DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY

CIRCULAR NO.SU/Sci./M.Sc./69/2021

It is hereby inform to all concerned that, the syllabus prepared by the concerned Board of Studies and recommended by the Dean, Faculty of Science & Technology the Hon'ble Vice-Chancellor has accepted the **Following Syllabus for affiliated Colleges and University Department** 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.	Syllabus (under Choice Based Credit System)
1.	M.Sc. Zoology semester Ist and IInd.
2.	M.Sc. Environmental Science semester Ist and IInd.
3.	M.Sc. Botany semester Ist and IInd.

This shall be effective from the Academic Year 2021-22 and onwards.

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

University Campus,
Aurangabad-431 004.
REF.NO. SU/SCI/2021/ 5355-66
Date:- 13.12.2021.

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Deputy Registrar,
Academic Section.

Copy forwarded with compliments to :-

1] **The Principal of all concerned Colleges,**
Dr. Babasaheb Ambedkar Marathwada University,
2] **Head of the Department, Department of Botany**
Dr.Babasaheb Ambedkar Marathwada University, Aurangabad.
3] **Head of the Department, Department of Zoology,**
Dr.Babasaheb Ambedkar Marathwada University, Aurangabad.
4] **Head of the Department, Department of Environmental Science,**
Dr.Babasaheb Ambedkar Marathwada University, Aurangabad.
5] **The Director, University Network & Information Centre, UNIC, with a request to upload this Circular on University Website.**

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

Department of Environmental Science

Structure and Curriculum

For

M.Sc. Ist year Environmental Science

of

College and University Department

(Choice Based Credit System)
with
O B E Pattern

(Effective from the Academic year 2021-22)

9/12/21

Dean
Faculty of Science & Technology
Dr. Babasaheb Ambedkar Marathwada
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Ad Hoc Board Chairman

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad.

Course Structure

M.Sc. (Environmental Science) in Choice Based Credit System

From Academic Year 2021-2022

106 credits against 2650 marks.

Course	Course Code	Paper Titles	Hrs/ week	Credits	Marks
		M.Sc. I year (Semester- I)			
COM	COM-100	Constitution of India	02	02	50
RM	ENV-001	Research Methodology Part-I	02	02	50
FC	ENV-401	Foundation Course on Environment	04	04	100
CC	ENV-402	Physical and Chemical Aspects of Environment	04	04	100
CC	ENV-403	Techniques in Environment & Analysis	04	04	100
EC	ENV-421A	Wildlife Conservation & Management	04	04	100
EC	ENV-421B	Environmental Metrology &Climate Change	04	04	100
LC	ENV-441	Lab Course-I	04	02	50
LC	ENV-442	Lab Course-II	04	02	50
LC	ENV-443	Lab Course-III	04	02	50
ELC	ENV-444A	Lab Course-IV	04	02	50
ELC	ENV-444B	Lab Course-IV	04	02	50
		Total Credits for Semester – I = 28 (Theory:20 &Lab:08) (With One Elective Course)			
		M.Sc. I Year (Semester-II)			
Course	**Course Code**	**Paper Titles**	**Hrs/ week**	**Credits**	**Marks**
RM	ENV-002	Research Methodology Part-II	02	02	50
CC	ENV-404	Environmental Biotechnology	04	04	100
CC	ENV-405	Applications of Green Technology	04	04	100
CC	ENV-406	Environmental Engineering & Technology	04	04	100
EC	ENV-422A	Environmental Management Systems	04	04	100
EC	ENV-422B	Environmental Statistics & Modeling	04	04	100
LC	ENV-445	Lab Course-V	04	02	50
LC	ENV-446	Lab Course-VI	04	02	50
LC	ENV-447	Lab Course-VII	04	02	50
ELC	ENV-448A	Lab Course -VIII	04	02	50
ELC	ENV-448B	Lab Course-VIII	04	02	50
		Total Credits for Semester – II = 26 (Theory:18 &Lab:08) (With One Elective Course)			

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	M.Sc. IInd year (Semester- III)				
Course	**Course Code**	**Paper Titles**	**Hrs/ week**	**Credits**	**Marks**
CC	ENV-501		04	04	100
CC	ENV-502		04	04	100
CC	ENV-503		04	04	100
EC	ENV-521A		04	04	100
EC	ENV-521B		04	04	100
SC	ENV-522		04	04	100
LC	ENV-541	Lab Course-IX	04	02	50
LC	ENV-542	Lab Course- X	04	02	50
LC	ENV-543	Lab Course- XI	04	02	50
ELC	ENV-544A	Lab Course- XII	04	02	50
ELC	ENV-544B	Lab Course- XII	04	02	50
Total Credits for Semester – III= 28 (Theory:20&Lab:08) (With One Elective Course)					
	M.Sc. IInd Year (Semester-IV)				
Course	**Course Code**	**Paper Titles**	**Hrs/ week**	**Credits**	**Marks**
CC	ENV-504		04	04	100
CC	ENV-505		04	04	100
CC	ENV-506		04	04	100
EC	ENV-523A		04	04	100
EC	ENV-523B		04	04	100
LC	ENV-545	Lab Course-XIII	04	02	50
LC	ENV-546	Lab Course- XIV	04	02	50
LC	ENV-547	Lab Course-XV	04	02	50
ELC	ENV-548A	Lab Course -XVI	04	02	50
ELC	ENV-548B	Lab Course-XVI	04	02	50
Total Credits for Semester – II = 24 (Theory:16&Lab:08) (With One Elective Course)					

9/12/24

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Faculty of Science & Technology
Dr. Babasaheb Ambedkar Marathwada
University, Aurangabad

Introduction:

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. Once the student is admitted he / she will be promoted to the 2nd year (3rd semester) if he / she qualify all courses 1st semester and 50 % of theory courses of 2nd semester. Students will have to register themselves for every consecutive semester. Dropout students will be allowed to register for respective semester as and when the concerned courses are offered by the course implementing institute/ department, however he / she should not exceed more than twice the duration of the course from the date of first registration. The admission of the concern student will be automatically cancelled if he / she fail to complete the M. Sc. degree within a period of maximum four years / eight semesters.

Course structure:

The M.Sc. Course is of two years period with 106 Credits of 2650 marks. The course is divided in to four semesters. In first semester there will be 28 credits with 700 marks. Second semester is of 26 credits with 650 marks, third semester is of 28 credits with 700 marks and fourth semester is of 24 credits with 600 marks. Paper No ENV- 522 of 4 Credits of 100 marks from IIIrd semester will be a **Service Course** which can be opt by the students from other department / institutions.

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

1.	**Core Courses**	**:- 44 credits**
2.	**Elective Courses**	**:- 16 credits**
3.	**Foundation Course**	**:- 04 credits**
4.	**Service Course**	**:- 04 credits**
5.	**Lab Courses**	**:- 24 credits**
6.	**Elective Lab Course**	**:- 08 credits**
7.	**RM Courses**	**:- 04 credits**
8.	**COM Course**	**:- 02 credits**
	Total Credits	**:- 106 credits**

Above credits includes the credits for Research Methodology /Research Project /in-plant training etc. in the following manner ,04 credits-RMC and 3 credits for Project dissertation, In-plant training and field work etc, with a total of 7credits devoted for research orient activities.

