Dr. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD

CIRCULAR NO.SU/Sci. & Tech./Colleges./NEP/16/2023

It is hereby inform to all concerned that, the syllabi prepared by the Board of Studies & Ad-hoc Boards and recommended by the Dean, Faculty of Science & Technology, the Hon'ble Vice-Chancellor has accepted **the following curriculum of All Post Graduate Degree Courses as per Norms of National Education Policy – 2020 under the Faculty of Science & Technology run to the Affiliated Colleges, Dr.Babasaheb Ambedkar Marathwada University** in his emergency powers under section 12(7) of the Maharashtra Public Universities Act, 2016 on behalf of the Academic Council as appended herewith.

Sr.No.	Syllabi of Affiliated BAMU, Aurangabad.	Semester
1.	M.Sc.Zoology	Ist and IInd Semester
2.	M.Sc.Microbiology	Ist and IInd Semester
3.	M.A/M.Sc.Mathematics	Ist and IInd Semester
4.	M.Sc.Geology	Ist and IInd Semester
5.	M.Sc.Biophysics	Ist and IInd Semester
6.	M.Sc.Bioinformatics	Ist and IInd Semester
7	M.Sc. Information Technology	Ist to IVth Semester
8.	M.Sc.Computer Science	Ist to IVth Semester
9.	M.Sc.Botany	Ist and IInd Semester
10.	M.Sc.Enviornmental Science	Ist and IInd Semester

This is effective from the Academic Year 2023-24 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,
Aurangabad-431 004.
REF.NO.SU/NEP/2023/ 8752-60
Date:- 08.08.2023.

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Deputy Registrar,
Academic Section

Copy forwarded with compliments to :-

1] **The Principal of all concerned affiliated 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.BAMU,A'bad.
2] The Section Officer,[M.Sc.Unit] Examination Branch,Dr.BAMU,A'bad.
3] The Programmer [Computer Unit-1] Examinations, Dr.BAMU,A'bad.
4] The Programmer [Computer Unit-2] Examinations, Dr.BAMU,A'bad.
5] The In-charge,[E-Suvidha Kendra], Rajarshi Shahu Maharaj Pariksha Bhavan, Dr.BAMU,A'bad.
6] The Public Relation Officer, Dr.BAMU,A'bad.
7] The Record Keeper, Dr.BAMU,A'bad.

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD

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)

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	
Exit option with Post-graduate Diploma (44 credits) after first year or two semester with completion of courses equivalent to 44 credits								
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: III[rd] 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 Foreignsic 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 45contact 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.

i) 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	

ii) 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 assed 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 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 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 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 – Wart 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 quadrate 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 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 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 toaware 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), Stochiometry, 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; NO_2, HC and PAN.

Course Outcome

Students should 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.Mannhan
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. Duffiy, Oxford Uni. Press, London.
6. Environmental Chemistry – R.C. Rasswell
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 – Lundgran,
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 hazards 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. Eqbal.
27. Environmental and Man: The chemical environmental: 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 at carbon dioxide from air by using Lungs Zecondroff apparatus
8. Determination of NOx 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 emition 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,NOx, CO,CO2, PAN and Hydrocarbons, Methods used, Cyclone separators, Fabric filters, Electrostatic precipitors, 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, Valuators`, 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 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 Bhattachraya and Ritu Banerjee
3. Water Analysis: AWWA, APHA
4. R. M. Atlas and R. Bartha - 1998 - Microbial Ecology - Fundamentals and applications. AddisonWesley Longman, Inc.
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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)
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16. Environmental pollution control engineering. C. S. Rao. New Age International Publishers.
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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 submission	:-	1 Record / semester			
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,UNFCC, 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 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.Tarbuck.
2. Introduction to weather and climate :-Trewartha
3. Introduction to climatology for topics :-Ayoade J.O.
4. General Climatology :- Critichfield 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 Hardood 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 Meterology :-Horace Robert Byers, Sc.D. 3rd Ed MCGRAW Hill Book Company new York Toronta, London.
17. Enviromental 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, Lawarence 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 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:

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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. "Stastical Methods" by S.P.Gupta, Publisher S.Chand and Sons.
4. "Fundamentals of Research Methodology and Stastics" by Yogesh Kumar Singh , New Age International Publication, New Delhi.
5. "How SAGE has shaped Research methods A 40 years history" by John W Cresewell, University of Nebraska. Lincoln.
6. "The Essence of Research Methodology, A Concise Guide for Master & Ph.D. students in management science, by Jan Jonker & BartjanPennink, 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 Kotharir 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. "Stastical Methods" by S.P.Gupta, Publisher S.Chand and Sons.
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12. "How SAGE has shaped Research methods A 40 years history" by John W Cresewell, 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		1 time during internal test			
Record submission	:-	1 Record / semester			
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 submission	:-	1 Record / semester			
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 titriometry.
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, Titriometry, 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 hybrization (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 Lafrry R. Faulkner (2001). Electrochemical Methods, 2nd Ed., John Wiley & Sons.
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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.
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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		1 time during internal test			
Record submission	:-	1 Record / semester			
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 Nephlometer/ 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 photoflorometer.
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.

Course Outcome

Students should be able to:

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

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 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. 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-IL-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- 111:-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 intemet 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 CENVDSE--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		1 time during internal test			
Record submission	:-	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.