# SACRED HEART COLLEGE (AUTONOMOUS), THEVARA
# KOCHI, KERALA, 682013

## CURRICULUM AND SYLLABUS

## CREDIT AND SEMESTER SYSTEM (CSS-PG)

## POST-GRADUATE PROGRAMME
## IN
## ENVIRONMENTAL SCIENCE

(INTRODUCED FROM 2021 ADMISSION ONWARDS)

## BOARD OF STUDIES IN ENVIRONMENTAL SCIENCE
## Department of Environmental Studies
## Sacred Heart College, Thevara, Kochi-13

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# 1. Introduction

Ever since the PG Programme in Environmental Science started, the department has taken tangible effort to keep abreast with the developments in the Environmental Science. We ventured a different approach to teach Environmental Science through our PG Programme. Through the incorporation of field study in every semester without compromising theory content the students are introduced to four of the ecosystems *in situ*. This was found to be not only very effective in inculcating students the spirit of Environmental conscience but also made it easy to impart theory content effectively. Another innovative experiment was devoting the fourth semester of the Programme entirely for research project and internship that made the students to apply what they studied in the past three semesters in such a way as to emerge as a full-fledged environmentalist. In this second revision we have not only maintained the same system but have introduced a new job as well as research oriented Course, Environmental Impact Assessment, EIA, for skill development in addition to the existing Courses -Disaster Management and GIS and Remote Sensing. We have also introduced a new section in the practical syllabus of every semester- a case study- to enable students to get trained in solving environmental problems that exist or that may ensue in future. Thanks to the dedicated effort of the learned members of the BOS and the timely, relevant and deductive inputs from our Principal, Rev Fr. Prasanth Palackappillil CMI, the revised Syllabus 2021 is a unique, student oriented and academically rich one.

# 2. Aims and Objectives of the Programme:

The objective of the course is to make the young students conscientious on the environment and sustainable development, to inspire and persuade them towards environmental protection and conservation making them the future guardians of nature. The Programme is also envisaged to equip the students to get acquainted with various tools and techniques for the study, research, protection and conservation of the environment. They are also trained to enable to understand, think and evolve strategies for management and conservation of the environment for sustaining life on earth.

# 3. Eligibility for Admissions

B.Sc Degree in any one of the science subjects (Botany/Zoology/Chemistry/Physics/EnvironmentalScience/EnvironmentManagement/ Microbiology /Biotechnology/Biochemistry/Agriculture/Horticulture/Forestry/any branch of Life Science/Geology/Geography) or an equivalent examination or an engineering degree in Civil/Mechanical/Chemical/ Environmental branch with an aggregate of 55% marks in the optional.

**3.1. Medium of Instruction and Assessment**: English

**3.2. Faculty under which the Degree is awarded:** This programme is carried out under the faculty of Environment and Atmospheric Science

# 4. SACRED HEART COLLEGE (AUTONOMOUS) THEVARA, KOCHI REGULATIONS FOR POST GRADUATE PROGRAMMES UNDER CREDIT SEMESTER SYSTEM (CSS) – 2021

## 4.1. TITLE

**These regulations shall be called 'SACRED HEART COLLEGE REGULATIONS FOR POST GRADUATE PROGRAMMES UNDER CREDIT SEMESTER SYSTEM (CSS) – 2021**

## 4.2. SCOPE

Applicable to all Post Graduate (PG) programmes of the college with effect from 2021-22 admissions. The provisions herein supersede all the existing regulations for the post graduate programmes of the college.

## 4.3. DEFINITIONS

**4.3.1.** '**Programme**' means the entire course of study and examinations.

**4.3.2. 'Duration of Programme'** means the period of time required for the conduct of the programme. The duration of post graduate programme shall be of four semesters spread over two academic years.

**4.3.3. 'Semester'** means a term consisting of a minimum of ninety working days, inclusive of examination, distributed over a minimum of eighteen weeks each having five working days, each with five contact hours of one hour duration.

**4.3.4. 'Course'** means a segment of subject matter to be covered in a semester. Each course is to be designed variously under lectures/ tutorials / laboratory or fieldwork/ study tour /seminar / project / practical training / assignments / evaluation etc., to meet effective teaching and learning requirements.