Courses:

1. **Core Course (C.C) :** Core course is a course that a student admitted to a particular P.G. Program must successfully complete to receive the degree. Normally no theory course shall have more than four credits.
2. **Elective Course (E.C) :** Elective course means an optional course from the basic subject or specialization.
3. **Foundation Course (F.C):** It includes fundamentals of environment, necessary to the students offering the course from other disciplines.
4. **Service Course (S.C):** Service course will be offered in IIIrd semester. Students must complete a service course for securing M.Sc. degree to acquire 4 credits.
5. **Lab Course (L.C) :**It includes all laboratory assignments related to theory courses.
6. **Elective Lab Course (E L C) :**It includes all laboratory assignments related to elective theory courses
7. **Research Methodology (R.M):** This course includes research related components to understand basics in the research and develop the research skill.
8. **Common Course (COM) :** This course is introduced to learn the Great Constitution of India.
9. **Bridge Course in Environmental Science:** This course is designed to provide some important concept's introduction as the base to science graduates, who have not studied the environmental science subject at graduate level. This course is being implemented at the beginning of M.Sc. Environmental Science Ist semester and will be used for **identification** of slow and fast learner student.

- Each course shall include lectures/ tutorials/laboratory or field work/seminar/practical training/assignments /mid-term and term end examination/paper/report writing or review of literature and any other innovative practices to meet effective teaching and learning needs.
- The result of examination conducted of 'Bridge Course in Environmental Science' will be used to identify the slow and fast learner students, which is an integral part of OBE pattern.
- The student will have to register the service course of his interest after the start of IIIrd semester in the concerned department on official registration form and is to be completed in this semester.
- No service course will be offered unless a minimum of 10 students are registered.

Choice Based Credit System (CBCS) :

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

- Students will have to earn 106 credits for the award of M.Sc. (Environmental Science) degree.
- Out of 106 credits, students will have to earn the credits from Core courses with 44 credits, foundation course worth 04 credits, elective courses worth 16 credits, laboratory courses worth 32 credits (24 credits for core Lab course and 8 credits for Elective Lab course), research methodology 4 credits, service course 4 credits and 02 credits from the compulsory course 'Constitution of India'.

Credit-to- contact hour Mapping:
One contact hour per week is assigned 1 credit for theory and 0.5 credits for laboratory courses/ research project. Thus a 4 - credit theory course corresponds to 4 contact hours per week and same analogy will be applicable for laboratory courses / research project, containing 4 contact hours per week for 2 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 course / paper should be taught about 56 contact hours in one semester.
- Teaching duration for LAB COURSES from first to fourth semesters should be of 04 hours per week per batch.

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

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 100 marks, there will be 40 marks for Continuous Internal Assessment (CIA) of the students, containing 20 marks for two midterm tests (10 marks per test), 08 marks for two tutorials (04 marks per tutorial), 08 marks for one seminar (06 marks for giving seminar and 02 marks for submission of hard copy of seminar) and 04 marks for attendance and overall performance.
- For theory paper of 50 marks, there will be 20 marks for Continuous Internal Assessment (CIA) containing 10 marks for one midterm test, 04 marks for one tutorial, 04 marks for one seminar (03 marks for giving seminar and 01 mark for submission of hard copy of seminar) and 02 marks for attendance and overall performance.
- 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 score obtained in continuous internal assessment by concern teacher, who is teaching that paper will be considered as internal score.
- There will be 20 marks for Continuous Internal Assessment (CIA) of lab course / practical paper of 50 marks, containing 08 marks for one practical test, 04 marks for record book submission, 04 marks field work / assignments / viva on practical's and 04 marks for attendance, discipline & overall performance of student.
- **There will be separate passing for internal and external examination.** The students have to earn minimum 40% marks for passing in internal and external examination separately
- The minimum passing marks for internal theory paper of 04 credits is 16 marks and 24 marks are for external examination.
- The minimum passing marks for internal theory and practical paper of 02 credits is 08 marks and 12 marks are for extensional examination

Semester End Examination (SEE):

- The semester end theory and practical examination will be conducted after completion teaching. The total marks shall be 100 for 4 credit theory courses, 50 marks for 02 credits theory course and 50 marks for 02 credits lab course / practical course. The semester end exam of 60 marks will be taken for 04 credits theory course and 30 marks for 02 credits theory course along with 30 marks lab course of 02 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 / appointed examiners.

A. Structure for theory course for Internal Assessment.

i) Theory paper of 100 marks

Test-I	Test-II	Two Tutorials/ Assignments	One Seminar	Attendance, Discipline & Overall performance etc.	Total Marks
10 marks	10 marks	08 marks	08 marks	04 marks	40 marks

ii) **Theory paper of 50 marks**

Test-I	One Tutorial/ Assignments	One Seminar	Attendance, Discipline & Overall performance etc.	Total Marks
10 marks	04 marks	04 marks	02 marks	20 marks

B. Structure **for lab course for Internal Assessment.**

Test-I	Record book	Field visit / Assignments / Viva	Attendance& Overall performance etc.	Total Marks
08 marks	04 marks	04 marks	04 marks	20 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 / appointed examiner center wise after getting at least minimum marks in each paper.

Every student will have to complete 106 credits to obtain the Masters degree in Environmental Science having practical's/ laboratory work / field work / demonstration work etc., of which 106 credits should be from their respective subject and four (04) credits from service courses

Pattern of semester end question paper will be as below:

- The semester end examination of theory course of 4 credit will have two parts A and B with (10+50 = 60 Marks). Part A will be consisting of 10 questions having 1 mark each (multiple choice questions / fill in the blanks/ answer in single sentence etc.) as compulsory questions and it should cover entire course curriculum. Part A will consist 10 Marks. Part B will carry 7 questions of which students will have to attempt any five questions each of 10 marks. The time duration of the paper will be 03 hours.
- The semester end examination of theory course of 2 credit will have two parts A and B with (06+ 24 = 30 Marks). Part A will be consisting of 06 questions having 1 mark each (multiple choice questions / fill in the blanks/ answer in single sentence etc.) as compulsory questions and it should cover entire course curriculum. Part A will consist 06 Marks. Part B will carry 5 questions of which students will have to attempt any three questions each of 08marks. The time duration of the paper will be 02 hours.

  (**Note**: -Number of sub questions (with allotment of marks) in a question may be decided by the examiner.)
- Semester end practical examination (for laboratory courses) will be of 30 marks each and 3 hours duration. Student must perform at least three experiments from each lab course containing one major and two minor experiments. The major question of 10 marks and minor Question 08 marks and 04 marks for viva-voce exam. The final practical examination will be conducted at the end of each semester along with the theory examination.

