year, Semester I
(CENV-MJ-501-P: Lab Course-I)
(Practical paper based on paper CENV-MJ-501-T)
(Laboratory Course with 01 credits)

Lab Course	Evaluation Scheme		
Practical :- 3 hr/week	Continuous Internal Assessment by teacher	:-	10 Marks
Internal Test :- 1 Tests /semester	Sem-End Examination	:-	15Marks
Internal Viva :- 1 time during internal test			
Record submission :- 1 Record / semester			
Total Credit :- 01	Total Marks :-		25 Marks

1. Identification and classification of phytoplankton's from fresh water Body (any 8).
2. Identification and classification of zooplankton's from fresh water body (any 8).
3. Quantitative analysis of zooplanktons and determination of percentage Composition by Sedgwick Rafter cell method.
4. Quantitative analysis of phytoplankton's and determination of percentage composition Lacky's drop count method.
5. Estimation of biomass from grassland by harvest method.
6. Productivity study of grassland ecosystem by harvest method.
7. Determination of species area curve for deciding minimum size quadrat for plant community study.
8. Determination of relative density of species by using simulation.
9. Determination of relative frequency of species by using simulation.
10. Determination of relative abundance of species by using simulation.
11. Determination of chlorophyll content from plant species.
12. Determination of primary production of water body by harvest method.
13. To study the ecological adaptation in plants to aquatic habitat (Hydrophytes)
14. Collection of hydrophytes, xerophytes and halophytic plants / animals Specimens.
15. To study the ecological adaptation in plants to mesophytes.

M. Sc. I Year, Semester I
(CENV-MJ-502-T: Environmental Chemistry)
 (Theory Course with 03 credits)

Teaching Scheme	Evaluation Scheme
Lectures :- 3 hr/week	Continuous Internal Assessment :- 30 Marks by teacher
Tutorials :- 2 per/ semester	Sem-End Examination :- 45Marks
Internal Test :- 2 Tests /semester	
Seminar :- 1 Seminar / semester	
Total Credit :- 03	Total Marks :- 75 Marks

Course Objectives:

Students will be able to know

- 1 Understand the basics concepts of Chemistry
- 2 Compare different instrumentation techniques to estimate environmental parameters & identify the better methods for analysis for environmental contaminants.
- 3 Differentiate point, nonpoint sources of pollutants and discuss consequences of criteria Pollutants
4. Evaluate the best practices in measurement of environmental Pollutants.
5. Examine soil quality in the different study areas. Develop skills to aware the community for the importance of soil, water based on scientific knowledge.

Unit – I: Basic concepts of Environmental Chemistry: (09) 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.

Unit -II: Chemistry of air: (09) 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.

Unit -III: Chemistry of water and soil: (09) Chemistry of water; structure of water molecule; solubility of compounds in water; dissociation constant; water quality parameters and standards. Chemistry of Soil: composition of soil; biogeochemical cycles (nitrogen, oxygen, carbon, sulphur, phosphorus etc); micronutrients of soil; factors affecting the soil quality; adsorption of contaminant in soil; toxic chemicals present in soil.

Unit -IV: Green House Effect: (09) Introduction; sources of green house gases; major green house gases; impact of green house gases on global climate; consequences of green house effects; remedial measures of green house effects; impact of global warming on-human health, agriculture, biodiversity etc.

Unit- V: Ozone layer depletion and photochemical smog: (09) Formation of ozone; mechanism of ozone depletion; Antarctic and Arctic ozone hole formation ; effects of ozone depletion; climatic effects of ozone depletion.CFC and ozone layer depletion; Chemical aspects of acid rain and photochemical smog, Formation of acid rain; adverse effects of acid rain; chemistry of photochemical smog; NO₂, HC and PAN.

Course Outcome

Students should be able to:

1. Demonstrate knowledge of chemical and biochemical principles of fundamental, environmental processes in Air, Water and Soil.
2. Recognize different types of toxic substances and responses and analyze toxicological information.
3. Describe causes and effects of Environmental Pollution and discuss some mitigation strategies.
4. Explain Energy crisis and different aspects of sustainability.
5. Discuss local and global environmental issues based on the knowledge gain throughout the course.

References:

1. Environmental Chemistry- G.S. Sodhi.
2. Environmental Chemistry- S. E. Manahan
3. Fundamentals of soil science- Henry D. Futh.
4. Environmental Chemistry – A.K. De
5. Environmental Chemistry-A global perspective; G.W. Vantoon and S.J. Duffy, Oxford Uni. Press, London.
6. Environmental Chemistry – R.C. Rasmussen
7. Fundamentals of environmental chemistry –Stanley E. Manahan
8. Limnology – Wetzel
9. Photo chemistry and spectroscopy – J.P. Simmons
10. Fundamentals of photo chemistry – K.K. Rohatgi - Mukherjee.
11. Elements of environmental chemistry – H.V. Jadhav
12. Environmental chemistry – B.K. Sharma
13. Environmental chemistry – B.K. Sharma and H. Kaur
14. Environmental pollution analysis – S.M. Khopkar
15. Environmental chemical analysis – Lanin L. Marr, Malcom S.
16. Environmental Geology – Lundgren,
17. Environmental Geology – Barbara, Wim Brain, J.S. Stephen.
18. Environmental Chemistry – Kanan Krishnan.
19. Environmental Geology – Keller
20. Natural Hazards – Alexander
21. Geo Environmental Engineering – Reddic.
22. Environmental Chemistry – S.K. Banerjee.
23. Environmental Chemistry – J.W. Moore and E.A. Moore.
24. Destruction of hazardous chemicals in the laboratory: G. Lunn and E.B. Sansone.
25. A text book of Environmental Chemistry and pollution control – S.S. Dara.
26. Environmental Chemistry – M. Satake, Do. S. Sethi, S.A. Egbal.
27. Environmental and Man: The chemical environment: J. Lenihan and W.W. Fletcher.

M. Sc. I Year, Semester I
(CENV- MJ-502-P: Lab Course-II)
(Practical paper based on paper CENV-MJ-502-T)
(Laboratory Course with 01 credits)

Lab Course		Evaluation Scheme	
Practical	:- 3 hr/week	Continuous Internal Assessment by teacher	:- 10 Marks
Internal Test	:- 1 Tests /semester	Sem-End Examination	:- 15Marks
Internal Viva	1 time during internal test		
Record submission	:- 1 Record / semester		
Total Credit	:- 01	Total Marks	:- 25 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. Determination of carbon dioxide from air by using Lungs Zecondroff apparatus
8. Determination of NO_x in ambient air by high volume sampler (HVS).
9. Measurement of SO_x by high volume sampler (HVS)
10. Determination of CO by using CO Detector.
11. Measurement of SPM by using high volume sampler (HVS)
12. Measurement of RSPM by using Respirable Dust Sampler
13. Determination of atmospheric lead & other metals by using impinger techniques and AAS
14. Identification of minerals on the basis of physical properties (10 minerals specimens)
15. Identification of rocks: Igneous rock, sedimentary rock and metamorphic rocks

M. Sc. I Year, Semester I
(CENV- MJ-503-T: **Environmental Pollution Studies**)
(Theory Course with 03 credits)

Teaching Scheme	Evaluation Scheme		
Lectures :- 3 hr/week	Continuous Internal Assessment :-	by teacher	30 Marks
Tutorials :- 2 per/ semester	Sem-End Examination :-		45Marks
Internal Test :- 2 Tests /semester			
Seminar :- 1 Seminar / semester			
Total Credit :- 03	Total Marks :-		75 Marks

Course Objectives

Students will be able to know

1. To understand how to protect the environment
2. To understand the protection of human health
3. To understand the process of waste management
4. Students will learn how to assess pollution sources
5. To Study the exposure to pollution and its impacts to Environmental parametric functions.

Unit-I: Air pollution:

(09)

Concept of air pollution; natural and anthropogenic sources of air pollution; mobile and stationary sources of air pollution; sinks of atmospheric gases ;major air pollutants and their classification; air quality standards; primary and secondary air pollutants; types of air pollution-indoor air pollution, transport and dispersion of air pollutants; vehicular pollution, air pollution episodes and disasters; industrial pollution; monitoring of major air pollutants; effect of air pollutants- on plants, animals, human being and on materials; status of air pollution in India. Control measures

Unit- II: Water pollution:

(09)

sources of water pollution; major pollutants; types of water pollution – fresh water (rivers, streams, ponds, lakes, and underground water resources), marine water pollution (coastal and estuarine);water pollution episodes and disasters; consequences of water pollution; effect of water pollution; eutrophication; oil pollution; Thermal pollution; Effect of thermal pollution; Monitoring of water pollution; River pollution status in India; preventive measures.

Unit – III: Noise Pollution:

(09)

Physiological & psychological effects of noise pollution, vibration and impact isolation, Indian scenario of noise pollution, noise exposure levels and noise level, monitoring of noise, principal & function of noise meter, remedial measures, noise pollution control equipments-ear muffs, silencers, noise absorbing devices, noise standards, industrial noise control.

Unit - IV: Land pollution:

(09)

Causes and effects of soil pollution; major soil pollutants and sources; effect on plants and animals; nutrients in soil (NPK); domestic, municipal, industrial and agricultural wastes and their role in soil degradation; physico-chemical and biological methods of soil reclamation; effect of modern agro-technology on soil, soil salination; Soil conservation measures.

Unit- V: Radiation pollution:

(09)

concept of radiation pollution; major sources of radioactive pollutants; nuclear fusion and fission reactions, radioactive isotopes, units of radiation, effects of radioactive pollution, radioactive decay; interaction of radiation with matter; associated biological impacts and health hazards; use of nuclear weapons and their consequences, Impacts of radioactive fallout on health & environment, radioactive risk assessment and waste disposal practices.

Course Outcome

Students should able to:

1. To understand major concepts and terminology in the field of environmental pollutants
2. The course will address environmental stressors and pollution, their sources in the natural and workplace Environments.
3. To distinguish the effect of sources and effects of pollutants in air, water and soil.
4. To study the various current local and global environmental issues.
5. To study the control techniques of various Environmental parameters.

References:

1. Air pollution-M.N. Rao
2. Air pollution- A.C. Stern, Academic press Vol. I-X.
3. Guidelines of micro meteorological technique in air pollution studies – ISI (1978)
4. Air pollution-V.P. Kudesia.
5. Pollution control in process industry- S.P. Mahajan
6. Global air pollution- Brijman
7. Environmental pollution and management-L.Mohan
8. Environmental radioactivity –M.Eisendbud,academic press
9. Environmental analysis- P.R. Trivedy&Gurdeep Ray
10. Measurement of air pollutants-M. Katz Who (1969)
11. air pollution control-NEERI
12. Air pollution-Leadbetter Vol. I and II
13. Air pollution-Magill Holder and Ackely
14. Water pollution-A.K. Tripathi and S.N. Pande
15. Waste water engineering, treatment, disposal and reuse-Metcalf and Eddy.
16. water supply and sanitary engineering-R.C. Rangwala
17. Water pollution V.P. Kudesai
18. Soil pollution and soil organism-P.C. Mishra
19. Environmental radiation and thermal pollution and their control-G.R. Chhatwal, M.C Mehra, M.Satake, T.Katyal.
20. Environmental air pollution and its control-G.R. Chhatwal
21. Introduction to waste water treatment process-Ramalho R.S.

M. Sc. I Year, Semester I
(CENV - MJ-503-P: Lab Course-III)
(Practical paper based on paper CENV-MJ-503-T)
(Laboratory Course with 01 credits)

Lab Course	Evaluation Scheme		
Practical :- 3 hr/week	Continuous Internal Assessment by teacher	:-	10 Marks
Internal Test :- 1 Tests /semester	Sem-End Examination	:-	15Marks
Internal Viva :- 1 time during internal test			
Record submission :- 1 Record / semester			
Total Credit :- 01	Total Marks :-		25 Marks

1. Measurement of noise level from silent zones- educational institution, library and hospital.
2. Monitoring of noise pollution from:- a) Market and public Place b) industrial area and highway (heavy .traffic zone)
3. Study of particulate matter from air by gravity technique and filtration technique.
4. Comparison study of dust deposition on plant leaves from the heavy traffic zone and non polluted site.
5. To study the effect of vehicular emission on chlorophyll content of plant.
6. Determination of Dissolved Oxygen from provided water sample
7. To study the BOD of sewage sample.
8. To study the COD of sewage sample.
9. Determination of oil and grease from waste water collected from vehicle servicing centre.
10. Nitrate content from sewage sample.
11. Phosphate content from sewage sample.
12. Qualitative detection of pesticides from contaminated soil.
13. To determination of soluble chloride content from saline soil.
14. Determination of total acidity of saline soil.
15. Determination of total alkalinity of saline soil.

M. Sc. I Year, Semester I
(CENV-MJ-504-T: Waste Monitoring and Quality Measures)
 (Theory Course with 02 credits)

Teaching Scheme	Evaluation Scheme	
Lectures :- 2hr/week	Continuous Internal Assessment :- by teacher	20 Marks
Tutorials :- 2 per/ semester	Sem-End Examination :-	30 Marks
Internal Test :- 2 Tests /semester		
Seminar :- 1 Seminar / semester		
Total Credit :- 02	Total Marks :-	50 Marks

Course Objectives:

1. To educate the students on the principles and process designs of various treatment systems for water and wastewater.
2. Develop an understanding of the characteristics of water and wastewater that must be considered during design of a treatment plant.
3. Students will gain competency in the iterative process employed in design of treatment systems and the components.
4. To familiarize with basic concepts of air quality and air pollution related problems to time varying fields.
5. To understand sewage and effluent treatment in industries.

Unit-I: Air Pollution, its Control and Monitoring: (10)

Air Pollutants, their effects and sources of origin, Dispersion of air pollutants into atmosphere, Control measures, Natural self cleaning properties of the environment, Dilution methods of controlling air pollution from stationary sources (Industries), Controlling air Pollution in automobile, equipments used to control air pollutants like SO₂, NO_x, CO, CO₂, PAN and Hydrocarbons, Methods used, Cyclone separators, Fabric filters, Electrostatic precipitators, Wet scrubbers, etc.

Unit – II: Sewage and Effluent Treatment in Industries: (10)

Primary Treatment : Types of Screening, Design and disposal of screening, Grit removal basins, Detritus tanks, Design of parabolic grit chamber, Removal of oil and grease, Skimming tanks, Valuator's, Disposal of Skimming, Principle of sedimentation, Types and design of sedimentation tank. *Secondary treatment* ; Principle and techniques of biological treatment, Oxidation and stabilization ponds, Aerated lagoons, Activated sludge process, Trickling filters, Techniques for sludge disposal thicker, digesters, conditioning and dewatering methods, Like sludge drying, Vacuum Filtration, Process filters, Centrifugation.

Unit – III: Advance Techniques used in Industrial Effluent Treatment: (10)

Removal of nitrogen, Phosphorous, Total dissolves solid and suspended solids, Reuse and re cycle of wastewater, Operation and designing of ETP in various industries like ; Sugar, Paper mill, Dairy Textile, Food processing, Fertilizer and Petrochemical, Concept of Common effluent treatment plant (CETP), Designing for public owned treatment plant. Radiation and Noise pollution Control Techniques: Types of radiation, Sources, Biological effects, Nuclear energy scenario, Control measures of beta radioactivity, Nuclear dilemma, Principle of Noise pollution, Decibel scale, Physiological and psychological effects of noise, Noise measurement, control criteria, Equipments used for measurement and Control measures in industries.

Course Outcome

Students should be able to:

1. Develop conceptual schematics required for the treatment of water and wastewater.
2. Ability to identify and formulate engineering problems.
3. Ability to design and conduct experiments and interpret generated data as necessary to obtain process performance data.
4. Develop advanced techniques used in ETP and STP.
5. Identify various types of solid waste management.