**4.3.5. 'Credit' (Cr)** of a course is the numerical value assigned to a course according to the relative importance of the content of the syllabus of the programme.

**4.3.6**. '**Extra credits**' are additional credits awarded to a student over and above the minimum credits required for a programme.

**4.3.7.** '**Programme Credit'** means the total credits of the PG Programmes. For PG programmes the total credits shall be eighty (80).

**4.3.8. 'Programme Elective Course'** means a course, which can be chosen from a list of electives and a minimum number of courses is required to complete the programme.

**4.3.9. 'Elective Group'** means a group consisting of elective courses for the programme.

**4.3.10**. '**Programme Project'** means a regular project work with stated credits on which the student undergoes a project under the supervision of a teacher in the parent department / any appropriate institute in order to submit a dissertation on the project work as specified.

**4.3.11**. '**Internship**' is on-the-job training for professional careers.

**4.3.12.** '**Plagiarism**' is the unreferenced use of other authors' material in dissertations and is a serious academic offence.

**4.3.13.** '**Seminar'** means a lecture by a student, expected to train the student in self-study, collection of relevant matter from the books and internet resources, editing, document writing, typing and presentation.

**4.3.14. 'Evaluation'** is the process by which the knowledge acquired by the students is quantified as per the criteria detailed in the regulations.

**4.3.15. 'Repeat Course'** is a course that is repeated by a student for having failed in that course in an earlier registration.

**4.3.16. 'Audit Course'** is a course for which no credits are awarded.

**4.3.17. 'Department'** means any teaching department offering a programme of study approved by the college / institute as per the Act or Statute of the University.

**4.3.18. 'Department Council'** means the body of all teachers of a department in a college.

**4.3.19. 'Faculty Advisor'** is a teacher nominated by a Department Council to coordinate the continuous evaluation and other academic activities undertaken in the department.

**4.3.20. 'College Coordinator'** means a teacher from the college nominated by the College Council to look into the matters relating to CSS-PG system.

**4.3.21. 'Letter Grade'** or simply **'Grade'** in a course is a letter symbol ($A^+$, A, $B^+$, B etc.) which indicates the broad level of performance of a student in a course.

**4.3.22. 'Grade Point'** (GP), is an integer indicating the numerical equivalent of the broad level of performance of a student in a course.

**4.3.23. 'Grade Point Average' (GPA)** is an index of the performance of a student in a course. It is obtained by dividing the sum of the weighted grade points obtained in the course by the sum of the weights of the course ($GPA = \sum WGP/\sum W$).

**4.3.24. 'Weighted Grade Point' (WGP)** is obtained by multiplying the grade point by its weight (WGP = GP x weight).

**4.3.25. 'Credit Point'** (CP) of a course is the value obtained by multiplying the grade

point (GPA) by the credit (Cr) of the course (CP = GPA x Cr).

**4.3.26. 'Semester Grade Point Average'** (SGPA) is the value obtained by dividing the sum of credit points (CP) obtained by a student in the various courses taken in a semester by the total number of credits of the courses taken by him/her in that semester. The SGPA shall be rounded off to two decimal places and it determines the overall performance of a student at the end of a semester.

**4.3.27. 'Cumulative Grade Point Average'** (CGPA) is the value obtained by dividing the sum of credit points in all the courses taken by the student for the entire programme by the total number of credits and shall be rounded off to two decimal places.

**4.3.28**. '**Grace Grade Points'** means grade points awarded to a student for course(s), in recognition of meritorious achievements in NSS/Sports/Arts and cultural activities, as per the orders issued by the college from time to time.

## 4.4. ATTENDANCE

Being a regular college, physical presence in the regular activities, especially, classes and exams, is mandatory for the students. However, if a student secures 75% of attendance he/she is eligible to appear for the exams, provided there are no other impediments like disciplinary proceedings, malpractice record etc.

**4.4.1. Absence:** A student found absent for one hour in the forenoon or afternoon session is deprived of the attendance for the entire session as far as eligibility for final exam is concerned.