- Semester end examination for project dissertation will be carried out in the respective semester. The content, presentation, interaction and submission will be considered during project dissertation assessment.
  (**Note:** The project dissertation will be a part of lab course from fourth semester and it will be allotted at the beginning of first semester and assessed in fourth semester.)
- The students will have to complete one month Inplant training in Industry / Institution /NGO / Laboratories / Municipal Corporation / Forest department / Pollution Board etc.
  (**Note** : Student will be deputed in summer vacation for inplant training after IInd Semester Examination and student will have to submit inplant training completion report with certificate to the department and it will be assess in final practical examination.)
- At the end of each semester the result will be forwarded to the Director of Examination Board by CAP chairman.

Earning Credits:

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

Grading System:

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

Table – I : Ten point grade and grade description

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

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

- Minimum P grade (4.00 grade points) shall be the limit to clear / pass the course / subject. A student with F grade will be considered as 'failed" in the concerned course and he / she have to clear the course by appearing in the next successive semester examinations.

- Every student shall be awarded grade points out of maximum 10 points in each subject (based on 10 point scale). Based on the grade points obtained in each subject, Semester Grade Point Average (SGPA) and then Cumulative Grade Point Average (CGPA) shall be computed. Results will be announced at the end of each semester and CGPA will be given on the completion of M. Sc. programme.

Computation of SGPA (Semester Grade Point Average) and CGPA (Cumulative Grade Point Average)

Grade in each subject / course will be calculated based on the summation of marks obtained in internal and semester end examination.

The computation of SGPA and CGPA will be as below

- Semester Grade Point Average (SGPA) is the weighted average points obtained by the students in a semester and will be computed as follows.

$$SGPA = \frac{\text{Sum (Course Credit X Number of Grade Points in concern Course Gained by the Student}}{\text{Sum (Course Credit)}}$$

The SGPA will be mentioned on the mark sheet at the end of every semester.

- The Cumulative Grade Point Average (CGPA) will be used to describe the overall performance of a student in all semester of the course and will be computed as under.

$$CGPA = \frac{\text{Sum (All four Semester SGPA)}}{\text{Total Number of Semester}}$$

The SGPA and CGPA shall be rounded off to the second place of decimal.

Grade Card:

Results will be passed through the Departmental Committee / Principal and the grade card (containing the grades obtained by the student along with SGPA) will be issued by the university after completion of every semester.

The grade card will be consisting of following details.

- Title of the courses along with code opted by the student.
- Credits associated with the course.
- Grades and grade points secured by the student.
- Total credits earned by the student in a particular semester.
- Total credits earned by the students till that semester.
- SGPA of the student.
- CGPA of the student (at the end of the 4th semester).

Cumulative Grade Card

The grade card sheet showing details grades secured by the student in each subject in all semester along with overall CGPA will be issued by the University at the end of 4th semester.

Semester - I

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

(Theory Course with 02 Credits)

Course Objectives

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

Teaching Scheme

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

Evaluation Scheme

Continuous Internal Assessment by Teacher :- 20 Marks
Sem-End Examination :- 30 Marks
Total Marks :- 50 Marks

Unit–I: **10+2**

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

Unit-II: **10+3**

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

Current developments in the subject.

Course Outcome

Students should able to:

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

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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.
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7. Research Methodology in Environmental Science, (Dr.Satish Patil) 2019, International Publications, Kanpur (ISBN 978-93-87556-42-3).

Semester – I

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

(Theory Core Course with 04 credits)

Course Objectives

Students will be able to know

1. Dynamics of human ecosystems, nature of a biotic and biotic components and balanced parameters t of ecosystem.
2. The concept of our earth's environment and the presence of unique environmental conditions are responsible for presence of living creature on our planet earth.
3. The different components of human ecology and their significance can be understood very well.
4. Nature and status of the major environmental issues of human environment can understood along with different anthropogenic impacts.

Teaching Scheme			**Evaluation Scheme**		
Lectures	:-	4 hr/week	Continuous Internal Assessment by Teacher	:-	40 Marks
Tutorials	:-	1 hr/ week	Sem-End Examination	:-	60 Marks
Test	:-	1 hr/week	**Total Marks**	:-	**100 Marks**
Total Credit	:-	04			

Unit-I: - **10+1**

Earth's Environment: Earths metamorphic changes and environmental conditions, Earths uniqueness for survival and flourishing living organisms, unique physical phenomenon in earth's environment, thermal balance in earth's environment, evolution of living organisms in earth's environment, interaction of living and nonliving components in earths biosphere, balanced environmental parameters in biosphere, basic issues in environments study, importance of earth's environment study.

Unit II: - **10+1**

Environmental Biology: the structure of Biosphere, evolution and development of living organisms diversity in biosphere, ecosystem development in biosphere, ecological processes and life support systems, impact of living organisms on nonliving environmental components, Impact of altered nonliving parameters on living organisms,

Unit-III: - **10+1**

Human ecology: Evolution of man in biosphere, concept of human ecology, principles and scope of human ecology, components of human ecology, human ecology and human settlements, man-environmental relationships – hunting gathering, fishing, mining, acquiring forestry and resources.
Energy flow, food chain and food web in human modified ecosystems.

Unit-IV: **10+1**

Anthropogenic impacts: Humans impact on the biosphere and its life support systems (including Flora, Fauna, soil, climate, atmosphere, terrestrial and aquatic ecosystems), Earth, Man and Environment - man modified ecosystem,

Unit V: **10+1**

Issues in human environment: Human population growth, population explosion, humans' food security, human health problems, urbanization, scarcity of natural resources, carrying capacity of man in its habitat or in environment, alteration in human's environmental balance.

Current development in the subject.

Course Outcome

Students should able to:

1. Define human ecological systems and its functionality along with stability concept of ecosystem
2. Describes and understand the earth environments balance.
3. Recognize ecological systems role in maintaining earth's environmental balance. .
4. Examine the importance of balanced environment for survival of mankind on planet earth for long time.

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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) Mc Graw Hill Book Company.
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16. Environment forest, ecology and man – Dixit R.K. Rastogi Publication, New Delhi.
17. Environment, energy, health planning for conservation – V. Vidyanath, Gyan Publishing House, New Delhi
18. Caring for the earth-A strategy for sustainable living; IUCN Publication.
19. Our planet, our health, our future: Human health and Rio Convention on biological diversity, change and desertification.
20. Report of the World Commission on Environment and Development: Our Common Future.
21. Environmental Earth Sciences Series Editor: James W. LaMoreaux.
22. Basic concepts: nature, ecology, environment.

Semester – I

CC (Env-402: - Physical and Chemical Aspects of Environment)

(Theory Core Course with 04 credits)

Course Objectives

Students will be able to know

1. Understand the basics of Environmental Chemistry
2. Acquire the knowledge of chemistry of Air, Water & Soil
3. Understand green chemistry and its role in sustainable development.
4. Analysis process for Air, Water & Soil

Teaching Scheme

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

Evaluation Scheme

Continuous Internal Assessment by Teacher	:-	40 Marks
Sem-End Examinatio	:-	60 Marks
Total Mark	**:-**	**100 Marks**

Unit-I: - Physical Aspects of Environmental Chemistry: **10+2**

Interaction of thermodynamics with environment, Oxidation – Reduction reactions. Chemistry of Carbonate compounds, chemistry of hydrocarbons: introduction, types and hydrocarbons in environment, Radionuclide: introduction, radionuclides in environment and their properties, Chemical speciation - introduction, example: Mercury, Lead and Copper, arsenic. ,etc.