REFERENCES:

1. Environmental Biotechnology: Alan Scragg
2. Environmental Biotechnology: Bimal Bhattacharya and Ritu Banerjee
3. Water Analysis: AWWA, APHA
4. R. M. Atlas and R. Bartha □ 1998 □ Microbial Ecology □ Fundamentals and applications. AddisonWesley Longman, Inc.
5. R.M.Maier, L.L.Pepper and C.P.Gerba 2010, Environmental Microbiology Academic Press
6. Rastogi & Sani, Microbes and Microbial Technology, 2011, pp 29□57, Molecular Techniques to Assess Microbial Community Structure, Function, and Dynamics in the Environment,
7. A K Bej and M H Mahbubani ,Applications of the polymerase chain reaction in environmental .Microbiology.Genome Res. 1992 1: 151□159.
8. The Metagenomics of soil by Rolf Daniel,470/June2005/vol3, www.nature.com/reviews
9. Metagenomics: DNA sequencing of environmental samples, Susannah Green Tringe and Edward M. Rubin,806/November2005/Volume
10. Brock Biology of microorganisms 12th ed Madigan, Martinko, Dunlap, Clara, Pearson Intl Ed
11. Microbial Diversity □ Current Perspective and Potential Application □ □ Johri and Satyanarayana
12. Methods in Microbiology Vol 35 □ Extremophiles (2006) Edited by Fred Rainey, Aharon Oren (Academic press)
13. Environmental microbiology. P. D. Sharma. Alpha Science International 2005 ed.
14. Wastewater engineering: Treatment and reuse. Metcalf and Eddy, Tata McGraw Hill Publishing Co. Ltd. 4th Ed.
15. A textbook of environmental pollution and control. S S. Dara
16. Environmental pollution control engineering. C. S. Rao. New Age International Publishers.
17. APHA 1998. Standard Methods for the examination of water and wastewater , 20th Ed.
18. Biotechnology of Odour and Air pollution Control. Springer
19. Water and Wastewater analysis Volume 1. Handbook of methods in environmental studies. S. K. Maiti. ABD Publishers 2004
20. Soil analysis Volume 2. Handbook of methods in environmental studies. S. K. Maiti. ABD Publishers 2004
21. Environmental management. H. V. Jadhav, Vipul Prakashan , 2002
22. Environmental management. R.K. Jain and others
23. Industrial hygiene and safety. M. H. Fulekar

M. Sc. I Year, Semester I
(CENV-DSE- 505-TA: Restoration Ecology and Watershed Management)
 (Elective Theory Course with 03 credits)

Teaching Scheme		Evaluation Scheme	
Lectures	:- 3 hr/week	Continuous Internal Assessment by teacher	:- 30 Marks
Tutorials	:- 2 per/ semester	Sem-End Examination	:- 45Marks
Internal Test	:- 2 Tests /semester		
Seminar	:- 1 Seminar / semester		
Total Credit	:- 03	Total Marks	:- 75 Marks

Course Objectives:

Students will be able to know

1. To explore fundamental ecological theories and their relevance to the practice of ecological restoration
2. Understand the link between environmental restoration and selected elements of water policy
3. Understand the principles of effective and integrative watershed management
4. Understand the diversity of options available to improve social-ecological conditions through land-use planning.
5. Develop their critical skills in reviewing, synthesizing, and distilling information in the form of digital presentations and technical briefs.

Unit-I: Restoration Ecology (09)

History of Eco Restoration, Definition and principles, Significances, Guidelines

Principles of Restoration and Applications of Restoration Ecology

Unit II: Restoration of urban ecosystem (09)

Ponds, lakes, river banks, avenue trees, Biodiversity restoration through gardens, park, restoration of dumping grounds, Restoration of ecosystem on hills, Restoration of soil in urban areas, Ground water resource – replenishment, Sewage or wastewater – recycling for supporting ecosystems

Unit III: Concept of watershed management (09)

Definition, principle, objectives, Watershed morphology, Characterization (with respect to size, elevation & slope, aspects & orientation, watershed shape, drainage network) Watershed functions and survey, Collection, storage, dispersal, habitat, Attenuation response, flushing Engineering surveys involved in watershed development

Unit IV: Concept of watershed management (09)

Definition, principle, objectives, Watershed morphology, Characterization (with respect to size, elevation & slope, aspects & orientation, watershed shape, drainage network)

Unit V: Water balance studies (09)

Topographical survey, drainage line survey, contour survey, Common instruments used for survey.

Course Outcome

Students should able to:

1. Define the different types of theories of Restoration and its application
2. Estimate the importance of interconnection between biotic, abiotic components of the ecosystem and relate it to environment protection and conservation issues through watershed management practices.
3. Examine different examples of restoration practices as well as watershed management projects and perform different pilot studies related to it and recognize environmental issues associated with it.
4. Examine different examples of restoration practices as well as watershed management projects and perform different pilot studies related to it and recognize environmental issues associated with it.
5. Analyse cost benefit analysis of restoration projects. Revise and evaluate restoration practices.

References:

1. Restoration of Ecology by Prakash Gole
2. Restoration Ecology the new frontier – edited by Jelte Van Andel and James Aronson – Wiley-Blackwell publication ISBN 9781444336368
3. A source book for Ecological Restoration, Foundation for Ecological Security 2008
4. Foundations of Restoration Ecology (The Science and Practice of Ecological Restoration Series), Donald A Falk, Margaret Palmer, Joy Zedler, Richard J
5. Watershed manual by BK Kakde (BAIF and LEAD India publication)
6. Water Harvesting and Sustainable Supply in India by RN Athavale Centre for Environment Education ISBN: 8170337526
7. Watershed Hydrology by Peter Black; Lewis Publishers: ISBN 1575040271
8. Soil and water conservation engineering by R. Suresh – Standard Publishers and Distributors ISBN 8180140008

M. Sc. I Year, Semester I
(CENV –DSE-505-PA: Lab Course-IV)
(Practical paper based on paper CENV-DSE-505-TA)
 (Elective Laboratory Course with 01 credits)

Lab Course	Evaluation Scheme		
Practical :- 3 hr/week	Continuous Internal Assessment by teacher	:-	10 Marks
Internal Test :- 1 Tests /semester	Sem-End Examination	:-	15Marks
Internal Viva :- 1 time during internal test			
Record :- 1 Record / semester			
submission			
Total Credit :- 01	Total Marks	:-	25 Marks

1. Visit to Restoration site and survey of techniques used in Restoration
2. Study of phytoremediation techniques.
3. Preparing/Monitoring a plan of restoration.
4. Delineation of watersheds using toposheets and estimation of perimeter, area and slope.
5. Surveying and preparation of watershed map.
6. Quantitative analysis of watershed characteristics and parameters.
7. Watershed investigations for planning and development: identifying specific watershed interventions required.
8. Visit to watershed development project areas
9. Role of R.S. and GIS in watershed management
10. To study the Drainage analysis
11. Role of Geomorphic features in watershed management
12. To study the thematic maps in different watershed management.
13. Restoration techniques for soil conservation.
14. To study the morphology of watershed.
15. To study the water holding capacity of soil.

M. Sc. I Year, Semester I
(CENV-DSE-505-TB: Environmental Meteorology and Geosciences)
 (Elective Theory Course with 03 credits)

Teaching Scheme	Evaluation Scheme	
Lectures :- 3 hr/week	Continuous Internal Assessment :- by teacher	30 Marks
Tutorials :- 2 per/ semester	Sem-End Examination :-	45Marks
Internal Test :- 2 Tests /semester		
Seminar :- 1 Seminar / semester		
Total Credit :- 03	Total Marks :-	75 Marks

Course Objectives

1. Students will have sound knowledge to identify and formulate challenging Environmental meteorological issues.
2. Students will study appropriate methodologies and use modern tools to provide technical solutions that are economically feasible and sustainable.
3. Students will possess analytical and lateral thinking ability to engage in lifelong learning for advancement to cope up with the environmental study.
4. Students will become socially responsible and will possess abilities to communicate effectively and work efficiently.
5. Students will make professional models for public services and community

Unit – I: Climate:

(09)

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

Unit II:- Climate of India:

(09)

Indian monsoon, 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, El-Nino, droughts, Tropical cyclones and western disturbances, IPCC, UNFCCC, Kyoto protocol.

Unit – III : Meteorology:

(09)

Scale of meteorology, Meteorological fundamentals, Primary and Secondary meteorological parameters, Temperature, Pressure, Wind, Humidity, Adiabatic lapse rate., Wind velocity, Wind roses, Turbulence, plume behavior, Weather forecasting, Establishing ambient and emission standards, Application of meteorological principles to transport and diffusion of pollutants.

Unit – IV: Environmental Geosciences:

(09)

Fundamental concepts, Earth system and biosphere: Conservation of matter in various Geosphere, Lithosphere, Hydrosphere, Atmosphere and biosphere; Energy budget of the earth, Earth's thermal environment and seasons. Mineral structures and their compositions, Trace elements and their partitioning during mineral formation.

Unit – V: Earths Processes and Geological Hazards:

(09)

Earth's 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, adjustments to hazardous activities, Assessment of geological hazards and risks.

Course Outcomes

Students should be able to:

1. Acquire in-depth knowledge of environmental meteorology including wider and global perspective.
2. To analyze complex Environmental meteorological problems.
3. To synthesize the information to conduct research in geosciences.
4. To evaluate a wide range of potential solutions and arrive at feasible, optimal solutions
5. To demonstrate knowledge and understanding of meteorological instruments.

References:

1. The Atmosphere : An Introduction to meteorology :- Frederic K. Lutgen E.J.Tarback.
2. Introduction to weather and climate :-Trewartha
3. Introduction to climatology for topics :-Ayoade J.O.
4. General Climatology :- Critchfield H.J.
5. Climatology ;Selected Application :-Henry D.Foth
6. Climatology: Fundamentals and Application:-Mater J.R.
7. Air pollution:- V.P. Kudesia Pragati Prakashan Meerut
8. Environmental Science :- A study of interrelation ship E.D. Enger,B. E. Smith, 5th ed; WCB Publication.
9. Fundamental of Ecology :- E.P. Odum, Revised Edition 1995-96 Edition 2003.
10. Forests of India :- Champion and Seth.
11. A Manual of Air Quality Monitoring :- NEERI Publication.
12. Environment, Energy, Health, Planning, for Conservation:-V. Vidyanath, Gyan Publication house, New Delhi.
13. Meteorology of Air Pollution :-R.S. Scores 1990 Ellis Harwood Pub.
14. Fundamentals of Air Pollution:- 2nd Ed. Arthur Co Stern Acad. Press 1984.
15. Air Pollution :- M.N. Rao, Mcgraw Hill 1993.
16. General Meteorology :-Horace Robert Byers, Sc.D. 3rd Ed MCGRAW Hill Book Company new York Toronto, London.
17. Environmental Chemistry :- A.K.De. Wiley Interscience.
18. Environmental Chemical Analysis :- Lain L. Marr, Malcom S. Cresser, international text book company, USA.
19. Environmental Geology : K.S Valdiya Indian Context Tata McGraw Hill Publication Co. New Delhi, 1987.
20. Environmental Geology : Barbara, Wim Brain, J.S. Stephan, C.P John Wiley & Sens. Inc
21. Environmental Geology : Lundegran, Lawrence Prentice Hall
22. Env. Geology : Keller
23. Nuclear Hazards : Alexander
24. Geo Environmental Engineering: Reddic, Tecnip books international, New Delhi.
25. Text of the Kyoto Protocol on www.unfccc.int.

M. Sc. I Year, Semester I
(CENV-DSE-505-PB: Lab Course-IV)
(Practical paper based on paper CENV-DSE-505-TB)
 (Elective Laboratory Course with 01 credits)

Lab Course	Evaluation Scheme		
Practical :- 3 hr/week	Continuous Internal Assessment by teacher :-		10 Marks
Internal Test :- 1 Tests /semester	Sem-End Examination :-		15Marks
Internal Viva :- 1 time during internal test			
Record submission :- 1 Record / semester			
Total Credit :- 01	Total Marks :-		25 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 of NO_x in ambient air by high volume sampler (HVS).
10. Measurement of SO_x by high volume sampler (HVS).
11. Measurement of SPM by using high volume sampler (HVS).
12. Measurement of RSPM by using Respirable Dust Sampler.
13. Identification of minerals on the basis of physical properties (5 minerals specimens).
14. Identification of rocks: Igneous rock, sedimentary rock and metamorphic rocks.
15. Identification of minerals on the basis of chemical properties (5 minerals specimens).

M. Sc. I Year, Semester I
CENV-RM-506-T: Research Methodology
 (Theory Course with 03 credits)

Teaching Scheme		Evaluation Scheme	
Lectures	:- 3 hr/week	Continuous Internal Assessment by teacher	:- 30 Marks
Tutorials	:- 2 per/ semester	Sem-End Examination	:- 45Marks
Internal Test	:- 2 Tests /semester		
Seminar	:- 1 Seminar / semester		
Total Credit	:- 03	Total Marks	:- 75 Marks

Course Objectives:

1. Understand some basic concepts of research and its methodologies
2. Select and define appropriate research problem and parameters
3. Organize and conduct research (advanced project) in a more appropriate manner
4. Student will know the different research approaches, scientific methods, criteria for good research and innovation.
5. Students will get the knowledge of data collection, presentation of data, data analysis and presentation of samples.

Unit-I: Foundations of Research:

(09)

Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method – Understanding the language of research – Concept, Construct, Definition, Variable. Research Process

Unit -II: Problem

Identification & Formulation

(09)

Research Question – Investigation Question – Measurement Issues – Hypothesis – Qualities of a good Hypothesis – Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic & Importance

Unit -III: Research Design:

(09)

Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables.

Unit IV:

Qualitative/Quantitative Research and Measurement:

(09)

Qualitative research – Quantitative research – Concept of measurement, causality, generalization, replication. Merging the two approaches, Concept of measurement– what is measured? Problems in measurement in research – Validity and Reliability. Levels of measurement – Nominal, Ordinal, Interval, Ratio

Unit- V: Sampling:

(09)

Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non Response. Characteristics of a good sample. Probability Sample – Simple Random Sample, Systematic Sample, Stratified Random Sample & Multi-stage sampling. Determining size of the sample – Practical considerations in sampling and sample size

Course Outcome

Students should be able to:

1. Understand the scope and nature of research.
2. State components related to scientific enquiry.
3. Explain key differences between qualitative and quantitative approach.
4. Examine case studies which followed different research approaches. Discuss importance of literature review and data collection while pursuing research.
5. Write a research report and specify methodology and approach which has been followed.

REFERENCES:

1. Research Methodology-Methods and Techniques, By Kothari C.R.(2011); New Age International Publisher, New Delhi.
2. "Research methodology-Text and cases with SPSS applications" by Gupta S.L. and Hitesh Gupta (2011); International book house Pvt.Ltd, New Delhi.
3. "Statistical Methods" by S.P.Gupta, Publisher S.Chand and Sons.
4. "Fundamentals of Research Methodology and Statistics" by Yogesh Kumar Singh, New Age International Publication, New Delhi.
5. "How SAGE has shaped Research methods A 40 years history" by John W Creswell, University of Nebraska. Lincoln.
6. "The Essence of Research Methodology, A Concise Guide for Master & Ph.D. students in management science, by Jan Jonker & Bartjan Pennink, Springer.
7. Research Methodology in Environmental Science, (Dr.Satish Patil) 2019, International Publications, Kanpur (ISBN 978-93-87556-42-3).
8. Research Methodology-Methods and Techniques, By Kothari C.R.(2011); New Age International Publisher, New Delhi.
9. "Research methodology-Text and cases with SPSS applications" by Gupta S.L. and Hitesh Gupta (2011); International book house Pvt.Ltd, New Delhi.
10. "Statistical Methods" by S.P.Gupta, Publisher S.Chand and Sons.
11. "Fundamentals of Research methodology and statistics" by Yogesh Kumar Singh, New Age International Publication, New Delhi.
12. "How SAGE has shaped Research methods A 40 years history" by John W Creswell, University of Nebraska. Lincoln.
13. "The Essence of Research Methodology A Concise Guide for Master & Ph.D. students in management science, by Jan Jonker & Bartjan Pennink, Springer.

M. Sc. I Year, Semester I
(CENV-RM-506-T: Lab Course-V)
(Based on CENV-RM-506-T)
(Laboratory Course with 01 credits)

Lab Course	Evaluation Scheme		
Practical :- 3 hr/week	Continuous Internal Assessment by teacher	:-	10 Marks
Internal Test :- 1 Tests /semester	Sem-End Examination	:-	15Marks
Internal Viva Record :- 1 time during internal test			
1 Record / semester submission			
Total Credit :- 01	Total Marks :-		25 Marks

1. To study sampling techniques in soil
2. To study sampling techniques in water.
3. To study wetland vegetation sampling, boundary declination, mapping and conservation.
4. To study methods of sampling terrestrial vegetation
5. To study preservation of samples
6. To study meteorological tools in Environmental Science.
7. To study principle and application of Spectroscopy/chromatography/ Atomic Absorption Spectrophotometer.
8. To study the tools for wildlife and behavioral study.
9. To study population size, density, species frequency and distribution.
10. Calculate mean and standard deviation of given data.
11. Calculate t- Test/ chi square Test of provided data.
12. Construction of graph of seed germination rates for a range of pH.
13. To study the application of MS-EXCEL to interpret environmental data.
14. To study the concept of hypothesis from provided data.
15. To study the Anti-Plagiarism software at UNIC.