**4.4.2. Leave**: A student has to formally report his/her absence with reasons either in advance, or immediately after the absence for obtaining an approved leave. This applies to all sorts of leave – medical, on duty or similar cases.

4.4.3. The student has to retain a copy/section of the approved leave form and produce the same as proof, in case there is any confusion regarding the leave sanctioning. In the absence of such proof, the claims will not be entertained.

**4.4.4. Duty Leave**: A student representing the college in sports, arts, social service or academic matters, has to get sanction from the class teacher concerned and submit the leave application form duly endorsed by the class teacher and the Head of the Department, and submit it to the Vice Principal. The same will be forwarded by the Vice Principal for attendance entry. The approval of the Department of Physical Education and the class teacher is required for granting attendance related to sports. The time limit for submission mentioned above is applicable in the case of duty leave as well.

**4.4.5. Condonation**: A student may have the privilege of condonation of attendance shortage (up to a maximum of ten days) on the basis of genuineness of the grounds of absence (medical reasons or college duty), duly recommended by the department. This is not a matter of right. It is a matter of privilege based on Principal's discretion and the good conduct of the student on the campus. A student of PG programme may have only one such opportunity.

**4.4.6. Re-admission**: A student whose attendance is inadequate will have to discontinue the studies. Such students, whose conduct is good, may be re-admitted with the approval of Governing Body, on the basis of recommendation from the department, and assurance from the student and the guardian regarding good conduct and compliance in academic and discipline matters. For this the prescribed re-admission fee has to be paid.

**4.4.7. Unauthorised absence & removal from rolls**: A student, absent from the classes continuously for ten consecutive working days without due intimation or permission, shall be removed from the rolls, and the matter shall be intimated to the student concerned. On the basis of recommendation of the department concerned, re-admission process may be permitted by the Principal.

## 4.5.PROGRAMME REGISTRATION

A student shall be permitted to register for the programme at the time of admission.

A PG student who registered for the programme shall complete the same within a period of eight continuous semesters from the date of commencement of the programme.

## 4.6. PROMOTION

A student who registers for the end semester examination shall be promoted to the next semester. However, in extreme circumstances, a student having sufficient attendance who could not register for the end semester examination may be allowed to register notionally by the Principal with the recommendation of the Head of the Department concerned and by paying the prescribed fee.

## 4.7. EXAMINATIONS

All the end semester examinations of the college will be conducted by the Controller of Examinations. The Principal will be the Chief Controller of Examinations. An Examination Committee consisting of the Chief Controller of Examinations, Controller of Examinations, Additional Chief Superintendent, Deans, IQAC Coordinator and other faculty members nominated by the Principal will act as an advisory body on the matters relating to the conduct of examinations.

## 4.8. EVALUATION AND GRADING

### 4.8.1. Evaluation

The evaluation scheme for each course shall contain two parts:

a. **Continuous Internal Assessment (CIA)**
b. **End Semester Examination (ESE)**

25% weightage shall be given to internal evaluation and the remaining 75% to external evaluation and the ratio and weightage between internal and external is **1:3**, for the courses with or without practicals (except the courses offered by the School of Communications). In the case of courses offered by the School of Communications, the internal-external assessment ratio shall be **1:1**. In their case, the components for evaluation and their respective weightage shall be determined by their Board of Studies. Both internal and external evaluation shall be carried out in the grading system and the GPAs are to be rounded to two places of decimals.

4.8.2. **Direct Grading:** The direct grading for the components of CIA shall be based on six letter grades (A+, A, B, C, D and E) with numerical values of 5, 4, 3, 2, 1 and 0 respectively as per the following scale of accuracy/level of quality. The questions for internal test papers and the end semester examination shall be prepared in such a way that the answers can be awarded A+, A, B, C, D and E grades.

| Grade | Grade Points | Scale of accuracy/Level of quality |
|---|---|---|
| A+ | 5 | Greater than or equal to 90% |
| A | 4 | 80% to less than 90% |
| B | 3 | 60% to less than 80% |
| C | 2 | 40% to less than 60% |
| D | 1 | 20% to less than 40% |
| E | 0 | Less than 20% |

4.8.3. **Grade Point Average (GPA):** Internal and external components are separately graded and the combined GPA shall be calculated for each course with weightage **1** for internal and **3** for external.