Unit-II: - Chemical Agents in Environment: **10+2**

Introduction, definition, Scope, bio-essential metals and their role in life processes, Chemical bonding, ionization, pharmaceutical Impurities: sources, and critical principles of pharmaceutical impurities, chemistry of emerging pollutants: introduction, chemistry of industrial pollutants organic and inorganic pollutants.

Unit –III: - Chemistry of Air: **10+2**

Classification of elements and periodicity in properties, chemistry of air, particles, Ions and radicals in the atmosphere and their role in atmospheric reactions, Chemistry of inorganic and organic particulate matter,.
Chemistry of heat trapping gases. Heat trapping gasses impact management, chemistry of acid rain, Impact of heat trapping gasses on global climate, , Impact of global warming, chemistry of ozone depleting gases and their reactions , impacts of CFC on stratosphere , Chemistry of photochemical smog , Chemistry of Biogases

Unit –IV: - Chemistry of Water: **10+2**

Chemistry of water, Solubility of compounds in water, Solubility of gases in water, Dissociating constant, Sample collection guidelines, Sample preservation , Sample order, Data collection and record keeping. Water quality parameters and standards,. Chemistry of cleaning agents, Soap, Detergents and bleaching agents, Chemistry of colloids, Gasoline and additives antiknock compounds, Lubricants and greases,

Unit – V: - Chemistry of soil: **10+2**

Chemistry of soil, Composition of soil, soil quality parameters, trace minerals of soil, Factors affecting the soil quality, Adsorption of contaminant.
Biochemistry of Toxic chemicals in environment : Pesticides, Insecticides, Arsenic, Cadmium, Lead, Mercury, Carbon monoxide and Ozone, MIC and other carcinogens in Environment

Current development in the subject

Course Outcome

Students should able to:

- Define physical and chemical aspects of environmental chemistry
- Apply the knowledge of chemistry to analyze air, water and soil quality
- Evaluate the level of contamination in environment
- Develop management strategies for industrial pollutants

References

1. Environmental Chemistry- G.S. Sodhi.
2. Environmental Chemistry- S. E.Mannhan
3. Environmental Chemistry – A.K. De
4. Environmental Chemistry-A global perspective; G.W. Vantoon and S.J. Duffiy, Oxford Uni. Press, London.
5. Environmental chemistry – B.K. Sharma
6. Environmental chemistry – B.K. Sharma and H. Kaur
7. Environmental pollution analysis – S.M. Khopkar
8. Environmental chemical analysis – Lanin L. Marr, Malcom S.
9. Environmental Chemistry – Kanan Krishnan.
10. Environmental Chemistry – S.K. Banerjee.
11. Environmental Chemistry – J.W. Moore and E.A. Moore.
12. Destruction of hazards chemicals in the laboratory: G. Lunn and E.B. Sansone.
13. A text book of Environmental Chemistry and pollution control – S.S. Dara.
14. Environmental Chemistry – M. Satake, Do. S. Sethi, S.A. Eqbal.
15. Environmental and Man: The chemical environmental: J. Lenihan and W.W. Fletcher.
16. Emerging pollutants: origin, structure and properties- Francisco G Calvo-Flores, Joaguin Isac and Jose, Wiley VCH

Semester – I

CC (Env-403: -Techniques in Environment & Analysis)

(Theory Core Course with 04 credits)

Course Objectives

Students will be able to

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

Teaching Scheme					**Evaluation Scheme**
Lectures	:-	4 hr/week			
Tutorials	:-	1 hr/ week	Continuous Internal Assessment by Teacher	:-	40 Marks
Test	:-	1 hr/week	Sem-End Examination	:-	60 Marks
Total Credit	:-	04	**Total Marks**	**:-**	**100 Marks**

Course Objectives

Unit-I: - Sampling and sample preparation: **10+2**

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 : **10+2**

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

Unit-III :- Separation Techniques : **10+2**

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

Unit-IV:- Biological Analysis: **10+2**

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 Equipments: **10+2**

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

Current developments in the subject.

Course Outcome

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. Students are expected to have a basic knowledge on various separation techniques such as chromatography and analytical methods like titrimetry.

Reference :

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.
13. APHA – AWWA- WPCF. (2012). Standard methods for the examination of water and waste water. Washington, D.C.\
14. Bender, G.T., W.K Saunders. (1972). Chemical Instrumentation. A Laboratory Manual based on Clinical Chemistry.
15. Christian Gary, D. (2001). Analytical Chemistry, 5th Ed. John Wiley & Sons, Inc. NY.
16. De A.K. (1994). Environmental Chemistry. New Age International Ltd. New Delhi.
17. Eving G.W. (1985). Instrumental Methods of Chemical Analysis, 5th Ed., Mc-Graw Hill Book Company.
18. Radojecic M. and Bashkin V.N. (2007). Practical Environmental Analysis. RSC Publishing, Cambridge.
19. Skoog D.A., F.J. Holler and Nieman, (2003). Principles of Instrumental Methods, 5th Ed., Thomson Asia Pvt. Ltd., Singapore.
20. Vogel A.I.(1999). Textbook of Quantitative Chemical Analysis, 5th Ed., Addison Wesley Longman Singapore Ltd.
21. Willard, Merritt, Dean, and Settle, (1986). Instrumental Methods of Analysis, 7th Ed., C B S Publishers & Distributors.

Semester – I

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

(Theory Elective Course with 04 credits)

Course Objectives

Students will be able to

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

Teaching Scheme			**Evaluation Scheme**		
Lectures	:-	4 hr/week			
Tutorials	:-	1 hr/ week	Continuous Internal Assessment by Teacher	:-	40 Marks
Test	:-	1 hr/week	Sem-End Examination	:-	60 Marks
Total Credit	:-	04	**Total Marks**	**:-**	**100 Marks**

Unit-I :- Introduction to wildlife : **10+2**

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 : **10+2**

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 : **10+2**

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

Unit – IV :- Wildlife Conservation : **10+2**

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: **10+2**

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.

Current developments in the subject.

Course Outcome

Students should be able to:

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

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 Diseases and Disorders, Arora dnBipulchakraborthyB.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, katwal/ 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.