M. Sc. I Year, Semester II
(CENV-MJ-551-T: Environmental Toxicology and Health)
 (Theory Course with 03 credits)

Teaching Scheme		Evaluation Scheme	
Lectures	:- 3 hr/week	Continuous Internal Assessment by teacher	:- 30 Marks
Tutorials	:- 2 per/ semester	Sem-End Examination	:- 45Marks
Internal Test	:- 2 Tests /semester		
Seminar	:- 1 Seminar / semester		
Total Credit	:- 03	Total Marks	:- 75 Marks

Course Objectives

1. To understand the basic concepts of toxicology.
2. To introduce learners with basic concepts of health and safety.
3. To understand the concept of safety management and hazardous waste.
4. To know about the toxicological effects and hazards.
5. To introduce about various applications of safety devices.

UNIT- I: Toxicology (09)

Basic principles of toxicology: Concept of toxicants and xenobiotics, Route of exposure, Environmental Toxicology, Classification of toxic materials. Industrial toxicants and hazardous materials.

UNIT- II: Toxic and hazardous waste management (09)

Classification of toxic material, Industrial toxicants and hazardous materials, Toxicant present in atmosphere, toxicants present in hydrosphere, Methods used for toxic and hazardous waste management, Physiological and metabolic effects of toxicants, e.g.1) VOC and organic solvents, used in industry 2) Heavy metals such as Hg, Pb, AS, Cd etc.

UNIT-III: Evaluation of toxicity (09)

Concept of Toxic kinetics and Toxicodynamics, Bioconcentration, Bioaccumulation, Biomagnifications and Bioavailability, Factors determining adverse effects of toxicants: Intrinsic toxicity, dose, exposure conditions, response of host Parameters of toxicity testing: Acute toxicity, Chronic toxicity TU, ICP TER, NOEC, LOEC, LC 50, LD50, TLM.

Unit – IV: Safety, Health and Environment (09)

Historical developments in EHS, Perspectives and concerns, Interrelationship and interactive approach on EHS, Development projects and related aspects of safety and health, Implementation of EHS practices in MNCs. International agreements on EHS, Case studies U

Unit-V Safety and Health Hazards (09)

Identification of potential safety and health hazards in industry, Occupational Health Hazards, Introduction to ISO 45001:2018 standard, Scope, Safety policy of the organization, Leadership and worker participation, operation and performance evaluation, Concept of Hazard and Risk, Risk Reduction strategies for hazards, Radiation and Industrial Hazards, Electrical Hazards and Fire hazards, National and international policies and legislation on safety in industries

Course Outcomes:

1. Acquire knowledge of fundamentals of occupational health and safety.
2. Students will be able to know the toxicological hazards.
3. Understand the role and responsibilities of an occupational health and safety practitioner.
4. Aware about policies and legislation on safety in industries and workplace environments.
5. Gain knowledge of the principles of toxicology.

References:

1. Principles of Environmental Toxicology, I.C.Shaw and J. Chadwick; Taylor& Francis Ltd.
1. Basic Environmental Health (2001): Annalee Yassi, Tord Kjellstom, Theo de Kok, Tee Guidotti. Oxford University Press.
2. Environmental Health (2005): Dade W. Moeller, Harvard University Press. USA
3. Handbook of Environmental Health and Safety: Principle and practices. Herman Koren and Michael S. Bisesi. Lewis Publishers.
4. Essentials of Environmental Health (2006): Robert Friis. Jones & Bartlett Publishers
5. Walker, C.H., Hopkin, S.P., Sibly, R.M., and Peakall, D.B. (2001):
6. Principles of Ecotoxicology. 2ndEd. Taylor & Francis, London.
7. Environmental Biology and Toxicology (2014): P. D. Sharma, Rastogi Publications.
8. Environmental Pollution and Toxicology: M.K. Rao. Manglam Publishers & Distributors.
9. Environmental Pollution: Health and Toxicology : S.V.S. Rana. Narosa Publishing House.
10. Toxicology (1999): A.Sood, Sarup and sons New Delhi.
11. Environmental Epidemiology : Anisa Basheer, Rawat Publication Jaipur, New Delhi
12. Industrial Hygiene & Chemical Safety: M.H.Fulekar, I. K.International Publishing House,
13. Principles of Fire Safety Engineering: Understanding Fire and Fire Protection (2014): Akhil Kumar Das. Prentice Hall India Learning Private Limited.
14. Industrial Safety and Environment (2013): AnupamaPrashar. S.K. Kataria& Sons.
15. Occupational Safety Management and Engineering (2001): Willie Hammer, Prentice Hall.
16. Fundamentals of Occupational Safety and Health, Mark A. Friend, James P. Kohn
17. Industrial Safety, Health Environment and Security, Basudev Panda.Laxmi Publications
18. Occupational Hygiene(1995):Blackwell Science,Harrington, J.M. & K. Gardiner. Oxford.
19. Industrial Safety, Health and Environment Management Systems: R..Jain and S. Rao.
20. Industrial Safety -National Safety Council of India. Reports and Survey Papers. The Factories Act with amendments. Govt. of India Publications DGFASLI, Mumbai.
21. Risk Characterization handbook, US-EPA,2000
22. Links: <https://www.epa.gov/risk>
23. <https://www.epa.gov/risk/conducting-human-health-risk-assessment#tab>

M. Sc. I Year, Semester II
(CENV-MJ-551-P: Lab Course-VI)
(Based on CENV-MJ-551- T)
(Laboratory Course with 01 credits)

Lab Course	Evaluation Scheme		
Practical :- 3 hr/week	Continuous Internal Assessment by teacher	:-	10 Marks
Internal Test :- 1 Tests /semester	Sem-End Examination	:-	15Marks
Internal Viva :- 1 time during internal test			
Record :- 1 Record / semester			
submission			
Total Credit :- 01	Total Marks	:-	25 Marks

1. Conducting ecological risk assessment.
2. Conducting Human risk assessment.
3. Effect of toxicant on chick embryo
4. Effect of toxicant on seed germination
5. Fish bioassay for toxicity testing
6. Profit Analysis for toxicity studies
7. Finding the LC_{50} / LD_{50} dose of toxicant/ pollutant
8. Survey for identification of effect of pollution on human health
9. Monitoring effect of pollution on aquatic ecosystem
10. Monitoring effect of pollution on plants
11. Safety audit in industries.
12. Epidemiological studies: Ecological Study/Cross sectional study
13. Determination of LC_{10} LC_{50} & LC_{90} of toxicant (pesticide/heavy metal compound) in aquatic animal (fish/snail) for 24, 48, 72 & 96 hour's exposure.
14. Determination of lethal dose of toxicant (pesticide / heavy metals) in test animal from LC_{50} values.
15. To study the common test animals of toxicity assessment and their acclimatization.

M. Sc. I Year, Semester II
(CENV-MJ-552-T: Solid and Hazardous Waste Management)
 (Theory Course with 03 credits)

Teaching Scheme	Evaluation Scheme		
Lectures :- 3 hr/week	Continuous Internal Assessment by teacher	:-	30 Marks
Tutorials :- 2 per/ semester	Sem-End Examination	:-	45Marks
Internal Test :- 2 Tests /semester			
Seminar :- 1 Seminar / semester			
Total Credit :- 03	Total Marks :-		75 Marks

Course Objectives:

1. To impart knowledge and skills in the collection, storage, transport, treatment, disposal and recycling options for solid wastes.
2. Understanding of problems of municipal waste, biomedical waste, hazardous waste, E- waste, industrial waste etc.
3. Become aware of Environment and health impacts solid waste mismanagement
4. Understand engineering, financial and technical options for waste management
5. To understand the awareness regarding hazardous waste related health and environmental problem

UNIT I : Sources, classification and regulatory framework: (09)

Types and Sources of solid and hazardous wastes - Need for solid and hazardous waste management –
 - Salient features of Indian legislations on management and handling of municipal solid wastes, hazardous wastes, biomedical wastes, nuclear wastes - lead acid batteries, electronic wastes , plastics and fly ash – Elements of integrated waste management and roles of stakeholders - Financing and Public Private Participation for waste management

UNIT II : Waste characterization and source reduction: (09)

Waste generation rates and variation - Composition, physical, chemical and biological properties of solid wastes – Hazardous Characteristics – TCLP tests – waste sampling and characterization plan - Source reduction of wastes –Waste exchange - Extended producer responsibility - Recycling and reuse

UNIT III : Storage, collection and transport of wastes: (09)

Handling and segregation of wastes at source – storage and collection of municipal solid wastes – Analysis of Collection systems - Need for transfer and transport – Transfer stations Optimizing waste allocation– compatibility, storage, labelling and handling of hazardous wastes – hazardous waste manifests and transport

UNIT IV: Waste processing

technologies: (09)

Objectives of waste processing – material separation and processing technologies – biological and chemical conversion technologies – methods and controls of Composting - thermal conversion technologies and energy recovery – incineration – solidification and stabilization of hazardous wastes treatment of biomedical wastes - Health considerations in the context of operation of facilities, handling of materials and impact of outputs on the environment.

UNIT V: Waste disposal: (09)

Waste disposal options – Disposal in landfills - Landfill Classification, types and methods – site selection - design and operation of sanitary landfills, secure landfills and landfill bioreactors – leachate and landfill gas management – landfill closure and environmental monitoring – Rehabilitation of open dumps – landfill remediation.

Course Outcome

At the end of the course, the student will be able to:

1. Identify various types of solid wastes and their sources
2. Examine the physical and chemical composition of wastes
3. Evaluate the techniques and methods used in recovery of materials and energy from solid wastes
4. Design a sanitary landfill for disposal of solid waste
5. Categorize and manage the hazardous waste

References:

1. Introduction to Environmental science by Y.Anjaneyulu BSP Bs publication.
2. Encyclopaedia of Hazardous Waste Managemtn by Dr.P.K. Behera, Dr. S.K.Sahu and M.S. Shivarama (Dominate publishers and distributors)
3. Environmental Engineering:- M.Narayanrao.
4. Solid Waste Management in developing countries:-A.D.Bhide
5. Integrated Solid Waste Management:-George Tehbanoglous Theisen and Vigil.
6. Guide lines for setting up operating facility:-Hazardous waste management CPCB Manual, 1998.
7. Environmental Pollution and Toxicology:-S.P.Ray, Chaudhari, D.S. Gupta.
8. Environmental Engineering designing approach:-Arcadia P. Sincero Gregoria A.Sincero Prentice hall of India Pvt. Limited.
9. Encyclopedia of Environmental control technology (9 Vols. Set):- Paul N.Cheremisinoff Technip Book International.
10. Hazardous waste management (2nd Edition): Michael D. La Grega, Phillip L. Buckingham, Jeffery C. Evans and Environmental Research Management, Mcgraw-Hill International Edition, New York.
10. Basic Environmental Technology (4th Edition): Jerry A. Nathanson, prentice – hall of India Private Limited, New Delhi – 110001.

M. Sc. I Year, Semester II
(CENV-MJ -552-P: Lab Course-VII)
(Practical paper based on paper CENV-MJ-552-T)
(Laboratory Course with 01 credits)

Lab Course		Evaluation Scheme	
Practical	:- 3 hr/week	Continuous Internal Assessment by teacher	:- 10 Marks
Internal Test	:- 1 Tests /semester	Sem-End Examination	:- 15Marks
Internal Viva	1 time during internal test		
Record submission	:- 1 Record / semester		
Total Credit	:- 01	Total Marks :-	25 Marks

1. Write a report on solid waste management practices adopted in the campus of the Institute.
2. Write a detailed report on legal aspects about Municipal Solid Waste Management Rules, 2016.
3. Write a detailed report on legal aspects about Biomedical Waste Management Rules, 2016.
4. Write a detailed report on legal aspects about Hazardous and other wastes management rules.
5. Write a detailed report on legal aspects about plastic waste management rules, 2016.
6. Determination of total waste soluble solids of municipal solid waste.
7. Determination of moisture content of municipal solid waste.
8. Determination of loss on ignition of municipal solid waste.
9. Determination of organic carbon from municipal solid waste.
10. Determination of total Kjeldhal nitrogen from municipal solid waste.
11. Determination of total phosphorous in municipal solid waste.
12. Determination of potassium of municipal solid waste.
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.

M. Sc. I Year, Semester II
(CENV-MJ-553-T: Environmental Instrumentation)
 (Theory Course with 03 credits)

Teaching Scheme	Evaluation Scheme	
Lectures :- 3 hr/week	Continuous Internal Assessment by teacher :-	30 Marks
Tutorials :- 2 per/ semester	Sem-End Examination :-	45Marks
Internal Test :- 2 Tests /semester		
Seminar :- 1 Seminar / semester		
Total Credit :- 03	Total Marks :-	75 Marks

Course Objectives:

Students will be able to

1. To give students and understanding regarding environmental sampling, analysis and the various techniques associated.
2. To make students know the importance of proper sampling in environmental research.
3. Students are expected to have basic awareness on various separation techniques such as chromatography and analytical method titrimetry.
4. Apply knowledge of instruments in Environmental fields.
5. Student will acquire the information and knowledge regarding Instrument handling and Analysis of samples.

Unit-I: - Sampling and sample preparation:

(09)

Air, Water, Soil and sediment; Types of Samples-Grab samples, composite samples, Integrated samples, Sampling methods- Manual sampling, Automatic sampling, Sorbent sampling; Sampling types- Simple random sampling, Systematic random sampling, Stratified random sampling, Representative sampling, Geo-statistical (random field) sampling, Adaptive cluster sampling; Sample collection equipments.

Unit — II :- Analytical Techniques :

(09)

Theory, principles, instrumentation and Environmental application- pH, conductivity, Turbidity, Titrimetry, Colorimetry, Spectrophotometry, Atomic Absorption Spectroscopy (AAS, Flame emission spectrometry, Inductively coupled plasma Atomic Emission Spectroscopy (ICP-AES), Inductively Coupled Plasma Mass Spectrometry (ICP-MS)

Unit-III :- Separation Techniques :

(09)

Principles, Types and Environmental application- Sedimentation, Centrifugation, Electrophoresis, Chromatography-paper, TLC, Ion-exchange, Gas chromatography, HPLC.

Unit-IV:- Biological Analysis:

(09)

Collection, preservation and enumeration of planktons; Molecular techniques- polymerase chain reaction (PCR) florescence In-situ hybridization (Fish), Fatty Acid methyl Ester (FAME) analysis.

Unit-V Microbiological instruments and Equipment's:

(09)

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

On completion of this course,

students should able to:

1. Comprehend the various sampling technique and its application.
2. Select sampling methods for making unbiased research.
3. Categorize analytical instruments used for environmental problems.
4. Design a sanitary landfill for disposal of solid waste
5. Categorize and manage the hazardous waste

References:

1. Analytical chemistry -Gary D.Christian.
2. Hand book of analytical instruments- Khandpur R.S.
3. Instrumentation methods for chemical analysis-B.K.Sharma
4. Instrumentation methods for chemical analysis- Chatwal and Anand
5. Instrumental methods of analysis :Willered merit and Dean (CBS publication , New Delhi)
6. Instrumental methods of Environmental analysis : Karan saveen (sarup and sons publishers, New Delhi) (2001)
 7. Instrumental methods of chemical analysis: H.Kaur, Pragati prakashan, merrut. (2009)
 8. Instrumental analysis for science and technology: W. Ferren (Agrobios Indian, Jodhpur).
 9. Instrumental methods: V.B.Borade, Niraliprakashan, Mumbai.
 10. Instrumental Methods of Analysis: G.W.Ewing.
 11. Instrumental Analysis: gurdeep Chatwal (Himalaya Publishing House, New Delhi, (2000)
 12. Allen J. Bard and Lafiry R. Faulkner (2001). Electrochemical Methods, 2nd Ed., John Wiley & Sons.
13. APHA — AWWA- WPCF. (2012). Standard methods for the examination of water and waste water. Washington, D.C.1
14. Bender, G.T., W.K Saunders. (1972). Chemical Instrumentation. A Laboratory Manual based on Clinical Chemistry.
15. Christian Gary, D. (2001). Analytical Chemistry, 5th Ed. John Wiley& Sons, Inc. NY.
16. De A.K. (1994). Environmental Chemistry. New Age International Ltd. New Delhi.
17. Eying G.W. (1985). Instrumental Methods of Chemical Analysis, 5th Ed., Mc-Graw Hill Book Company.
18. Radojecic M. and Bashkin V.N. (2007). Practical Environmental Analysis. RSC Publishing, Cambridge.
19. Skoog D.A., F.J. Holler and Nieman, (2003). Principles of Instrumental Methods, 5th Ed., Thomson Asia Pvt. Ltd., Singapore.
20. Vogel A.I.(1999). Textbook of Quantitative Chemical Analysis, 5th Ed., Addison Wesley Longman Singapore Ltd.
21. Willard, Merritt, Dean, and Settle, (1986). Instrumental Methods of Analysis, 7th Ed., C B S Publishers & Distributors.

M. Sc. I Year, Semester II
(CENV-MJ-553-P :Lab Course- VIII)
(Based on CENV-MJ-553-T)
(Laboratory Course with 01 credits)

Lab Course	Evaluation Scheme		
Practical :- 3 hr/week	Continuous Internal Assessment by teacher :-		10 Marks
Internal Test :- 1 Tests /semester	Sem-End Examination :-		15Marks
Internal Viva Record :- 1 time during internal test 1 Record / semester			
submission			
Total Credit :- 01	Total Marks :-		25 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
5. Studies on the principle, components and working operations of spectrophotometer.
6. Determination of Enzymes by Thin layer chromatography.
7. Demonstration of HPLC for pesticide analysis.
8. Determination of dissolved oxygen content from sewage samples by using DO meter.
9. Study of color of water /sewage sample by using tintometer.
10. Determination of fluorescent compound by using photofluorometer.
11. Separation of chlorophyll pigments of green leaf by using thin layer chromatographic technique.
12. Separation of a mixture of amino acid by using paper chromatography.
13. Separation of geometric isomer compounds by using column chromatography.
14. Demonstration atomic absorption spectroscopy (AAS) for heavy metal analysis.
15. Study of High Volume Air Sampler for bio-monitoring.

M. Sc. I Year, Semester II
(CENV-MJ-554-T: Fire & Safety)
(Theory Course with 02 credits)

Teaching Scheme		Evaluation Scheme	
Lectures	:- 2hr/week	Continuous Internal Assessment by teacher	:- 20 Marks
Tutorials	:- 2 per/ semester	Sem-End Examination	:- 30 Marks
Internal Test	:- 2 Tests /semester		
Seminar	:- 1 Seminar / semester		
Total Credit	:- 02	Total Marks	:- 50 Marks

Course Objectives

1. Understand the challenges to safety in built and industrial environment and approaches to addressing the same.
2. Become aware of the history and current role of safety related legislation and role of agencies involved with implementation.
3. Understand different design approaches for addressing fire and safety challenges in the built environment
4. Become familiar with current fire & safety engineering
5. Safety management concepts and practices followed in the industry.

Unit-I: Challenges to safety and Concepts: (10)

Challenges to safety in built environment, types of hazards likely to cause harm (fire, burns, electric shock, falls), natural disasters, fatalities involving hazardous environments. The Concept of industrial safety, its need, nature and importance. Focus on Human resource, and concept of importance of 'man' as central theme in safety. Concept of accident prevention, occupational health and environmental protection. Problems of Industrial safety, occupational health and environmental pollution & modern concept of SHE.

Unit -III: History of Safety (10)

History and role of building codes and safety legislation, concept of safety versus risk, enforcement of codes and standards, role of government agencies and emergency services in enforcing legislation, government framework and infrastructure involved in safety legislation enforcement. Role of code enforcement, plan review and approval, record keeping, public education, etc., in fire & safety

Unit- III: Management concepts of Fire and Safety (10)

Industrial Fire & Safety management concepts – hazard identification and risk assessment, risk reduction and control methods. Design aspects such as segregation and separation, fire resisting construction, emergency exit arrangements and access for emergency agencies, fire protection systems, safe operational practices, maintenance and upkeep of systems, planning for emergency response.

Course Outcome

1. Students will understand the fire and safety challenges faced by the built and industrial environment, and the current approaches taken to address the same.
2. Students will become familiar with the history and development of fire & safety legislation, their

current form and role of different agencies involved in their implementation.

3. Students will be able to explain the different design approaches for addressing the fire & life safety challenges in built and industrial environments.
4. Students will become aware of the different engineering and management concepts applied for addressing fire and safety risks in industrial scenarios.
5. Students will become more aware of fire and its associated dangers.

REFERENCES:

1. Cote, Arthur, Section 1, Fire protection Handbook, 20th Edition, NFPA
2. Handbook of Industrial Safety by K.U. Mistry, Siddarth Prakashan, Gujarat
3. Industrial Accident Prevention by H.W. Heinrich, McGraw Hill Book Co.
4. Techniques of Safety Management by Dan Pederson.
5. Purandare D.D. Handbook on Industrial Fire Safety, P&A Publications
6. Industrial Safety and Environment, A.K.Gupta, Laxmi Publications, New Delhi
7. Industrial Safety: Concepts and Practices , K.T. Kulkarni, Pune Vidyarthi Griha Prakashan, 1786, Sadashiv Peth, Pune
8. Environment Management in India, R K Sapru, Ashish Publishing House, New Delhi
9. The Factories Act, 1948 & Factory Rules
10. Environment (Protection) Act, 1986 and Rules
11. Industrial Safety, Health and Environment Management Systems, R.K.Jain and Sunil S.Rao, Khanna publishers , New Delhi (2006)
12. The Maharashtra Fire Prevention and life Safety Measures Act 2006 and Rules
13. Industrial Safety and pollution control handbook: National Safety Council and Associate publishers Pvt. Ltd, Hyderabad (1993).
14. Publications from Inter National standard organizations like ISO, OSHA, IOSH, NEBOSH etc.

M. Sc. I Year, Semester II
(CENV-DSE-555-TA: Wildlife Conservation and Management)
 (Elective Theory Course with 03 credits)

Teaching Scheme	Evaluation Scheme	
Lectures :- 3 hr/week	Continuous Internal Assessment :- by teacher	30 Marks
Tutorials :- 2 per/ semester	Sem-End Examination :-	45Marks
Internal Test :- 2 Tests /semester		
Seminar :- 1 Seminar / semester		
Total Credit :- 03	Total Marks :-	75 Marks

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.
5. To know the management of Forest fires and water resources.

Unit-I :- Introduction to wildlife :

(09)

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.

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

(09) 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.

Unit- III :- Endangered Fauna of India :

(09)

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

Unit — IV :- Wildlife Conservation :

(09)

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.

Unit- V:- Wildlife Management:

(09)

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.

M. Sc. I Year, Semester II
(CENV-DSE-555-PA: Lab Course- IX)
(Based on CENV-DSE-555-TA)
 (Elective Laboratory Course with 01 credits)

Lab Course	Evaluation Scheme		
Practical :- 3 hr/week	Continuous Internal Assessment by teacher :-		10 Marks
Internal Test :- 1 Tests /semester	Sem-End Examination :-		15Marks
Internal Viva :- 1 time during internal test			
Record submission :- 1 Record / semester			
Total Credit :- 01	Total Marks :-		25 Marks

1. Identification of wild animals by using pug marks.
2. Identification of wild species by using feeding signs and artifacts.
3. Determination of relative abundance of light attracting insects by using light trap.
4. Determination of relative abundance of creeping invertebrates by using pitfall trap.
5. Determination of birds population by using Lincoln index (Simulation)
6. Determination of total population of birds/ bats in their roost by using extrapolation method.
7. Determination of total population /density of birds from nesting ground during breeding season / or determination of total population of birds by using nests.
8. Identification of mammals from the hair morphology and histology.
9. To study the bird species by using vocal display.
10. Identification of wild species by direct observation in their habitat.
11. Determination of burrowing animal's population by using their artifacts.
12. Field visit for the study of wild species and collection of samples from various domestic and wild animals.
13. Visit to Zoo/ National park /Sanctuary / Aquarium ect. for the study of wildlife.
14. Field visit to study the habitat components of wild species.
15. To study the natality of wild species during breeding season at zoo/aquarium / in closed ecosystem.

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, extinction 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.
5. Student will be able to study the various case studies.

References

1. Zoos in India: legislation, policy, Guidelines and strategy, Central zoo authority, New Delhi 2007.
2. Wildlife ecology, conservation and Management , Anthony R.E.Sinclair, John M.Fryxell and Graeme Caughly , Blackwell publishing,U.S,A. 2006.
3. Colorful Atlas on Indian wildlife Siseases and Disorders, Arora dnBipulchakraborty B.M.IBDC, Lucknow,2008.
4. Indian wildlife yearbook ,Arora B.M., Editor., AIZ and WV .Bareilly and central zoon authority, New Delhi 2002.
5. Rehabilitation in free living wild animals, Arora.B.M. AIZ and W,V.,Bareilly., 2007.
6. Reproduction in Wild Mammalia & Conservation, Arora B.M. AIZ and WV., 2002.
7. Wild Animals in Central India, Brander,A.A. Natraj Publisher, Dehradun.
8. The Temple Tiger. Corbett,Jim., Oxford University Press, New Delhi., 2007.
9. Handbook of Environment, Forest and Wildlife Protection Laws in India., justice Kuldip Singh, Natraj Publishers, Dehradun., 1998.
10. Biodiversity conservation in managed and protected areas, katwalf Banerjee, Agrobios, India., 2002.
11. The Ecology of wildlife Diseases. Peter J.Hudson, Annapaola Rizzoli, Bryan T. Grenfell, Hans Heestribeek and Andy P. Dobson, Oxford University Press. Oxford ., 2002.
12. Text book of wildlife management, Singh, S.K, IBDC, Lucknow., 2005.

M. Sc. I Year, Semester II
(CENV-DSE-555-TB: Environmental Statistics and Modelling)
 (Elective Theory Course with 03 credits)

Teaching Scheme	Evaluation Scheme
Lectures :- 3 hr/week	Continuous Internal Assessment :- 30 Marks by teacher
Tutorials :- 2 per/ semester	Sem-End Examination :- 45Marks
Internal Test :- 2 Tests /semester	
Seminar :- 1 Seminar / semester	
Total Credit :- 03	Total Marks :- 75 Marks

Course Objectives

Students will be able to

1. Apply the fundamental concepts of statistics in environmental analysis.
2. Know the concept of probability poison and binomial distribution for the application of environmental variables.
3. Explain the concept of hypothesis, ANOVA, and regression lines to predict environmental situations.
4. Understand application of computer to interpret environmental data.

Unit - I:- Fundamental Concepts of Statistics in Environment: (09)

Statistical sampling, Purpose of sampling, Principles of sampling, Merits of sampling, Basics and types of samplings, Simple random sampling, Stratified random sampling, Systematic sampling, multi stage sampling. Statistical methods for environmental systems, Primary and secondary data collection, Methods of data representation.

Use of the statistical components for the representation of data obtained from environmental system: Measures of central tendency-mean and its types, Median, mode, Measures of dispersion-Variance, Standard Deviation, Mean Deviation, Coefficient of Variation, Range and quartile deviation, Concept and types of Skewness and Kurtosis in collected environmental data.

Unit-II-Application of Probability in environmental data : (09)

Basic Concept of probability - Addition and multiplication theorem of probability, Conditional probability and unconditional probability, Problems on probability depending on environmental systems data or data of environmental case studies.

Unit- III:-Applications of test of significance in environmental data : (09)

Hypothesis — Types of hypotheses: Null and Alternative hypothesis, Application of tests of significance in environmental systems data or in environmental case studies - t test, F test, I test , Chi-square tests, and A NOVA test, Concept of, regression analysis, -Application of regression equation in environmental data.

Unit- IV:-Computer applications in environmental science (09)

Introduction to computer, Computer organization, Concept of software and hardware, Functions, Capabilities and limitations of computers, Use of computer in environmental Science, Applications of Windows XP, MS Word, MS Excel, MS Power Point, Adobe Page Maker, Adobe Photoshop in environmental science, Use of internet in environmental science, Applications of computer in environmental science.

Unit -V:-Environmental Modeling: (09)

Introduction to environment systems, concept of modeling and simulations, Types of modeling, simple regression models, Validation of models and forecasting, Population growth model, Lotka Volterra model, Gaussian plume model for dispersion of air pollutants, Box and pipe model for energy flow in ecosystem, Point source stream pollution model.

Current developments in the subject

Course Outcome

Students should be able to:

1. Apply the fundamental concepts of statistics in environmental analysis.
2. Bullet concept of probability in environmental variables.
3. Hypotheses the problems and apply the test of significance
4. Illustrate the environmental models for point and non-point source of pollution.
5. Will able to modelling, sampling, validation and forecasting of various Environmental Parameters.

References

1. Bodkin, Daniel D. (1995). Environmental Science- Earth As a Living Planet, John Wiley & Sons, New York.
2. Clark, C.W. (1976). Mathematical Bioeconomics: Optimal Management of Renewable Resources, John
3. Gore, Anil and Paranjpe, S.A. (2000). A Course on Mathematical and Statistical Ecology, Kluwer.
4. Jorgensen, Environmental Modeling.
5. Ludwig, J.A. and Judwig, J.F. (1988). Statistical Ecology, Wiley and Sons, New York.
6. Pielou, E.C. (1997). An Introduction to Mathematical Ecology, John Wiley and Sons, New York.
7. Ray, Devraj (1998). Development Economics, Oxford University Press, Oxford.
8. Snape and Dunn, Dynamics of Environmental Bioprocesses-modeling and simulation.
9. Sen, A. (1997). Poverty and Inequality, Oxford University Press, Oxford.
10. Smith, J. M. (1982). Evolution and the Theory of Games, Cambridge University Press, Cambridge.

M. Sc. I Year, Semester II
(CENV-DSE-555-PB: Lab Course- IX)
(Based on CENV DSE--555-TB)
 (Elective Laboratory Course with 01 credits)

Lab Course	Evaluation Scheme		
Practical :- 3 hr/week	Continuous Internal Assessment by teacher	:-	10 Marks
Internal Test :- 1 Tests /semester	Sem-End Examination	:-	15Marks
Internal Viva :- 1 time during internal test			
Record submission :- 1 Record / semester			
Total Credit :- 01	Total Marks :-		25 Marks

1. Calculation of central tendency parameters:
 - i) Mean value calculation from the primary data collected from environmental system.
 - ii) Mode value calculation from the primary data collected from environmental system
 - iii) Median value calculation from the primary data collected from environmental system
2. Calculation of standard deviation to the primary data collected from environmental system.
3. Calculation of Karl Person's Co-efficient of Co-relation to the data obtained from environmental study.
4. Calculation of Regression equation Y on X & X on Y from the environmental variables data and calculation of unknown value of dependent variable by using regression equation.
5. Calculation of variance from the environmental data.
6. Calculation of standard error (SE) from environmental data.
7. Problems on probability based on environmental data.
8. Application oft-test for conclusion from environmental data.
9. Application of Z test for conclusion from environmental data.
10. Application of F test for conclusion from environmental data.
11. Application of ANOVA test for conclusion from environmental data.
12. Application of chi square test for conclusion from environmental data.
13. Application of Power point presentation in environmental data presentation.
14. Use of MS-Excel in environmental data analysis.
15. Application of MS Word in environmental data presentation

M.Sc. Ist Year, Semester – II
(CENV-OJT-556-P :- Lab Course-X – On Job Training(OJT) / Field Project(FP))
(Laboratory Course with 04 credits)

Lab Course		Evaluation Scheme	
Practical	:- 12hr/week	Continuous Internal Assessment by teacher	:- 40 Marks
Internal Test	:- 1 Tests /semester	Sem-End Examination	:- 60 Marks
Internal Viva Record submission	1 time during internal test :- 1 Report / semester		
Total Credit	:- 04	Total Marks	:- 100 Marks

The student has to undergo 4 (four) weeks industrial internship [On Job Training (OJT)] at the end of II nd semester. The candidate has to produce the certified (OJT) report strictly within a week after the completion of the said training with the structured evaluation pattern. The deputation of the students in industry will be done by Placement cell of college or by Department.