Semester – I

EC (Env-421-B: - Environmental Meteorology &Climate Change)

(Theory Elective Course with 04 credits)

Course Objectives

Course Objectives

Students will be able to

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

Teaching Scheme			**Evaluation Scheme**		
Lectures	:-	4 hr/week			
Tutorials	:-	1 hr/ week	Continuous Internal Assessment by Teacher	:-	40 Marks
Test	:-	1 hr/week	Sem-End Examination	:-	60 Marks
Total Credit	:-	04	**Total Marks**	**:-**	**100 Marks**

Unit – I :- Climatology: **10+2**

Introduction of climatology, fundamental principles of climatology, the climate system, controls on climate, Global Climate classification, major climatic regions of the world based on latitude and distribution of vegetation, earth-sun relation, coastal effect on climate, orographic effect on climate, different climate zone, trends of climate and its variability, climate modification. Inter annual variability of climate and its effect on biosphere, different climate methods, Regional distribution and seasonal variation of cloud, precipitations and fog etc.

Unit – II :- Applied Climatology : **10+2**

Climate and water resources, climate and agriculture, climate change and ecosystem, climate change and food security, climate change and green housegases, Effect of change on ecology, biodiversity reproduction, species etc, climate change and disease, climate change and global catastrophic risk, climate change and diseases.

Unit-III: - Climate of India: **10+2**

Weather, Climate, Physiographic and geological homogeneity of India, Geo-economic significance, Classification of climates, Criteria for classification, Thornthwaites and Koppens classification, Climates of India, Indian monsoon, Jet streams general circulation, The seasons mechanism of monsoon, Forecast of monsoon various seasons, Distribution of rainfall, Drought prone areas, Flood prone areas, Climate change, Causes and consequences of global warming, Ozone hole , Sea level rise in climate, Climatic considerations in industrial locations, (El-Nino, droughts, tropical cyclones and western disturbances, IPCC, UNFCC, Kyoto protocol)

Unit – IV :- Meteorology: **10+2**

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

Unit – V :- Earths Processes and Geological hazards : **10+2**

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

Current developments in the subject.

References

1. The Atmosphere : An Introduction to meteorology :- Frederic K. LutgenE.J.Tarbuck.
2. Climatology ;Selected Application :-Henry D.Foth
3. Climatology: Fundamentals and Application:-Mater J.R.
4. Air pollution:- V.P. Kudesia Pragati Prakashan Meerut
5. Environmental Science :- A study of interrelation ship E.D. Enger,B. E. Smith, 5th ed; WCB Publication.
6. Fundamental of Ecology :- E.P. Odum, Revised Edition 1995-96 Edition 2003.
7. A Manual of Air Quality Monitoring :- NEERI Publication.
8. Environment, Energy, Health, Planning, for Conservation:-V. Vidyanath, Gyan Publication house, New Delhi.
9. Meteorology of Air Pollution :-R.S. Scores 1990 Ellis Hardood Pub.
10. Fundamentals of Air Pollution:- 2nd Ed. Arthur Co Stern Acad. Press 1984.
11. Air Pollution :- M.N. Rao, Mcgraw Hill 1993.
12. General Meterology :-Horace Robert Byers, Sc.D. 3rd Ed MCGRAW Hill Book Company new York Toronta, London.
13. EnviromentalChemistry :- A.K.De. Wiley Interscience.
14. Environmental Chemical Analysis :- Lain L. Marr, Malcom S. Cresser, international text book company, USA.
15. Environmental Geology : K.S Valdiya Indian Context Tata McGraw Hill Publication Co. New Delhi, 1987.
16. Environmental Geology : Barbara, Wim Brain, J.S. Stephan, C.P John Wiley & Sens. Inc
17. Environmental Geology :Lundegran, Lawarence Prentice Hall
18. Geo Environmental Engineering :Reddic, Tecnip books international, New Delhi.
19. Text of the Kyoto Protocol on www.unfccc.int
20. Physical Climatology-William D.Sellers.
21. Climatology-Bernhard-Haurwitz and J.M. Austin.
22. Dynamical and Physical Meteorology-George J. Haltiner and F.L. Martin
23. Physics of Monsoon-Keshav Murthy and Sankar Rao.
24. Essentials of meteorology-C.Donald Ahrens.
25. Foundation of Climatology-E.T.Stinger.
26. Climate Change : Emerging Scenarios and adaptation strategies :Vol I (2020) : Satish S. Patil, International Publication. Kanpur, (ISBN 978-93-87556-88-1)
27. Climate Change : Emerging Scenarios and adaptation strategies :Vol II (2020) : Satish S. Patil, International Publication. Kanpur, (ISBN 978-93-87556-88-1)
28. An Introduction to Climate-G.W.Threwartha.
29. The Nature and Causes of Climate Change-Goodies, Paultikaf and Davies.

LC: ENV 441: Lab Course – I

(Based on FC Env. 401)

Lab Course	:-	4 hr/week	**Evaluation Scheme**		
Assignment / field work/ outreach activities	:-	2 hr/week	Continuous Internal Assessment by Teacher	:-	20 Marks
			Sem-End Examination	:-	30 Marks
Total Credit	:-	02	**Total Marks**	**:-**	**50 Marks**

1. Determination of GPP & NPP water body used for aquaculture purpose by light and dark bottle technique.
2. Identification and qualitative study of phytoplankton in water body used for fish cultivation by man.
3. Identification and qualitative study of zooplanktons in water body used for fish cultivation by man
4. Ecological study of living organisms from human habitat / man modified ecosystem, which ensures food security of man.
5. Quantitative analysis of planktons by Sedgwick rafter cell method.
6. Estimation of biomass from agricultural cropland / grazing grassland by harvest method.
7. Productivity study of agricultural cropland / grazing grassland by harvest method.
8. Determination of relative density of species from man modified ecosystem or from forest ecosystem by using simulation.
9. Determination of relative frequency of species from man modified ecosystem or from forest ecosystem by using simulation.
10. Determination of relative abundance of species from man modified ecosystem or from forest ecosystem by using simulation.
11. Identification pest species from man modifies ecosystem / agricultural crop.
12. Profile study of natural pond/lake and manmade reservoir.
13. To study the cover and based area study of tree species
14. To study the light intensity by sunshine record.

Field activities:

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

LC: ENV 442: Lab Course – II

(Based on CC Env. 402)

Lab Course	:-	4 hr/week			**Evaluation Scheme**
Assignment / field work/ outreach activities	:-	2 hr/week	Continuous Internal Assessment by Teacher	:-	20 Marks
			Sem-End Examination	:-	30 Marks
Total Credit	:-	02	**Total Marks**	:-	**50 Marks**

1. Studies on the concept of molarities, normality and buffer solutions.
2. Studies on Acid-base titration-principles, reaction and equilibrium.
3. Determination of organic matter by Walkley`s and Black method from soil.
4. Determination of bicarbonate and carbonate alkalinity of water.
5. Estimation of volatile solids from sewage sample by gravimetric analysis.
6. Determination of dose of chorine for disinfection of sewage.
7. Determination of alum dosage for deflouridation of water by jar test method.
8. Determination of sewage and waste strength.
9. Estimation of hydrogen sulphide from waste water.
10. Estimation of DO, BOD and COD from waste water.
11. Quantification of NPK from field soil samples.
12. Estimation of residual chlorine by chlorotex method.
13. Estimation of micronutrients of soil.
14. Determination of relative density of sewage sample.