M Sc. IInd Year, Semester – III
(CENV-MJ-601-T :- Environmental Plan, Policies and Legislation)
 (Theory Course with 03 credits)

Teaching Scheme		Evaluation Scheme	
Lectures :-	3 hr/week	Continuous Internal Assessment by teacher :-	30 Marks
Tutorials :-	2 per/ semester	Sem-End Examination :-	45Marks
Internal Test :-	2 Tests /semester		
Seminar :-	1 Seminar/ semester		
Total Credit	03	Total Marks	75 Marks

Course Objectives

Students will be able to know

- To provide an understanding of the fundamentals of environmental planning and the formulation of environmental policies.
- To understand the structure and function of environmental laws and regulations.
- **Overview of Environmental Legislation**
- To provide knowledge about the processes and significance of EIA and SEA.
- To understand the principles of environmental governance and the integration of environmental policies into broader governance frameworks.
- To explore the emerging trends and future directions in environmental planning, policies, and legislation.

Unit 1: Introduction to Environmental Planning and Policies

Environmental Planning Basics: Definition and importance of environmental planning, History and evolution of environmental planning, Key principles and objectives of environmental planning.

Environmental Policy Framework: Definition and scope of environmental policies Policy development process, Stakeholders in environmental policy making.

Case Studies on Environmental Policies: Analysis of successful environmental policies, Lessons learned from failed policies, Role of policy analysis in environmental planning

Unit 2: Environmental Legislation and Regulatory Framework

Introduction to environmental law, Types of environmental laws (national, regional, international), Key components of environmental legislation

National Environmental Laws: Examination of key national environmental laws (e.g., Clean Air Act, Clean Water Act), Enforcement mechanisms and agencies, Challenges in implementing national environmental laws

International Environmental Agreements: Overview of major international environmental treaties (e.g., Kyoto Protocol, Paris Agreement), Role of international organizations (e.g., UNEP, UNFCCC), Compliance and enforcement of international agreements

Comparative Environmental Law: Comparison of environmental laws in different countries Case studies on cross-border environmental issues, Role of international cooperation in environmental protection.

Unit 3: Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA)

Introduction to EIA: Definition and purpose of EIA, EIA process and methodology, Legal requirements for EIA

EIA Case Studies: Detailed analysis of EIA reports, Successes and shortcomings of EIA in different projects, Role of public participation in EIA

Strategic Environmental Assessment (SEA): Definition and differences between EIA and SEA
Process and benefits of SEA, Integration of SEA into policy and planning.

SEA Case Studies: Review of successful SEA implementations, Challenges in conducting SEA
Future trends in SEA

Unit 4: Environmental Governance and Policy Integration

Principles of Environmental Governance: Definition and scope of environmental governance
Key principles (transparency, accountability, participation), Governance structures and institutions

Policy Integration and Mainstreaming: Integrating environmental concerns into sectoral policies, Tools and methods for policy integration, Examples of successful policy integration

Multilevel Environmental Governance: Role of local, regional, and global governance in environmental protection, Case studies on multilevel governance, Challenges in coordinating multilevel governance.

Public Participation in Environmental Governance: Importance of public participation, Mechanisms for involving the public in decision-making, Case studies on effective public participation

Unit 5: Current Trends and Future Directions in Environmental Planning and Policies

Emerging Environmental Issues: Climate change and policy responses, Biodiversity loss and conservation policies, Pollution control and management.

Innovation in Environmental Policy and Planning: Role of technology and innovation, Green economy and sustainable development, Policy innovations for environmental sustainability

Future Directions in Environmental Legislation: Trends in environmental legislation
Anticipated changes in regulatory frameworks, Role of science and research in shaping future legislation

Course outcomes

Students should be able to:

1. Comprehensive Understanding of Environmental Systems and Policies
2. Critical Thinking and Analytical Skills
3. Practical Skills in Environmental Assessment and Planning
4. Increased Awareness and Advocacy Skills
5. Career Readiness and Professional Development

REFERENCES

1. Hand Book of Env. Laws, Acts, Rules, Guidelines, Compliance and Standard Vol. 1 & 2: R. K. Trivedy Environmental Edition: 1st 1996.
2. Pollution control Acts, Rules and notifications issued there under: Central Pollution Control Board April. 1995.
3. Environmental Protection and the Laws: C. N. Mehta, 1991.
4. Environmental Policy: New Directions for the Twenty-First Century" by Norman J. Vig and Michael E. Kraft
5. "Environmental Law and Policy" by Jonathan R. Nash
6. "The Principles of Sustainability" by Simon Dresner
7. "Introduction to Environmental Impact Assessment" by John Glasson, Riki Therivel, and Andrew Chadwick
8. "Governing the Environment: Interdisciplinary Perspectives" edited by Marc Allen Eisner, Kristin R. Schreckhise, and Kevin T. Smith

MSc II Year, Semester – III
(CENV-MJ-601-P :- Lab Course- XI)
(Laboratory Course with 01 credits)

Lab Course		Evaluation Scheme
Practical	:- 3 hr/week	Continuous Internal Assessment by teacher :- 10 Marks
Internal Test	:- 1 Tests /semester	Sem-End Examination :- 15Marks
Internal Viva	1 time during internal test	
Record submission	:- 1 Record / semester	
Total Credit	:- 01	Total Marks :- 25 Marks

1. Conduct an EIA for a proposed local development project.
2. Analyze a specific environmental policy (e.g., Clean Air Act, Paris Agreement) and evaluate its effectiveness.
3. Conduct a case study on a city that has implemented sustainable urban planning practices.
4. Perform water quality tests on a local water body.
5. Conduct a biodiversity assessment in a local natural area.
6. Calculate the carbon footprint of a local community or institution.
7. Design a small-scale renewable energy project (e.g., solar panel installation).
8. Develop a waste management plan for a local community or institution.
9. Organize and conduct a workshop to engage the public in environmental decision-making.
10. Compare environmental laws from different countries or regions.
11. Use Geographic Information Systems (GIS) to create maps for environmental planning purposes.
12. Conduct air quality measurements in different areas and analyze the data.
13. Evaluate the sustainability of agricultural practices on a local farm.
14. Evaluate the sustainability of agricultural practices on a local farm.
15. Conduct a compliance audit of a local business or industry with respect to environmental regulations.

M Sc. IInd Year, Semester – III
(CENV-MJ-602-T : Environmental Microbiology)
 (Theory Course with 03 credits)

Teaching Scheme	Evaluation Scheme
Lectures :- 3 hr/week	Continuous Internal Assessment by teacher :- 30 Marks
Tutorials :- 2 per/ semester	Sem-End Examination :- 45Marks
Internal Test :- 2 Tests /semester	
Seminar :- 1 Seminar / semester	
Total Credit :- 03	Total Marks :- 75 Marks

The Course Objectives

1. Students will be able to know will know the basic concept of environment, its scope.
2. Students will be able to know different types of theories of Ecology and its applications.
3. Examine different measures to remediate ecosystems by natural recovery.
4. Students will be able to assess the role of individuals in prevention of pollution.
5. Student will be able to know the Study of population and community and recognize environmental issues associated with it.

Unit-I: Introduction:

(09)

Definition, Branches of Microbiology, (Industrial, Medical, Mycology, Environmental microbiology), History of Microbiology). Kingdom Protista: Concepts and classification of: Prokaryotes (Bacteria and Cyanobacteria) Eukaryotes (Algae, Fungi and Protozoans)
 Scope of Microbiology

Unit -II: Microbial Ecology:

(09)

Microbial communities and interactions.
 Biogeochemical cycles (Carbon, Nitrogen , Sulfur, Phosphorus).
 Symbiotic relationships.
 Pathogenic microorganisms and diseases.
 Role of microbes in health and diseases

Unit -III: Microbial Habitats:

(09)

Soil Microbiology : Soil microbes.
 Factors affecting microbial community.
 Microorganisms associated with Microbial degradation.
 Aquatic microbiology: (Freshwater and marine ecosystem),
 microbial analysis of water (MPN and IMVIC tests.)
 Purification of water: Disinfection.
 Extreme environments: (thermophiles, psychrophiles, halophiles, acidophyles).

Unit IV: Environmental Biotechnology:

(09)

Bioremediation (Principle and Application)
 Bioleaching and Biosorption . Waste water treatment (aerobic and anaerobic processes)
 Microbial transformation of heavy metals and xenobiotics

Unit V: Environmental Microbiology :

(09)

Organic compost. Vermicomposting, Biogas.
 Wastewater treatment (sewage) ,
 Biofiltration, Biodeterioration, Microbial plastic

Course outcomes

Students should able to:

1. Define microbiology and its functionality along with stability of microbiology.
2. Describe various types of microbiological aspects and their role in restoration of ecosystems.
3. Examine nature and status of microorganisms
4. Acquire the knowledge of microbial techniques in biotechnology
5. Acquire the knowledge of remediation of pollutant from soil and the water

References

1. Fundamentals of Microbiology- Pelczar Pub.
2. Elements of Microbiology-Pawar and Dagainawala (Vol.I,II)
3. Microbiology-P.D.Sharma.
4. Environmental Microbiology- Vijay Ramesh , M.J.P.Pub.
5. Role of Microbes in Management of Environmental Pollution-edited by R.Tiwari.
6. Practical Microbiology-R.C. Dubey, D.K.Maheshwari, S.Chand Pub.
7. Elements of Bio-technology-B.D.Singh.
8. Soil Microbiology-Pawar and DagainwaleMicrobiology-P.D. Sharma , Rastogi publisher, Meerut
9. Fundamental principle of bacteriology-P.C.Salle
10. Microbiology-Pelczar, M.S. Chand.
11. Global environmental Biotechnology : D.L. Wise.
12. Methods in Biotechnology: Hans Peter Schmauder
13. Introduction to Environmental Biotechnology, A.K.Chatterji, Prentice Hall of India Pvt.Ltd, New Delhi.
14. Environmental Biotechnology-Basis Concepts and Applications Indu Shekhar Thakur I.K. International Pvt.Ltd.New Delhi.
15. Environmental Biotechnology S.K. Agawal.APH Publishing Corp, New Delhi.
16. Elements of Biotechnology, by Jogdand S.N., Himalaya Publishing House, New Delhi.
17. Biotechnology, by B.D.Singh, Kalyani Publishers, New Delhi.
18. A Text Book of Biotechnology, R.C.Dubey, S.Chand & company Ltd., New Delhi.
19. Environmental Biotechnology by S.V.S.Rana (Rastogi publication, Meerut)
20. Biotechnological methods of pollution control, Abbasi, Sia and E Rameshwani

MSc II Year, Semester – III
(CENV-MJ-602-P :- Lab Course-XII)
(Laboratory Course with 01 credits)

Lab Course		Evaluation Scheme
Practical	:- 3 hr/week	Continuous Internal Assessment by teacher :- 10 Marks
Internal Test	:- 1 Tests /semester	Sem-End Examination :- 15Marks
Internal Viva	1 time during internal test	
Record submission	:- 1 Record / semester	
Total Credit	:- 01	Total Marks :- 25 Marks

1. To study the principle and applications of instruments used for microbiological study- Incubator, Inoculation chamber, Microscope.
2. To study the morphological characters of bacteria by Simple staining method
3. Study of bacteria by Grams staining method.
4. Study of bacteria by negative staining method.
5. IMVIC Test (Faecal and non faecal coliforms)
6. Qualitative analysis of water by MPN technique.
7. Identification of bacterial growth by Streak plate, Pour plate and Spread plate method.
8. Motility of bacteria by hanging drop technique.
9. Sterilization of culture media.
10. Preparation of pure culture.
11. Membrane technique (Demonstration)
12. Study of standard plate count (SPC).
13. Isolation of Fungi from given water sample
14. Determination of Dissolved oxygen from waste water sample
15. Determination of BOD from Waste water sample

M Sc. IInd Year, Semester – III
(CENV-MJ-603-T : Waste Water Engineering)
 (Theory Course with 03 credits)

Teaching Scheme	Evaluation Scheme
Lectures :- 3 hr/week	Continuous Internal Assessment by teacher :- 30 Marks
Tutorials :- 2 per/ semester	Sem-End Examination :- 45Marks
Internal Test :- 2 Tests /semester	
Seminar :- 1 Seminar / semester	
Total Credit :- 03	Total Marks :- 75 Marks

Course Objectives

Students will be able to know

1. Students will be able to identify advances waste water treatment technology for industrial and municipal waste water.
2. Student will be able to know proper industrial waste water treatment and air pollution monitoring and control for partial techniques in industry.
3. Students will be able to explain hazardous waste treatment and soil pollution control techniques for the soil pollutants.
4. Students will be able to know and plan for engineered biotechnology for the detoxification of phenols, biodegradation of pesticides and application for the treatment of spent wash, whey, high street waste etc.

Unit-I: - Water and Wastewater Treatment Technologies: 09

Water and wastewater treatment and analysis, various steps in water treatment, Screening and types of screening , sedimentation, types and design of sedimentation tank, filtration, ultra filtration, nano filtration, disinfection, removal of iron and manganese, softening of water, taste and odour removal, removal of oil and grease, skimming Tank, function of skimming tank, disposal of skimming.

Unit-II: - Industrial Wastewater Treatment 09

Industrial wastewater treatment, general characters of industrial wastewater, theories of treatment, Concept of Effluent Treatment Plant (ETP), design of ETP, Concept of Common Effluent Treatment Plant, design and functioning of CETP plant for public owned treatment plant, Effluent treatment methods for pharmaceutical and automobile industry, iron and steel industry. Dairy industry, pulp & paper industry, sugar industry, distillery industry, leather industry.

Unit III: Advanced Waste water Treatment Techniques: 09

Advanced technologies for wastewater treatment - Ozonation, Fluoridation. Reverse Osmosis, Electro Dialysis, Desalination method and Ion Exchange Methods, Advanced Oxidation Process, Thermal Evaporation, adsorption method. Membrane technology,

Unit —IV: - Industrial Hazardous Waste Treatment and Disposal Methods 09

Hazardous waste treatment, sources and characteristics, Hazardous waste treatment methods: Physical, Chemical and Biological treatment methods. Hazardous waste disposal methods, soil pollution, sources and monitoring, soil reclamation methods and soil pollution control. Treatment and Management: physical, chemical and biological treatments of Solid waste, three R"s, current management practices.

Unit —IV: - Industrial Air Pollution and control Techniques: 09

Air pollution monitoring and control techniques, sampling and monitoring of gaseous and particulate air pollutants, ambient and stack emission monitoring, major bioreactors for waste gas purification, biofilters, biotrickling filters, and bioscrubers, prevention of indoor air pollution. Air pollution control methods for industries-application of different air pollution

control technique in cement industry. Thermal power plant, Mining industry, stone crushing, asbestos industries etc. Urban Air pollution control Techniques.

Unit -V: - Environmental Engineering and Biotechnology

09

Environmental Engineering and biotechnology, introduction, scope and application, detoxification of phenols and biodegradation of pesticides, primary and secondary sludge phenol and cyanide removal. Bioremediation for removal of industrial pollutants.

Course outcomes

Students should be able to:

1. Define hazardous and non-hazardous waste treatment methods.
2. Express the air pollution control technologies for industries.
3. Use the treatment methods for hazardous and non hazardous waste management.
4. Use the advanced wastewater treatment technologies for industrial wastewater.
5. Design the biotechnology for waste management.

REFERENCES

1. Rao C.S,1991, Environmental Pollution Control Engineering, wing Eastern Ltd., New Delhi.
2. Pandey G.N. and Carney G.C., 2002, Environmental Engineering, Tata Mcgraw-hill Pub.Co., New Delhi.
3. Minakshi P., 2005, Elements of Environmental Science and Engineering, Prentice hall of India Pvt. Ltd., New Delhi.
4. Al-Sulaimi, J. and T.Asano.2000. Water reclamation and reuse, new age international publisher, new Delhi.
5. American Public health Association (APHA), 1992.Standard methods of water and waste water analysis, Washington D.C.
6. De,A.K, Environmental Chemistry, new Age International Pvt.Ltd, New Delhi.
7. Gujar, B.R. 2001, Sludge treatment and disposal. oxford and IBH publishing co. PVT.Ltd, New Delhi
8. Peavey KH. S. 1985 Environmental Engineering , New Delhi
9. Eco- Technology for pollution — Trivedi R. K. and Arvind Kumar
10. Environmental Pollution Engineering —n C. S. Rao
11. Waste Water Engineering Treatment, Disposal, Reuse — Metcalf and Eddy
12. Pandey G. N. and Carney G. C. 2002- Environmental Engineering, Hill Pub. New Delhi.
13. Advanced Treatment Techniques for Industrial Wastewater - Athar Hussain and Strajuddm

MSc II Year, Semester – III
(CENV-MJ-603-P :- Lab Course-XIII)
(Laboratory Course with 01 credits)

Lab Course		Evaluation Scheme
Practical	:- 3 hr/week	Continuous Internal :- 10 Marks
Internal Test	:- 1 Tests /semester	Assessment by teacher
Internal Viva	1 time during internal test	Sem-End Examination :- 15Marks
Record submission	:- 1 Record / semester	
Total Credit	:- 01	Total Marks :- 25 Marks

1. Determination of Biological Oxygen Demand in waste water
2. Determination of Chemical Oxygen Demand in waste water
3. Determination of oil and grease in waste water.
4. Determination of H₂S in waste water.
5. Characterization of solid waste.
6. Determination of water soluble aluminum compounds as Alumina (Al₂O₃) from alum by using gravimetric method.
7. Determination of moisture content in activated carbon.
8. Determination of available chlorine in bleaching powder.
9. Determination of sodium hydroxide content from caustic soda.
10. Determination of effective size and coefficient of uniformity of filter sand
11. Determination of bulk density of filter sand.
12. Determination of moisture content in lime powder.
13. Determination of percentage of calcium in lime.
14. To study the design, working and problems of primary clarifier, trickling filter and septic tank.
15. Determine of MLSS, MLVSS, & SVI of industrial waste water.

M Sc. IInd Year, Semester – III
(CENV-MJ-604-TP : Environmental Economics and Social Welfare.)
 (Theory Course with 02 credits)

Teaching Scheme	Evaluation Scheme
Lectures :- 2 hr/week	Continuous Internal :- 20 Marks
Tutorials :- 2 per/ semester	Assessment by teacher
Internal Test :- 2 Tests /semester	Sem-End Examination :- 30 Marks
Seminar :- 1 Seminar / semester	
Total Credit :- 02	Total Marks :- 50 Marks

Course Objectives

1. This course introduces you to economic perspectives on modern environmental issues.
2. The students will study economic theories related to natural resources, with an emphasis on the strengths and weaknesses of alternative viewpoints.
3. The students will learn that economic objectives do not necessarily conflict with environmental goals, and that markets can be harnessed to improve environmental quality.
4. The students will also discuss the limitations of economic analysis to provide policy guidance on environmental issues

Unit I. Introduction to Environmental Economics:

10

Economy-environment interaction; Material Balance Principle; entropy law; market failure; property rights; common accessible resources; resource economics – environmental economics – ecological economics: characteristics and synergy
 Relation between human development and natural resources; Environmental Kuznet's curve hypothesis – theory and empirical evidence; concept of sustainable development; indicators of sustainability; various approaches to environmental accounting

Unit II. Economics of Resources:

11

Competitive market structures and optimal extraction policy; monopoly, oligopoly, cartel and other market structures – optimal extraction policy; uncertainty and the rate of resource extraction; exploration and extraction; resource scarcity – indicators, evidence and critique.
 economic models of fisheries resources, economics of optimal harvest cycles of forests; extinction of species, economics of Biodiversity.
 Resource evaluation and public policy; measuring demand for environmental goods – consumer surplus, compensating and equivalent surplus, weak substitutability; Measuring values, benefits and costs – overview; total value – use and non-use values of goods;

Unit III. Green Economy:

09

Sectors of green economy, Energy economics in ecosystem, Green accounting, National policy on biofuels, Sustainable transport, Low carbon vehicles, Managing transport demands, Electric public transport efficiency, The political economy of congestion changes

Course outcomes

1. The overall aim is to give students an understanding of why market failures with negative environmental impacts occurs.
2. The students will demonstrate the various economic policy measures having role in human welfare.
3. After completion of the course, the student is expected to be able to explain key concepts in the field of environmental and natural resource economics.
4. After completion of the course, the student is expected to be able to explain why market failures occur .

5. After completion of the course, the student is expected to be able to account for different criteria with respect to sustainable development

Reference Books:

- Hanley, N., J.F. Shogren, and B. White, *Environmental Economics: In Theory and Practice*, Oxford University Press, 2006.
- Kolstad, C., *Environmental Economics*, Oxford University Press, 2000.
- Conrad, J.M. and C. Clark, *Natural Resource Economics – Notes and Problems*, Cambridge University Press, 1987.
- Dasgupta, P.S. and G.M. Heal, *Economic Theory and Exhaustible Resources*, University Press (Selected chapters), 1979.
- Bhattacharya, R.N. (2001), *Environmental Economics – An Indian Perspective*, Oxford University Press, Delhi.
- Singh, K. and A. Shishodia (2007), *Environmental Economics: Theory and Applications*, Sage Publications, New Delhi.
- Bateman, Ian J. et al.: *Economic Valuation with Stated Preference Techniques: A Manual*, Edward Elgar, 2002.
- Freeman, A. M.: *The Measurement of Environmental and Resource Values*, 2nd Edition, Resources for the Future, 2003.
- Johansson, P.-O.: *Cost-benefit analysis of environmental change*, Cambridge University Press, 1993.
- Kadekodi, G.K. (ed.) (2004), *Environmental Economics in Practice – Case Studies from India*, Oxford University Press, Delhi.
- Chopra, K. and V. Dayal (ed.) (2009), *Handbook of Environmental Economics in India*, Oxford University Press, Delhi.
- Haque, A.K.E., M.N. Murty, and P. Shyamsundar (ed.) (2011), *Environmental Valuation in South Asia*, Cambridge University Press, Delhi
- Green Economy by Dr. S.S.Patil, Publisher ; International Publications, Kanpur 2020

M Sc. IInd Year, Semester – III
(CENV-DSE-605-TA : Climate Change and Global Environmental Issues)
 (Theory Course with 03 credits)

Teaching Scheme	Evaluation Scheme
Lectures :- 3 hr/week	Continuous Internal :- 30 Marks
Tutorials :- 2 per/ semester	Assessment by teacher
Internal Test :- 2 Tests /semester	Sem-End Examination :- 45Marks
Seminar :- 1 Seminar / semester	
Total Credit :- 03	Total Marks :- 75 Marks

Course Objectives

Course Objectives

1. Identify the major global environmental changes and the upstream drivers behind these changes
2. Identify the health risks of climate variability and change, including the sources of vulnerability and exposure to those risks
3. Enumerate key issues in implementing, monitoring, evaluating, learning from, and continuously updating, adaptation policies and programs
4. Identify the health co-benefits of mitigation policies to reduce greenhouse gas emissions.

Unit I- Introduction to Climate Change:

09

The climate system, and interaction among the sub-systems, The Earth's natural greenhouse Effect, radiation balance, Climates of the past: last hundred, thousands and millions years; natural versus anthropogenic causes of climate change, enhanced greenhouse effect, climate forcing agents- greenhouse gases, aerosols, clouds, land use etc; global warming: role of CO₂, CH₄, water vapor etc., global warming potentials, the runaway greenhouse effect, CO₂ emissions and the Earth's carbon reservoirs,

Unit II- Climate Change Impacts:

09

Impact on agriculture, coastal system, food supply and demand, biodiversity.Land degradation- desertification, precipitation, polar ice melting and sea level rise.Climate change on health- overview- food- biological and seasonal cycle- economy. Direct effect- health injuries,thermalstress,infectious,malnutrition,mental stress,

Unit III - Climate change- adaptation, mitigation and sustainability:

09

Adaptation to climate change, Carbon sequestration, Mitigation technologies and potential in 2030, Zero carbon future, temperature stabilization, mitigation- carbon dioxide removal (CDR), reduction of global warming by geoengineering, carbon free renewable energy technology- alternative energy, efficient use of energy and its conservation,climate change preparedness, education and awareness. Alternative development models. Mission LiFE.

Unit IV - Global environmental issues in present scenario :

09

Interaction between Earth, Man and Environment. Case studies on: Toxic Chemical Pollution and Cross-Border Transfer of hazardous waste; Emerging pollutants; Water crisis; Soil fertility; Forest cover changes; Natural and anthropogenic disasters; Urbanisation and Industrialisation; Biodiversity loss; Public health issues; Population and Society.

Unit V – Local Environmental Issues and its Impact:

09

Global warming, Climate Change, Floods, Draught, Solid waste problems, Air pollution, Water pollution,Smog , Fog, Its Impact on Human Health and Agriculture and Ecosystem.

Course outcome:

1. To understand global environmental Issues.
2. To investigate climate change impact on local Area.
3. To understand climate change adaptation mitigation and sustainability.
4. Awareness by sustainable utilization of Natural Resources.
5. Students can analyze relation of climate change and environmental issue.

Reference:

1. Atmosphere, weather and climate 2002, K. Siddhartha, Taylor & Francis, 2010
2. Climate Change, Central pollution control board (2002)
3. Climate Change 2007: The Physical Science Basis, Intergovernmental Panel on Climate Change Report (<http://www.ipcc.ch>)
4. Stern Review: The Economics of Climate Change (2007)
5. *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* <www.ipcc-nggip.iges.or.jp/public/gl/invs1.htm>
6. (IPCC) *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* <www.ipcc-nggip.iges.or.jp/public/gp/spanish/gpgaum_es.htm>
7. Data base on GHG Emission Factors (web application through <www.ipcc-nggip.iges.or.jp/EFDB/main.php>)
8. GHG Inventory Software for the Workbook <www.ipcc-nggip.iges.or.jp/public/gl/software.htm>

MSc II Year, Semester –III
(CENV-DSE-605-PA :- Lab Course-XIV)

(Laboratory Course with 01 credits)

Lab Course		Evaluation Scheme
Practical	:- 3 hr/week	Continuous Internal Assessment by teacher :- 10 Marks
Internal Test	:- 1 Tests /semester	Sem-End Examination :- 15Marks
Internal Viva	1 time during internal test	
Record submission	:- 1 Record / semester	
Total Credit	:- 01	Total Marks :- 25 Marks

1. Estimation of Dissolved CO₂ in water.
2. Estimation of Dissolved Nitrates from a provided water sample.
3. Determination of PM₁₀ and PM_{2.5} from Air by using HVAS.
4. Determination of settleable particulate matter by using beaker method/tile method.
5. Determination of Ambient Air Temperature.
6. Preparation of summer cause and activity of Sarovar.
7. Inlist the cause, consequences and effect of Methyl Isocynide from Bhopal Gas tragedy disaster.
8. Determination of rate carbon assimilation in aquatic ecosystem.
9. Determine the effect of greenhouse gas with respect to case studies.
10. Calculations of carbon footprint from various activities of individuals.
11. Determine the various activities by environmentalist activists in India.
12. Study the role of different ENGIOS working in the field of climate change with their objectives and activities.
13. Studies on the industrial sustainable issues from the Marathwada region.
14. Study of 17 sustainable development Goals.
15. Study of Pollen grains. (Identification and Detection)

M Sc. IInd Year, Semester – III
(CENV-DSE-605-TB: Disaster Management)

(Theory Course with 03 credits)

Course Objectives

Students will be able to know

Teaching Scheme		Evaluation Scheme	
Lectures :-	3 hr/week	Continuous Internal Assessment by teacher :-	30 Marks
Tutorials :-	2 per/ semester	Sem-End Examination :-	45Marks
Internal Test :-	2 Tests /semester		
Seminar :-	1 Seminar / semester		
Total Credit :-	03	Total Marks :-	75 Marks

Course Objectives

1. Long-term planning for particular disaster to reduce its risk.
2. Shifting exposure from vulnerable area into safe place.
3. Ensuring safety, equity, equality to all organisms specially human beings.
4. Increasing the availability, safety of natural resources.
5. Creating awareness about disaster and its mitigation process among people.
6. To make the efforts for conservation of environment

Unit I - Understanding of key concepts in Disasters Management: 09

Hazards, Disasters, Vulnerability, Resilience, Disaster Management, Disaster Cycle, risk, prevention, mitigation, relief and response, recovery and rehabilitation etc – Brief history of disaster management in India and world- The emerging field of disaster management- Role of social sciences and natural sciences and multidisciplinary nature of disaster management as applied disciplines

Unit II - Natural Disasters: 09

Global and Indian geographic distribution of Disasters: Earthquakes, Volcanoes, Cyclones, Tsunamis, Storm surge, Floods, Droughts, Famines, Landslides, Avalanches, Sea level rise and Coastal erosion Climate change, environmental stress, Biological and Technological disasters – Overview through case studies.

Unit III - Man-Made Disasters: 09

Chemical, Industrial (including mining) and Nuclear Accidents, Oil Slicks and Spills, Accidents(Air, boat & road accidents) & Environmental Disasters (Air, water & soil pollution- sources and remedial measures), War and Conflicts, Fires explosion Climate change, environmental stress, Biological and Technological disasters – Overview through case studies.

Unit IV - Impacts of Disasters: 09

Economic Consequences, Loss of Human and Animal Lives, Destruction of Ecosystem and Environment. Impact on Health and Sanitation (Diseases and Epidemics)

Unit V - Disaster Response, Recovery and Reconstruction: 09

Disaster Preparedness for Response - Scenario building and contingency planning, Mock drills and table top exercises - Emergency Support Functions and Coordination, Incident Response System - Evacuation - Search and Rescue - Emergency Health Management, Early recovery and long term recovery - Inclusive recovery - Livelihood recovery - Psycho-social recovery, Concept and principles of Build Back Better - Build back houses and habitat - Build back infrastructure - Build back communities

Course outcomes:

1. To understand different major disasters at Global level.
2. Investigation of post-disaster effects on the environment and society.
3. Awareness regarding manmade and Natural disasters.
4. Students can find out the different traditional and new modern techniques for disaster management.
5. Investigate local disaster causes and impacts.

References

1. Bankoff, G., Frerks, G. and Hilhorst, D. 2004. (eds.) Mapping Vulnerability: Disasters, Development, and People, Earthscan, London.
2. Birkmann, J. 2007. "Risk and vulnerability Indicators at Different Scales: Applicability, Usefulness and Policy Implications", *Environmental Hazards*, 7 (1): 20-31.
3. Burton, I., Kates, R.W. And White, G.F. 1968. "The Human Ecology of Extreme GeoPhysical Events", *Natural Hazard Research*, Working Paper#1 Karuson, K.
4. MacManus, S.A. 2011. "Gauging Disaster Vulnerabilities at the Local Level: Divergence and Convergence in an all Hazard System", *Administration and Society*, XXX:1-26
5. Quarantelli, E. L. 1998 (eds) *What is a Disaster? Perspectives on the Question*, Routledge, London.
6. Wisner, B., Blaikie, P., Cannon, T. and Davis, I. 2004. *At Risk: Natural Hazards, People's Vulnerability and Disasters*, Second Edition, Routledge, London.
7. Birkmann J (2006): *Measuring Vulnerability to promote disaster resilient societies: Conceptual frameworks and definitions*, United Nations University Press, Pg. 9-54. Coburn, Spence & Pomonis (1991): *Actions to reduce risk in Disaster Mitigation*, UNDP/UNDRO Manual, Pg. 15 – 27.
8. Bryant Edwards, 2005. *Natural hazard*. Cambridge University press, UK. Coburn, Spence & Pomonis (1991): *Mitigation Strategies*, UNDP-UNDRO Manual, Pg. 29 – 34.
9. Jeannette Sutton and Kathleen Tierney (2006) *Disaster Preparedness: Concepts, Guidance, and Research*, Natural Hazards Center, Institute of Behavioral Science, University of Colorado, Accessible at McEntire D A (2005): *Why Vulnerability Matters: Exploring the merit of an inclusive disaster reduction concept*, *Disaster Prevention and Management*, 14 (2), Pg. 206- 222.
10. Morrow B H (1999): *Identifying and Mapping Community Vulnerability*, *Disasters*, 23 (1): 1-18.
11. Rautela P and RK Pande (2005): *Implications of ignoring the old disaster management plans: Lessons from the Amparav tragedy of 23 September 2004 in the Nainital district of Uttaranchal (India)*, *Disaster Prevention and Management*, 14 (2), Pg. 388-394.
12. Weichselgartner F (2001): *Disaster Mitigation: The concept of Vulnerability Revisited*, *Disaster Prevention and Management*, 10 (2), Pg. 85- 94.
13. Wisner B (2004): *Assessment of Capability and Vulnerability in Bankoff G, Frerks G and Hilhorst D eds. 'Mapping Vulnerability: Disasters, Development & People'*, Earthscan, Pg. 183-193.
14. Wisner B et al (2005): *At Risk: Natural Hazards, People's Vulnerability and Disasters*, London and New York, Routledge, Pg. 319 – 376.
15. Wisner B et al (2005): *At Risk: Natural Hazards, People's Vulnerability and Disasters*, London and New York, Routledge, Pg. 49-87.
16. Edward A Keller and Robert H Blodgett. 2008. *Natural hazards*. Pearson Prentice Hall, 488p.
2. Donald Hyndman and David Hyndman. 2009. *Natural hazards and disasters*. Brooks/Cole. 555p.