Activities :- Industrial field visit to chemical and Pharmaceutical industries and report writing .

LC: ENV 443: Lab Course – III

(Based on CC Env. 403)

Lab Course	:-	4 hr/week			**Evaluation Scheme**
Assignment / field work/ outreach activities	:-	2 hr/week	Continuous Internal Assessment by Teacher	:-	20 Marks
			Sem-End Examination	:-	30 Marks
Total Credit	:-	02	**Total Marks**	:-	**50 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 and spectrophotometer.
5. Demonstration of HPLC for pesticide analysis.
6. Determination of dissolved oxygen content from sewage samples by using DO meter.
7. Study of color of water /sewage sample by using tintometer.
8. Determination of fluorescent compound by using photoflorometer.
9. Separation of chlorophyll pigments of green leaf by using thin layer chromatographic technique.
10. Separation of a mixture of amino acid by using paper chromatography.
11. Separation of geometric isomer compounds by using column chromatography.
12. Demonstration atomic absorption spectroscopy (AAS) for heavy metal analysis.
13. Study of Tilak Air Sampler / Anderson air sampler for bio-monitoring .

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

ELC (ENV 444 – A: Lab Course – IV)

(Based on EC Env. 421 -A)

Lab Course	:-	4 hr/week			**Evaluation Scheme**
Assignment / field work/ outreach activities	:-	2 hr/week	Continuous Internal Assessment by Teacher	:-	20 Marks
			Sem-End Examination	:-	30 Marks
Total Credit	:-	02	**Total Marks**	:-	**50 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.

ELC (ENV 444-B: Lab Course – IV)

(Based on EC Env. 421-B)

Lab Course	:-	4 hr/week				**Evaluation Scheme**
Assignment / field work/ outreach activities	:-	2 hr/week	Continuous Internal Assessment by Teacher		:-	20 Marks
			Sem-End Examination		:-	30 Marks
Total Credit	:-	02	**Total Marks**		**:-**	**50 Marks**

1. **Collection techniques and sampling devices for gaseous pollutants**
   i) Absorption sampling, ii) Adsorption sampling, iii) Freeze out or condensation sampling, iv) Grab sampling.

2. Study of micrometeorological equipments.
3. Determination of relative humidity of air .
4. Determination of atmospheric pressure by using Barometer.
5. Determination of wind speed by using Anemometer.
6. Determination of wind direction by using wind vane.
7. Interpretation of wind rose diagram.
8. Determination of Air pollution index.
9. Determination of NOx 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 (10 minerals specimens).
14. Identification of rocks: Igneous rock, sedimentary rock and metamorphic rocks.

Semester - II

RM (ENV- 002: Research Methodology – Part-II)

(Theory Course with 02 Credits)

Course Objectives

1. Students can collect the research data through experimentation, questioner, by direct observations and sensitivity study of spatial and temporal data.
2. Students will know importance of proper interpretation and conclusion of the collected research data and proper interpretation of produced research.
3. Students can design the research project with the help of review of produced results, techniques of interpretation, published literature and proper layout of research report

Teaching Scheme			Evaluation Scheme		
Lectures	:-	2 hr/week			
Tutorials	:-	1 hr/ week	Continuous Internal Assessment by Teacher	:-	20 Marks
Test	:-	1 hr/week	Sem-End Examination	:-	30 Marks
Total Credit	:-	02	**Total Marks**	**:-**	**50 Marks**

Unit-I: **10+2**

Tools of data collection in environmental research, Measures for maintaining accuracy in data, Sensitivity study of data, spatial and temporal environmental data., Sampling for environmental research -Probability sampling and non- probability sampling, Need of data analysis, processing and analysis of data, interpretation of data, -

Unit- II: **13+2**

Interpretation of produced results, Techniques of interpretation, Conclusion of research work, reviewing of produced results/ output/data with the help of published literature, Scientific output as scientific principle or literature, Research report writing, Steps in writing report, Layout of research report, Types of reports, research article writing, review article writing, Research proposal writing, research ethics and plagiarism in research report and in research articles.

Current developments in the subject.

Course Outcome

Students should be able to:

1. Collect research data through experimentation, questioner y by direct observations and sensitivity study of spatial and temporal data.
2. Infer the important output from the collected research data and proper interpretation of produced research
3. Design the research project with the help of review of produced research, techniques of interpretation, published literature and proper layout of research.

References

1. Research Methodology-Methods and Techniques , By Kotharir C.R.(2011); New Age International Publisher, new Delhi.
2. "Research methodology-Text and cases with SPSS applications" by Gupta S.L. and Hitesh Gupta (2011); International book house Pvt.Ltd, new Delhi.
3. "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 & Bartjan Pennink, Springer.

Semester – II

CC (Env-404: - Environmental Biotechnology)

(Theory Core Course with 04 credits)

Course objectives

1. Students will able to understand biotechnology.
2. Students will able to assess biotechnological tools used in pollution abatements.
3. Students will able understand bio-safety regulations and protocol.

Teaching Scheme

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

Evaluation Scheme

ontinuous Internal Assessment by Teacher	:-	40 Marks
Sem-End Examination	:-	60 Marks
Total Marks	:-	**100 Marks**

Unit-I :- Understanding of Biotechnology : **10+2**

Definition, scope and concept of Biotechnological Interdisciplinary, Activity of Biotechnology, Development of Biotechnology in all sectors.

Unit-II :- Bioremediation: **10+2**

Concept, principles and application; types-Insitu, Exsitu; Microbes involved; rhizo-remediation, phyto-remediation, bio-mining ; microbial leaching of low grade mineral ores; molecular probes for organisms in mines and minc tailings .

Unit –III :- Biotechnology for Pollution Abatement: **10+2**

Air pollution abatement; bio-filters, bios-crabbers, Bio-trickling filters; water pollution abatement; Activated sludge process, Sequence batch reactors, rotation biological contractors (RBC), fluidized bed reactor, anaerobic sequencing batch reactor (ASBR), anaerobic packed bed reactor (APBR), two phase anaerobic digester.

Unit –IV :- Environmental Biotechnology: **10+2**

Fermentations technology, Vermi culture technology, microbial composting technology, Bio-fertilizer technology, waste management technology-role of microorganisms in the degradation of natural and man-made compounds-pesticides recalcitrant chemicals, persistent organic pollutants (POP).

Unit – V :-GMOs and Bio-safety: **10+2**

Genetically modified organisms and their environmental implications- pros and cons (Eg.BT cotton, GM food) GEAC and their roles, Cartagena protocol, bio-safety regulations, scope of bio-safety, regulatory frame work, bio-safety assessment and decision making, development in transgenic research and its application in India.

Current development in the subject.

Course Outcome :

On completion of this course, students should able to :

1. Students should be able to realize the activities and roles of microbes in environment and know how to use them in different applications.
2. Students should be aware of the modern bio-technological approaches in Environmental analysis and management and need how to use this understanding in real life situations.
3. Students should able to use the regulation of biosafety protocols for decision making development in transqenic research.