MSc II Year, Semester – III
(CENV-DSE-605-PB :- Lab Course-XIV)

(Laboratory Course with 01 credits)

Lab Course		Evaluation Scheme
Practical	:- 3 hr/week	Continuous Internal Assessment by teacher :- 10 Marks
Internal Test	:- 1 Tests /semester	Sem-End Examination :- 15Marks
Internal Viva	1 time during internal test	
Record submission	:- 1 Record / semester	
Total Credit	:- 01	Total Marks :- 25 Marks

1. Study of different instrument and warning system used for Disaster management.
2. Study of Rainfall pattern in Maharashtra.
3. Identify the Impact of Natural Disaster in your Area.
4. Prepare the chart or map of different disaster prone area of India.
5. Assessment of Pre-disaster and Post-Disaster effects on community.
6. Study of different Industrial Disaster.
7. Case study on Post Disaster Response, Relief, Recovery and Reconstruction after Landslide/Floods/Earthquake/Draught in Maharashtra.
8. One day field visit to India Meteorological Department for orientation and demonstration of early warning of disasters.
9. Visit to NDRF Academy at Nagpur.
10. Make the profile of different Natural Disaster in Maharashtra.
11. Signs and symbols of Hazards
12. Preparedness for Disaster Management
13. Use of Seismograph for earthquake monitoring
14. Study of different stages of Disaster Management
15. Identify and discuss some types of hazardous material in different disasters (Earthquake, Industrial Fire, Nuclear Accident and oil spill etc).

MSc II Year, Semester – III
(CENV-RP-649-P :- Lab Course-XV- Research Project-I)
(Laboratory Course with 04 credits)

Lab Course		Evaluation Scheme	
Practical	:- 12 hr/week	Continuous Internal Assessment by teacher	:- 40 Marks
Internal Test	:- 1 Tests /semester	Sem-End Examination	:- 60 Marks
Internal Viva	1 time during internal test	Total hours	:- 120
Record submission	:- Record or Submissions / semester		
Total Credit	:- 04	Total Marks	:- 100 Marks

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|---|----------|
| 1. The review writing of selected topics. | 40 Marks |
| 2. Research project writing for funding agencies. | 40 Marks |
| 3. Industrial Visit Report. | 20 Marks |

M Sc. IInd Year, Semester – IV

(CENV-MJ-651-T :- Air, Noise and Radiation Pollution: Management and Mitigation)

(Theory Course with 03 credits)

Course Objectives

Teaching Scheme		Evaluation Scheme	
Lectures :-	3 hr/week	Continuous Internal Assessment by teacher :-	30 Marks
Tutorials :-	2 per/ semester	Sem-End Examination :-	45Marks
Internal Test :-	2 Tests /semester		
Seminar :-	1 Seminar / semester		
Total Credit :-	03	Total Marks :-	75 Marks

Course Objectives:

1. Understand the sources and impacts of pollution of various environmental Matrices
2. Explain the fate and transport of various pollutants
3. Learn methods for the analysis of various pollutants
4. Understand the environmental monitoring techniques and quality standards
5. Understand the different pollution control measures

Unit-I :

09

Air Pollution control: Control methods for particulates-gravitational settling chambers, Centrifugal collectors, Wet collectors, Fabric filters, electro static precipitators. Control methods for gaseous pollutants- adsorption, absorption, condensation, combustion.

Unit-II:

09

Gaseous emissions and its control: Sources of air pollution from fossil fuels and industrial processes. Prevention and reduction of emissions, cleaner production.

Carbon sequestration techniques,

Air pollution control by absorption, adsorption, condensation, incineration, bioscrubbers, biofilters, etc.

Unit-III:

09

Generation and propagation of sound; sound power, sound intensity and sound pressure levels; plane, sources; outdoor and indoor noise propagation; psycho-acoustics and noise criteria. Noise problem analysis- OSHA regulations, Annoyance rating schemes; noise standards and limit values. Effects of noise on health, Noise pollution measuring instrumentation and monitoring procedure. Noise pollution prevention and control.

Unit-IV:

09

Noise Pollution Control: Absorbing materials, barrier materials, damping materials, acoustical enclosures, Reactive silencers and filters; Active noise control methods. Noise pollution regulation and standards.

Unit- V:

09

Definition and types of radiation . Ionizing radiation , Non Ionizing radiation
Sources of radiation. Radioactive decay; Interaction of radiation with matter;
Biological impact and health hazards associated with radiation, Units of radioactivity and radiation dose; Protection against ionizing isotopes and their applications in waste water and air pollution analysis and treatment;
Radioactive waste disposal.

Course Outcome:

1. Understand the Air Pollution and its management
2. Acquire knowledge of Various control instruments
3. Understand the noise pollution and its management.
4. Acquire the knowledge noise pollution standards and legislation.
5. Understand the health hazard and applications of radioactive compounds

References:

- 1) J.N.B. Bell (2002) Air Pollution and Plant Life, 2nd Edition, John Wiley and Sons, New Delhi.
- 2) Christon J. Hurst, Ronald L. Crawford, Guy R. Knudsen, Michael J. McInerney, Manual of Envi- ronmental Microbiology, 2nd edition, ASM Press. 2001.
- 3) Bruce Rittman, Perry L. McCarty. Environmental Biotechnology: Principles and Applications, 2nd Edition, McGraw-Hill, 2000.
- 4) Air Pollution – Stern
- 5) Environmental Pollution Control Engineering: C. S. Rao
- 6) Environmental Chemistry : B.K. Sharma, and H. Kaur
- 7) Air pollution – threat and response: D. A. Lynn
- 8) Air pollution and Environmental Protection – Legislative policies, Judicial trend and Social perceptions: N. Kumar; Mittal Publication
- 9) Trivedi P R Gurdeep Raj , Noise pollution, Akash deep Publishing House New Delhi
- 10) Vanloon Gary W Duffy Stephen J., Environmental chemistry: a global perspective, University Press Oxford

MSc II Year, Semester – IV
(CENV-MJ-651-P :- Lab Course- XVI)

(Laboratory Course with 01 credits)

Lab Course	Evaluation Scheme
Practical :- 3 hr/week	Continuous Internal :- 10 Marks
Internal Test :- 1 Tests /semester	Assessment by teacher
Internal Viva 1 time during internal test	Sem-End Examination :- 15Marks
Record submission :- 1 Record / semester	
Total Credit :- 01	Total Marks :- 25 Marks

1. Determination SOX concentration in air.
2. Determination NOX concentration in air.
3. Determination PM Concentration in air.
4. Determination of heavy metals in collected air samples.
5. Estimation of Carbon dioxide from air sample.
6. Study the principle and working of High Volume Air Sampler
7. Study the dust fall measurement by tile method
8. Detection and Identification of Pollen grains
9. Measurement of Noise by dB meter
10. Measurement of Humidity by Psychrometer
11. Study the principle and working of Cyclone Collector
12. Study the principle and working of Electrostatic precipitator
13. Isolation of fungi from environment.
14. Study the principle and working of Settling Chamber
15. Isolation Of Bacteria From Air sample

M Sc. IInd Year, Semester – IV
(CENV-MJ-652-T : Environmental Impact Assessment)
 (Theory Course with 03 credits)
Course Objectives

Teaching Scheme	Evaluation Scheme
Lectures :- 3 hr/week	Continuous Internal Assessment by teacher :- 30 Marks
Tutorials :- 2 per/ semester	Sem-End Examination :- 45Marks
Internal Test :- 2 Tests /semester	
Seminar :- 1 Seminar / semester	
Total Credit :- 03	Total Marks :- 75 Marks

Course objective:

1. To provide a foundational understanding of the EIA process, its history, and its importance in environmental management.
2. To understand the importance of baseline studies and methods for collecting and analyzing data.
3. To provide knowledge on predicting environmental impacts and assessing their significance.
4. To understand the requirements for EIA reporting and the process for reviewing EIA reports.
5. To explore the latest developments and best practices in the field of EIA.

Unit 1: Introduction to Environmental Impact Assessment

Overview of EIA: Definition and objectives of EIA, History and evolution of EIA, Legal and regulatory framework for EIA, **Principles and Concepts of EIA:** Key principles of EIA, Types and categories of impacts, Scope and significance of EIA

EIA Process and Methodology: Steps in the EIA process (screening, scoping, baseline data collection, impact prediction, mitigation, reporting, review, and decision-making), Different methodologies used in EIA (checklists, matrices, networks, overlays)

Stakeholder Involvement in EIA: Importance of public participation, Techniques for stakeholder engagement, Case studies on effective stakeholder involvement

Unit 2: Baseline Studies and Data Collection

Baseline Environmental Conditions: Purpose of baseline studies, Components of baseline data (physical, biological, socio-economic, cultural)

Data Collection Techniques: Field surveys and sampling methods, Remote sensing and GIS in baseline studies, Secondary data sources and their use

Environmental Indicators and Metrics: Selecting relevant environmental indicators, Quantitative and qualitative data analysis, Using indicators to assess environmental conditions

Case Studies on Baseline Data Collection: Examples of baseline studies in different sectors (industrial, agricultural, urban development), Challenges and best practices in data collection

Unit 3: Impact Prediction and Assessment

Methods of Impact Prediction: Predictive modeling and simulation, Expert judgment and Delphi technique, Scenario analysis

Assessing Impact Significance: Criteria for significance assessment, Impact magnitude, duration, and reversibility, Cumulative impact assessment

Mitigation Measures and Alternatives: Identifying and evaluating mitigation measures, Environmental management plans (EMP), Considering project alternatives

Case Studies on Impact Prediction and Mitigation: Real-world examples of impact prediction and mitigation strategies, Lessons learned and best practices

Unit 4: EIA Reporting and Review

Structure and Content of an EIA Report: Key components of an EIA report (executive summary, project description, baseline conditions, impact assessment, mitigation measures, monitoring plan), Best practices for writing clear and comprehensive reports

Reviewing EIA Reports: Criteria for reviewing EIA reports, Role of regulatory agencies and the public in the review process, Common shortcomings and how to address them

Decision-Making in EIA: Integrating EIA findings into decision-making, Balancing environmental, social, and economic considerations, Post-decision monitoring and follow-up

Case Studies on EIA Reporting and Review: Examples of successful and unsuccessful EIA reports, Analysis of the review process and decision-making outcomes

Unit 5: Emerging Trends and Best Practices in EIA

Strategic Environmental Assessment (SEA): Differences between EIA and SEA, Benefits and challenges of SEA, Case studies on SEA implementation

Social Impact Assessment (SIA): Integrating social impacts into EIA, Methods for assessing social impacts, Case studies on SIA

Cumulative Impact Assessment (CIA): Importance of considering cumulative impacts, Methods and tools for CIA, Case studies on CIA

Future Directions in EIA: Emerging trends (e.g., climate change considerations, biodiversity offsets, ecosystem services valuation), Innovations in EIA methodologies, Role of technology in enhancing EIA practices

Course outcomes:

1. **Enhanced Analytical and Critical Thinking Skills**
2. Practical Knowledge and Hands-On Experience
3. Understanding of Environmental Legislation and Policy Frameworks
4. Enhanced Communication and Stakeholder Engagement Skills
5. Career Readiness and Professional Development

Recommended Reading:

1. "Introduction to Environmental Impact Assessment" by John Glasson, Riki Therivel, and Andrew Chadwick
2. "Methods of Environmental and Social Impact Assessment" by Riki Therivel and Graham Wood
3. "Environmental Impact Assessment: Theory and Practice" by Peter Morris and Riki Therivel
4. "Handbook of Environmental Impact Assessment" edited by Judith Petts
5. "Environmental Impact Assessment: A Guide to Best Professional Practices" by Charles H. Eccleston

MSc II Year, Semester – IV
(CENV-MJ-652-P :- Lab Course- XVI)
(Laboratory Course with 01 credits)

Lab Course		Evaluation Scheme
Practical	:- 3 hr/week	Continuous Internal Assessment by teacher :- 10 Marks
Internal Test	:- 1 Tests /semester	Sem-End Examination :- 15Marks
Internal Viva	1 time during internal test	
Record submission	:- 1 Record / semester	
Total Credit	:- 01	Total Marks :- 25 Marks

1. Identify and document key environmental issues for a proposed project.
2. Conduct field surveys to collect baseline environmental data (e.g., water quality, air quality, soil characteristics).
3. Use software tools (e.g., GIS, air quality models) to predict the environmental impacts of a proposed project.
4. Organize a mock public consultation meeting to discuss a proposed project.
5. To practice stakeholder engagement and public participation techniques.
6. Create an environmental impact matrix for a specific project.
7. Conduct a social impact assessment for a proposed development project.
8. Evaluate the cumulative impacts of multiple projects in a region.
9. Propose and evaluate mitigation measures for identified environmental impacts.
10. Propose and evaluate mitigation measures for identified environmental impacts.
11. Prepare a comprehensive EIA report for a hypothetical or real project.
12. Conduct an audit to ensure a project complies with relevant environmental regulations.
13. Perform a risk assessment for potential environmental hazards associated with a project.
14. Design a monitoring plan to track environmental impacts during and after project implementation.
15. Analyze a real-world EIA case study to identify best practices and lessons learned.

M Sc. IInd Year, Semester – IV
(CENV-MJ-653-T : Environment and Sustainable Developmental)
 (Theory Course with 03 credits)

Teaching Scheme		Evaluation Scheme	
Lectures	:- 3 hr/week	Continuous Internal Assessment by teacher	:- 30 Marks
Tutorials	:- 2 per/ semester	Sem-End Examination	:- 45Marks
Internal Test	:- 2 Tests /semester		
Seminar	:- 1 Seminar / semester		
Total Credit	:- 03	Total Marks	:- 75 Marks

Course Objectives:

The Course aims

- To understand the status of environment
- To assess the concept of sustainability on various sectors
- To know actions taken against the climate change in the world and national level
- To impart knowledge on the principles for balancing social, economic and environmental dimensions of development and the associated international and national frameworks
- To learn about environmental management

Unit I: Environmental Assessment:

09

National environmental policy act of 1969 – Environmental Impact Assessment – Project categories based on environmental impacts – Impact identification methods–Environmental impact assessment process.

Unit II: Environmental Management and Social Dimensions:

09

Revisiting complex issues – Sector policies concerning the environment – Institutional framework for environmental management–Achievements in environmental management – People’s perception of the environment–Participatory development–NGOs –Gender and development–Indigenous peoples Social exclusion and analysis.

Unit III: Challenges of sustainable development and global Environmental issues:

09

Status of Global and Indian environment - Environmental, Social and Economical issues- Need for sustainability-Nine ways to achieve sustainability- population, resources, development and environment. Concept of sustainability - Factors governing sustainable development - Linkages among sustainable development - Environment and poverty - Determinants of sustainable development - Case studies on sustainable development - Population, income and urbanization-Healthcare-Food, Fisheries and agriculture- Materials and energy flows.

Unit IV: Sustainable Development Indicators:

09

Need for indicators – Statistical procedures – Aggregating indicators – Use of Principal component analysis – Three environmental quality indices.