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Semester – II

CC (Env-405: -Application of Green Technology)

(Theory Core Course with 04 credits)

Course objectives

Students will be able to know

1. The concept and application of green chemistry for minimization of wastes and environmentally balanced industrial complexes.
2. To design green product to maintain quality, predictability, functionality and upgradability in order to improve performance of the products, in environment.
3. The application of green nanotechnology, carbon nanotubes, green nano particle, and biocompatibility for resource conservation, ecosystems, non-medical applications and human being.
4. The use of green chemistry in industries, fuel cell, solar energy, electric vehicles, solar photovoltaic technology and in biofuel production etc.

Teaching Scheme			**Evaluation Scheme**		
Lectures	:-	4 hr/week			
Tutorials	:-	1 hr/ week	ontinuous Internal Assessment by Teacher	:-	40 Marks
Test	:-	1 hr/week	Sem-End Examination	:-	60 Marks
Total Credit	:-	04	**Total Marks**	:-	**100 Marks**

Unit-I :- Overview, Principle, concepts and tools of Green Technology: **10+2**

Overview of green chemistry, chemistry of the atmosphere, principles of sustainable and green chemistry, basic principles of green technology , concepts of atom economy and carbon trading, tools of green technology, waste minimization and climate change, zero waste technology, concept of environmentally balanced industrial complexing and industrial ecology.

Unit-II :-Green Product Design: **10+2**

Green product design definition, product strategy, life cycle of product, ISO 14000, environmental load of product, material selection, resources use, production requirements and planning for the final disposition (recycling, reuse or disposal) of a product, integration with existing product design approaches such as quality, producibility , and functionality, upgradability, disassembly, Greening supplier inputs, improving whole systems, international was on take-back laws, extended responsibility, eco-labeling examples from pharmaceuticals, foods, cosmetics, packaging, computers, polymer, automobiles, electronics industry.

Unit –III :- Green Nanotechnology: **10+2**

Introduction to Nanomaterials and green nanotechnology, fullerene, carbon nanotubes, nanoparticles, green nanoparticle production and characterization, biocompatibility, nanomedical applications of green nanotechnologies, use of nanotechnologies and materials impact on biodiversity, resources conservation, ecosystems and human.

Unit –IV :- Green technology applications : **10+2**

Biocatalysts, green chemistry in industries, fuel cell and electric vehicles, solar energy and hydrogen production, energy from alternate sources, solar photovoltaic technology, biofuel production (bio-ethanol and biodiesel), biomass, prevention/minimization of hazardous /toxic products, agricultural related practices and food processing, production of biodegradable materials, concept of green building, pollution free engineering process.

Unit – V :-Environmental Engineering and Pollution Prevention: **10+2**

Separation technique for removal and recovery of pollutants, socio-economic aspects recovery waste as abatement, end of pipe solutions, life cycle analysis of plastics, palters, tins, identification of waste streams from process, waste minimization strategies, prioritizing pollution prevention options, selecting environmentally compatible materials , design of unit operation for pollution prevention, economics of pollution prevention, process flow sheeting for pollution prevention.

Current development in the subject.

Course Outcome

Students should be able to:

1. Define the concept and application of green chemistry foir minimization of wastes and environmentally balanced industrial complexes.
2. Design green product to maintain quality predictability, functionality and upgradability to improve performance of the products in environment
3. Apply the concept of green nanotechnology, carbon nano tubes, green nano particles and biocompatibility for resource conservation, ecosystems, non medical applications and human being.
4. Choose the applications of green chemistry in industries, fuel cell, solar photovoltaic technology and in bio fuel product etc.

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Semester – II

CC (Env-406: - Environmental Engineering and Technology)

(Theory Core Course with 04 credits)

Course Objectives

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

Teaching Scheme			**Evaluation Scheme**		
Lectures	:-	4 hr/week			
Tutorials	:-	1 hr/ week	Continuous Internal Assessment by Teacher	:-	40 Marks
Test	:-	1 hr/week	Sem-End Examination	:-	60 Marks
Total Credit	:-	04	**Total Marks**	:-	**100 Marks**

Unit-I :- Water and Wastewater Treatment Technologies : **10+2**

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

Unit-II: - Industrial Wastewater Treatment **10+2**

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

Unit III: Advanced Waste water Treatment Techniques:

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

Unit –III :- Industrial Hazardous Waste Treatment and Disposal Methods **10+2**

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

Unit –IV: - Industrial Air Pollution and control Techniques

Air pollution monitoring and control techniques, sampling and monitoring of gaseous and particulate air pollutants, ambient and stack emission monitoring, major bioreactors for waste gas purification, biofilters, biotrickling filters, and bioscrubers, prevention of indoor air pollution. Air pollution control methods for industries-application of different air pollution control technique in cement industry. Thermal power plant, Mining industry, stone crushing, asbestos industries etc. Urban Air pollution control Techniques.

Unit – V: - Environmental Engineering and Biotechnology **10+2**

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

Current development in the subject.

Course Outcome

Students should able to:

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

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13. Advanced Treatment Techniques for Industrial Wastewater - Athar Hussain and Sirajuddin .

Semester – II

EC (Env-422 A: - Environmental Management Systems)

(Theory Elective Course with 04 credits)

Course Objectives

1. Students will be able to understand the concept of Environmental Management System with International and National standards.
2. Students will be able to plan for environmental planning for air, water, soil, natural heritages, Demography and Natural Assets.
3. Students will be able to indentify micro and macro planning for natural resources at national and regional level rural and urban areas.
4. Students will be able to know the concept of LCA, functions of environment and enterprises, concept and applications of ISO 14000 and OSHAS 18000 for ecolabeling.
5. Students will be able to plan for total quality management and business environment, fair environmental practice and international environmental initiatives.

Teaching Scheme			**Evaluation Scheme**		
Lectures	:-	4 hr/week			
Tutorials	:-	1 hr/ week	Continuous Internal Assessment by Teacher	:-	30 Marks
Test	:-	1 hr/week	Sem-End Examination	:-	50 Marks
Total Credit	:-	04	**Total Marks**	**:-**	**100 Marks**

Unit –I: Environmental Management: **10+2**

Environment Management system - Principle and elements, Concept and Scope, Systems and approach, Standards- International and National; Eco-mark, Environmental accounts and auditing, Green funding and taxes, Trade and Environmental Management.

Unit-II: Environmental Planning: **10+2**

Historical Background to know the adverse effects of lack of environmental planning, Importance and Measurement of baseline environmental data and their appraisal such as Water, Soil, Air, Natural assets, Demography, Heritage.

Unit-III: Environmental planning, Micro & Macro planning, rural & urban planning: **10+2**

Concept and need for environmental planning, Levels of planning-Micro &Macro Planning, National and regional Planning, Basic difference in rural and urban planning, Demographic consideration, Dynamic, Available resource planning, Gandhian concept of self relined Villages.