Unit V: Sustainable Development through Environmental Law:

09

History of environmental law, environmental legislation in India, Central and state boards for the prevention and control of environmental pollution, powers and functions of pollution control boards, penalties and procedure, duties and responsibilities of citizens for environment protection

Wildlife Act 1972, Air and Water act, Water cess Act, Forest Act, Environmental protection Act 1986, Hazardous waste (Management and Handling) rules 1989, Bio medical waste (Management and Handling) rules 1998. Ministry of Environment and forests – notification

relating to hazardous microorganisms and genetically modified organism 1999. Public liability insurance Act 1995. Noise pollution 2000. National environment tribunal Act 1995. International cooperative movements. Global Environment monitoring systems (GEMS). Antarctica convention, Stockholm summit, UNCED and its four conventions-climate change biodiversity, desertification, tropical forest, Ramsar convention.

Course Outcome:

- Attaining the national and global environmental, economic and social issues and the principles of different sustainable development frameworks
- Applying the sustainable development principles during the planning of developmental activities
- Develop better understanding of natural resources, their distribution, inter-relationships, uses and the institutional arrangements governing their utilization.

Reference Books:

- 1 Sayer, J. and Campbell, B., "The Science of Sustainable Development: Local Livelihoods and the Global Environment"(Biological Conservation, Restoration &Sustainability), Cambridge University Press, London, 2003.
2. Kirkby, J., O'Keefe P. and Timberlake, "Sustainable Development", Earth scan Publication, London, 1993.
3. PeterP. Rogers,KaziF. Jalal, JohnA. Boyd, "An introduction to sustainable development", Glen Educational Foundation, 2008.
4. Jennifer A. Elliott, "An introduction to sustainable development". London: Routledge: Taylor and Francis group, 2001.
5. Low, N. Global ethics and environment. London: Routledge. 1999.
6. Douglas Muschett, Principles of Sustainable Development, St. Lucie Press, 19.

MSc II Year, Semester – IV
(CENV-MJ-653-P :- Lab Course-XVIII)

(Laboratory Course with 01 credits)

Lab Course		Evaluation Scheme	
Practical	:- 3 hr/week	Continuous Internal Assessment by teacher	:- 10 Marks
Internal Test	:- 1 Tests /semester	Sem-End Examination	:- 15Marks
Internal Viva	1 time during internal test		
Record submission	:- 1 Record / semester		
Total Credit	:- 01	Total Marks	:- 25 Marks

1. Case studies on smart cities and their environmental impact.
2. Carbon footprint analysis of different sectors.
3. Evaluating the economic and environmental benefits of solar and wind energy.
4. Assessing the impact of pollution on freshwater resources.
5. Designing and evaluating biodiversity conservation projects.
6. Developing sustainable soil and water management practices.
7. Evaluating the effectiveness of different waste management strategies.
8. Conducting EIAs for proposed development projects.
9. Assessing the benefits of electric and hybrid vehicles.
10. Designing sustainable buildings using green building standards.
11. Evaluating the role of local communities in environmental conservation.
12. Developing sustainable tourism plans for ecologically sensitive areas.
13. Implementing and evaluating air quality monitoring systems.
14. Assessing the impact of fishing practices on marine ecosystems.
15. Case studies on successful corporate sustainability practices.

M Sc. IInd Year, Semester – IV
(CENV-DSE-654-TA : Natural Resource Management)
 (Theory Course with 03 credits)

Teaching Scheme	Evaluation Scheme
Lectures :- 3 hr/week	Continuous Internal :- 30 Marks
Tutorials :- 2 per/ semester	Assessment by teacher
Internal Test :- 2 Tests /semester	Sem-End Examination :- 45Marks
Seminar :- 1 Seminar / semester	
Total Credit :- 03	Total Marks :- 75 Marks

Course Objectives:

- To understand the importance of natural resources
- To know the role of water, soil conservation and management
- To create awareness on sustainable utilization of resources
- To gain knowledge on various hurdles of resource management

Unit: 1:Natural Resources:

09

Definition of Natural resources; Classification of natural resources based on utility potential. Water resources in India- Water budget of India .Dams: Types- Impact on environment— alternatives; Floods: Causes and control Strategies; Water conservation Strategies in India— Watershed management; Rain Water Harvesting; River linking etc.

Unit: 2: Mineral Resources and Metals:

09

Mineral resources- Important mineral resources, use of mineral resources, Environmental problems due to mining of minerals, cause of degrading mineral resources, Mineral resources and population, Oceans as new areas for exploration of mineral resources, Reclamation of mining areas, Environmental impact of overexploitation of mineral resources, Conservation of mineral resources; Metals- exploitation of metallic ores, use of metals, smelters and environmental degradation.

Unit: 3: Energy Resources and Conservation:

09

Definition- Classification of energy resources; Conventional: Fossil fuels, Nuclear energy and their impacts. Non-conventional: Solar, Wind, Tidal, Micro hydel, Ocean Thermal energy, Geothermal. Energy use pattern, Environmental problems due to use of conventional energy resources.

Unit: 4:Forest Resources:

09

Importance of Forestry- Types of Forests-Impacts of Deforestation; Minor forest Products; Forest based Industries; Forest Fires and their control; Forest conservation Social Forestry- Agroforestry— Sacred Groves-Joint forest Management; Chipko and Appiko Movements; Ecotourism and its impacts. Salient features of the Indian forest Act, 1927.

Unit: 5 :Conservation of resources and sustainable development:

09

Policies and practices needed for sustainability, natural resource conservation practices for sustainability, Conservation of forest, water conservation, conservation of energy resources, recovery of resources, recycle of resources, reuse of resources, Industrial waste management through 3-R principles, Cleaner production. .

Course Outcomes :

Students should be able to

- 1: Understand the value of natural resources
- 2: Investigate pros and cons of non-renewable energy utilization
- 3: Understand environmental implications of resource extraction
- 4: Awareness on natural resources conservation practices
5. Students can analyze the relationship between natural resources, animals, plants as well as human being.

References:-

1. Fundamental of Ecology-Dash M.C. Tata McGraw Hill Pub. Co. Ltd. New Delhi.
2. Concepts of Ecology (Fourth Edition) – Edward J. Kormondy, Prentice Hall of India Pvt. Ltd. New Delhi.
3. Environment forest, ecology and man –Dixit R.K. Rastogi publication, New Delhi.
4. Living in the environmental – T.J.Miller
5. Natural resource conservation –Owen and Chiras
6. Encyclopedia Energy –I&II
7. Physical geography-Dasgupta
8. Environmental Science-Emger Smith
9. Environmental Science-Nebel
10. Elements of Biotechnology-P.K. Gupta, Rastorgi Publication, Meerut.
11. Sustainable development:- N.L. Gupta R.K. Gurjav [630.72(Gup/Gur)29.6858].
12. Sustainable development :- A.K. Shrivastave APH Publishing
13. Corporati 5, Ansavi Raod, Darya Ganj, New Delhi – 11002 [574.5
14. (SRI) 324429].
15. Water harvesting and sustainable supply in India :- R.N. Athavale Rawat Publication Jaipur and New Delhi. [628.168(ATH) 318328].
16. Environment sustainable development: - V. Rajyalakshmi APH. Publishing corporation 5, Ansari. Road Darya Ganj New Delhi – 11002 [630.72 (RaJ) 322614].
17. Sustainable Economic development & low income economics (LIEs):- Raj Kumar Sen Kartic C. Roy Atlantic Publishing and distributors in collaboration with International institute for development studies (IIDS) Calcutta – 700 004 [3238.9(Sen/Roy) 323042].
18. Sustaining development Human Resources gender and environment: - R.N. Ghosh R. Gabby K.C. Roy Altantic publisher and distributors. New Delhi- 110002 [574.5 (GHO) 32 3041].
19. Environmental priorities in India and sustainable development :- TN Khoshoo
20. Resources and Human Well Being :- Archana Sharma.
21. Encyclopedia of energy **resource management**:- Priorities for 21st century (2 Vols), 2000, Sarup and Son's Publishers, New Delhi.
22. Environmental planning for rural development 2001: K.K. Singh, S. Ali Sarup and **Son's publisher** New Delhi.
23. Forest of India by Champion and Seth.
24. Environmental Science: A study of Interrelationship by E.D. Enger, & B.E. Smith WCB, Publication.
25. Fundamentals of Ecology by E.P. Odum (Revised edition)
26. Environment, Energy, Health, Planning for conservation By V.Vidyanath, Gnyan Publishing house, New Delhi.
27. Resource & Hum well-Being by Archana Sharma
28. Natural Resources by Oliver S. Owen.
29. Environmental priorities in India and Sustainable Development by T.N. Khoshro.
30. Environmental Geology by Barbara, Wim Brain, J.S. Stephen; John Wily & Sons Inc.
31. Environmental Biology by K.C. Agrawal.

32. Environmental & Ecology by P.D. Sharma.
33. Anil Tyagi, Environmental Science, Danika publishing company, New Delhi, 2007.
34. Barrington EJW, Environmental Biology. Resource and Environmental Science series, Edward Arnold (pub) Ltd. London.
35. Purohit, S.S, Shammi, Q. Land Agarwal, A.K; A text book of Environmental science, student edition publishers, Jodhpur, 2004.
36. R.K khitoliya and K. Venkatachalam) (1997), Urban settlements and Natural hazards. Proceedings of seminar on Natural hazards in the urban habitat. November, New Delhi.
37. Arya,A.S(1997)Seminaron“BuiltEnvironment&Naturalhazards”.Indianbuildingscongress .February, New Delhi

MSc II Year, Semester –IV
(CENV-DSE-654-PA :- Lab Course-XIX)
(Laboratory Course with 01 credits)

Lab Course		Evaluation Scheme	
Practical	:- 3 hr/week	Continuous Internal Assessment by teacher	:- 10 Marks
Internal Test	:- 1 Tests /semester	Sem-End Examination	:- 15Marks
Internal Viva	1 time during internal test		
Record submission	:- 1 Record / semester		
Total Credit	:- 01	Total Marks	:- 25 Marks

1. To study the cover and basal area study of tree species.
2. Determination of Important value index (IVI) for tree species & Identification its timber potential.
3. Profile study of natural pond/lake and manmade reservoirs.
4. Study of energy resources plants
5. To study the calorific value of biomass.
6. To study fresh water resources water quality parameters-pH, electric conductivity, total acidity, total alkalinity, dissolved oxygen, carbon dioxide TS, TDS and TSS.
7. Determination of moisture content and water holding capacity of soil.
8. Determination of residual chlorine content in treated drinking water.
9. To study the permanent hardness of treated drinking water.
10. Determination of total inorganic phosphorus content of soil.
11. To study Net Primary Productivity of water body (lake/pond) by Gaarder and Gran's method.
12. To study the Gross Primary Productivity of water resources (lake /pond) by Gaarder Gran's method.
13. To study the light intensity by sun shine recorder.
14. To prepare a list of trees available in the Campus.
15. To identify and describe the given minerals.

M Sc. IInd Year, Semester – IV
(CENV-DSE-654-TB: Biodiversity Conservation and Management)
 (Theory Course with 03 credits)

Teaching Scheme	Evaluation Scheme
Lectures :- 3 hr/week	Continuous Internal :- 30 Marks
Tutorials :- 2 per/ semester	Assessment by teacher
Internal Test :- 2 Tests /semester	Sem-End Examination :- 45Marks
Seminar :- 1 Seminar / semester	
Total Credit :- 03	Total Marks :- 75 Marks

Course Objectives

1. To assess biodiversity loss and the importance of biodiversity conservation.
2. To emphasis regional diversity hotspots and important conservation areas.
3. To develop biotechnological methods in pollution abatement and develop eco-friendly bio-products for environmental health.

Unit-I: Introduction:

09

Definition and concept of Biodiversity, Types of diversity: Ecosystem diversity, Species diversity, and Genetic diversity. Alfa, Beta and Gamma diversity. Integrated Biological Indices. Biodiversity values: economical values, food & agriculture, medicine, Industrial material, cultural and aesthetic values, Ecological values. Key stone, Umbrella & Flag ship species, endemic species. Biodiversity issues. Loss of Biodiversity-causes and consequences. Species Extinction.

Unit -II: Measures of Biodiversity:

09

Alfa, Beta and Gamma diversities – Indices of diversity and evenness-The Simpson Index Diversity of fully censured communities – Estimating the diversity of large community – Evenness and Equitability – Hierarchical diversity.

Unit-III: Threats to Biological Diversity:

09

Habitat Degradation, Fragmentation, Global Climate Change, over extraction, over abundance, alien and invasive species, diseases, pollution, Endangered and Threatened species, IUCN, Red Data Book.

UNIT – IV: Conservation and Management of Biodiversity:

09

Biodiversity Conservation and Management Biodiversity Conservation: Importance and need of biodiversity conservation. Strategies for Biodiversity conversation: In-situ National parks, Sanctuaries, Biosphere reserves, N Preservation plots, Sacred groves Ex-situ conservation: Botanical gardens, Zoos, Aquaria, Herbaria. In vitro conservation: Germplasm & gene bank, Tissue culture, Pollen, spore and seed bank, DNA bank. Man and biosphere programme (MAB). New Conservation strategies: Community reserves, community-oriented approaches, drawing from local values, knowledge and experiences, rendering civil society more responsive, harnessing voluntary action. REDD and REDD+

UNIT-IV : Biodiversity Convention and Biodiversity Act :

09

Relevant article on CBD, sharing benefit, biological resources, Biotechnology. Conservation of Eco-System, Sustainable use of biodiversity, transfer of technology, adaption of biodiversity protocols, Biodiversity- IPR, wildlife protection act 1972, Forest Act, International and National policies, Role of WWF, WCU, CITES, TRAFFIC. Role of Government and NGOs. Environmental education and Conservation. State and National Biodiversity Board

Course Outcomes:

1. To understand the value of biodiversity
2. To understand the effect of Biodiversity loss through human interference.
3. Awareness on Biodiversity conservation practices.
4. Students can analyze the relationship between natural resources, animals, plants as well as human being.
5. To find out the sustainable use of biodiversity.

References

1. Sutherland, W. J. 2004. The Conservation Handbook, Research, Management and Policy, Blackwell Science Ltd. P278.
2. Nair, S. C. Southern Western Ghats: A biodiversity conservation Plan, INTACH, New Delhi. P92.
3. Michael E. Soule and Bruce Wilcox, 1980. Conservation Biology: An Evolutionary-Ecological Perspective.
4. Lewis, M. 2003. Inventing Global Ecology: Tracking the biodiversity ideal in India, Orient Longman. P369.
5. Martin, G.J. 1995. Ethnobotany - A methods manual. Chapman & Hall. Madras.
6. Maxted, N., B. V. Ford-Lloyd and J. G. Hawkes. 1997. Plant Genetic conservation- the insitu approach. Chapman & Hall, Madras.
7. Ahmadullah, M and Nayar, M. P. 1987. Endemic plants of the Indian Region. Vol. I Botanical Survey of India.
8. Heywood, V. H. (ed) 1995. Global Biodiversity Assessment (UNEP), Cambridge University Press, Cambridge.

MSc II Year, Semester – IV
(CENV-DSE-654-PB :- Lab Course-XIX)
(Laboratory Course with 01 credits)

Lab Course		Evaluation Scheme
Practical	:- 3 hr/week	Continuous Internal Assessment by teacher :- 10 Marks
Internal Test	:- 1 Tests /semester	Sem-End Examination :- 15Marks
Internal Viva	1 time during internal test	
Record submission	:- 1 Record / semester	
Total Credit	:- 01	Total Marks :- 25 Marks

1. Adaptations in animals : Morphological and physiological adaption's in animals with respect to specific environmental parameters or ecosystem types..
2. Adaptations in plants : Morphological and physiological adaption's in plants with respect to specific environmental parameters or ecosystem types.
3. Insectivorous plants : Identification, morphological adaptations and ecological distribution.
4. Estimate primary production using water samples from different aquatic habitats.
5. Study of some pioneer communities in succession; Lichen and their types, mosses and their types, coral and their types.
8. To study ecological role / functions of plant species (predominant trees / shrubs species) from various Biomes.
9. Identification of marine and fresh water planktons (preserved water samples may be used).
10. The study of major sanctuaries / national parks from India by using phyto-geographic maps.
11. Preparation of herbaria by using suitable fresh local plant samples (spreading, drying, pressing and labelling).
12. To study the human-wildlife conflict, and developmental activity from local areas, which has potential threat to local biodiversity.
- 13.. Determination Density selected species by using quadrat method.
14. Determination of Simpson Index of species by making survey of species from selected area or by simulation method.
15. Determination of Shannon and Wiver index of species by making survey of species from selected area or by simulation method.
- 16 Field visit report / study visit report (The visits report will be submitted as part of the Practical work).