Unit- IV : Environment Management plan and ISO:14000 series: **10+2**

Scope of environmental management, Importance, Principle functions of environment and enterprise, Objectives and need for training staff, Criteria for environment instruments, Project management, Production Management, Back ground and development of ISO 14000, OSHAS 18000.

Life Cycle Assessment: introduction about LCA, Characteristics of LCA, History of LCA, Application of LCA, ISO 14000 series/protocols for LCA, Procedure of LCA, Case studies of LCA-PVC industry, Steel industry , Pulp and paper industry.

Unit- V : Fair Environmental Practices: **10+2**

Total quality management and business environment; Business ethics, Traditional trade and commerce practice and fair environment practice, Quality management and its impact on human society, Environmental initiative and national environmental policies; Environmental initiatives at national and global level; National environmental policies and its implementation structure; Role of NGO's and public participation in environment movements; International environmental initiatives-Stockholm's declaration, Rome report, Ramsar convention on wetlands, Vienna convention and Montreal protocol, Earth summit, Kyoto protocol.

Current developments in the subject.

Course Outcome

Students should be able to:

1. Illustrate the concept of environmental management system the national and international standards.
2. Asses the plan for environmental planning for air, water, soil, heritage, demography and natural assets.
3. Identify micro and macro- planning for natural resource at national, regional, rural and urban areas.
4. Define the concept of LCA, environmental enterprises, ISO 14000 and OSHAS 18000, total quality management and business environment, fair environmental practices and international environmental initiatives.

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2. Vijay Kulkarni and T V Ramchandra. "Environmental management" Capital Publishing.
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Semester – II

EC (Env-422 B: - Environmental Statistics & Modeling)

(Theory Elective Course with 04 credits)

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.

Teaching Scheme			**Evaluation Scheme**		
Lectures	:-	4 hr/week			
Tutorials	:-	1 hr/ week	Continuous Internal Assessment by Teacher	:-	40 Marks
Test	:-	1 hr/week	Sem-End Examination	:-	60 Marks
Total Credit	:-	04	**Total Marks**	**:-**	**100 Marks**

Unit - I:- Fundamental Concepts of Statistics in Environment: **10+2**

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

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

Unit-II:-Application of Probability in environmental data : **10+2**

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

Unit- III:-Applications of test of significance in environmental data : **10+2**

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, Z test , Chi-square tests, and ANOVA test, Concept of, regression analysis, -Application of regression equation in environmental data.

Unit - IV:-Computer applications in environmental science: **10+2**

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

Unit -V:-Environmental Modeling: **10+2**

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.

References

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LC: ENV 445: Lab Course – V

(Based on CC Env. 404)

Lab Course	:-	4 hr/week	**Evaluation Scheme**		
Assignment / field work/ outreach activities	:-	2 hr/week	Continuous Internal Assessment by Teacher	:-	20 Marks
			Sem-End Examination	:-	30 Marks
Total Credit	:-	02	**Total Marks**	:-	**50 Marks**

1. Determination of total bacterial and fungal count from garbage piles in housing colonies..
2. Personal protection and conduct in microbiology laboratory.
3. To study the construction and working of laminar air flow bench
4. To study morphology of yeast cell by negative staining technique.
5. Developing stir tank reactor / suspension reactor for Ex-situ bioremediation.
6. Developing different types of reactor, for sewage treatment.
7. Isolation of insectivecidal microorganism
8. Developing phyto remediation system.
9. To study the growth pattern of E-coli on Macconkey's broth.
10. To study the growth pattern of salmonella on xylose-lysin-agar medium..
11. Developing vermiculture technology.
12. Encapsulation techniques.
13. Demonstration of PCR techniques.

Field activities:-

1. Visit to biotechnology lab / Institute / Industries and work report.
2. Visit to various bioreactor and note down the performance of reactor and learn maintenance.

LC: ENV 446: Lab Course – VI

(Based on CC Env. 405)

Lab Course	:-	4 hr/week			**Evaluation Scheme**
Assignment / field work/ outreach activities	:-	2 hr/week	Continuous Internal Assessment by Teacher	:-	20 Marks
			Sem-End Examination	:-	30 Marks
Total Credit	:-	02	**Total Marks**	:-	**50 Marks**

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

LC: ENV 447: Lab Course – VII

(Based on CC Env. 406)

Lab Course	:-	4 hr/week			**Evaluation Scheme**
Assignment / field work/ outreach activities	:-	2 hr/week	Continuous Internal Assessment by Teacher	:-	20 Marks
			Sem-End Examination	:-	30 Marks
Total Credit	:-	02	**Total Marks**	:-	**50 Marks**

1. Determination of Biological Oxygen Demand in waste water
2. Solve the given problems on BOD.
3. Determination of Chemical Oxygen Demand in waste water
4. Determination of oil and grease in waste water.
5. Determination of H_2S in waste water.
6. Characterization of solid waste.
7. Analysis of chemicals used in waste and waste water treatment :
   i. Analysis of alum Non-ferric alum
   a. Determination of water insoluble matter in non-ferric alum
   b. Determination of water soluble aluminum compounds as Alumina (Al_2O_3) from alum by using gravimetric method.
   c. Determination of water soluble aluminum compounds as Alumina (Al_2O_3) from alum by using volumetric method.
8. Analysis of activated carbon
   a. Determination of moisture content in activated carbon.
   b. Determination of adsorbing power of activated carbon.
9. Analysis of bleaching powder.
   a. Determination of available chlorine in bleaching powder.
   b. Determination of stability of bleaching powder.
10. Analysis of caustic soda
    a. Determination of sodium hydroxide content from caustic soda.
    b. Determination of silicates from caustic soda.
    c. Determination of sulphates from caustic soda.
    d. Determination of chlorides from caustic soda.
11. Analysis of filter sand:
    a. Determination of effective size and coefficient of uniformity of filter sand
    b. Determination of bulk density of filter sand.
12. Lime analysis:
    a. Determination of moisture content in lime powder.
    b. Determination of percentage of oxides and hydroxides in lime.
    c. Determination of percentage of calcium in lime.

13. Problems on calculation of capacity of aeration tank in activated sludge process.
14. To study the design , working and problems of primary clarifier, trickling filter and septic tank.
15. Determine of MLSS, MLVSS, & SVI of industrial waste water.

ELC: ENV 448- A: Lab Course – VIII

(Based on EC Env. 422 -A)

Lab Course	:-	4 hr/week			**Evaluation Scheme**
Assignment / field work/ outreach activities	:-	2 hr/week	Continuous Internal Assessment by Teacher	:-	20 Marks
			Sem-End Examination	:-	30 Marks
Total Credit	:-	02	**Total Marks**	:-	**50 Marks**

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

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

ELC: ENV 448- B :Lab Course – VIII

(Based on EC Env. 422 -B)

Lab Course	:-	4 hr/week			**Evaluation Scheme**
Assignment / field work/ outreach activities	:-	2 hr/week	Continuous Internal Assessment by Teacher	:-	20 Marks
			Sem-End Examination	:-	30 Marks
Total Credit	:-	02	**Total Marks**	:-	**50 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 of t-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

9/12/21

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