4.8.4. **Components of Continuous Internal Assessment (CIA)**: Grades shall be given to the evaluation of theory/practical/project/comprehensive viva-voce and all internal evaluations are based on the Direct Grading System.

**The Board of studies of the respective subject is permitted to make changes, if necessary, with regard to the weightages for the components of CIA without changing the total weightage of 5.**

**a. Components of Internal Evaluation (for theory)**

| Sl.No | Components | Weightage |
|---|---|---|
| i. | Assignments | 1 |
| ii. | Seminar | 1 |
| iii. | Quiz/Field study/Industrial Visit/Viva Voce/Study Tour | 1 |
| iv. | Test paper-1 | 1 |
| v. | Test paper-2 | 1 |
| | Total | 5 |

**b. Components of Internal Evaluation (for practical)**

| Components | Weightage |
|---|---|
| Laboratory Involvement | 1 |
| Written/ Lab Test | 2 |

| | |
|---|---|
| Record | 1 |
| Case Study | 1 |
| Total | 5 |

**c. Components of Internal Evaluation (for project)**

| Components | Weightage |
|---|---|
| Title/Topic | 1 |
| Experimentation / Data collection | 2 |
| Punctuality – Regularity | 1 |
| Compilation and Presentation/Analysis | 2 |
| Discussion/Inference/Interpretation | 5 |
| Importance/Relevance | 2 |
| Presentation and Viva Voce | 2 |
| Total | 15 |

**d. Components of Internal Evaluation (Field Study)**

| Components | Weightage |
|---|---|
| Topic/Title | 1 |
| Reviewing literature | 1 |
| Analysis/Data collection | 1 |
| Compilation and presentation of results | 2 |
| Interpretation and Discussion | 2 |
| Reference | 1 |
| Punctuality-Regularity | 1 |
| Involvement | 1 |
| **Total** | **10** |

**e. Components of Internal Evaluation (Internship)**

| Components | Weightage |
|---|---|
| Experimentation/instrumentation | 1 |
| Importance/utility | 1 |
| Presentation | 1 |
| Reflections/experience | 1 |
| Punctuality-Regularity | 1 |
| **Total** | **5** |

**f. Components of Internal Evaluation (viva voce)**

| Components | Weightage |
|---|---|
| Compilation | 1 |
| Presentation | 2 |
| Question-answer/Explanation | 1 |
| Mannerism | 1 |
| **Total** | **5** |

### 4.8.5. Components of End Semester Examination (ESE):

**a. For Theory**

Evaluation shall be based on the following pattern of questions:

| Sl. No. | Type of Questions | Weight | *Number of questions to be answered |
|---|---|---|---|
| 1 | Short answer type Questions | 1 | 8 out of 10 |
| 2 | Short essay/problem solving type questions | 2 | 6 out of 8 |
| 3 | Long essay/problem solving type questions | 5 | 2 out of 4 |

*Board of studies of respective subjects can decide on the number questions in each of type of questions.

**b. For Practical**

**Components of External Evaluation (for practical)**

| Components | Weightage |
|---|---|
| Written/ Lab Test | 9 |
| Record | 2 |
| Case study | 4 |
| Total | 15 |

**c. Components of External Evaluation (for project)**

| Components | Weightage |
|---|---|
| Title/Topic | 2 |
| Introduction/Introducing the topic | 2 |
| Reviewing literature | 3 |
| Experimental design/ Experimentation / Data collection | 8 |
| Compilation and Presentation/Analysis | 8 |
| Discussion/Inference/Interpretation | 13 |
| Conclusion | 2 |
| Reference | 2 |
| Importance/Relevance | 3 |
| Summary/Synopsis/Abstract | 2 |
| **Total** | **45** |

**d. Components of External Evaluation (Field Study)**

| Components | Weightage |
|---|---|
| Topic/Title | **2** |
| Reviewing literature | **3** |
| Data collection | **4** |
| Compilation/Analysis and presentation of results | **6** |
| Interpretation and Discussion | **6** |
| Conclusion | **3** |
| Reference | **3** |
| Significance | **3** |
| **Total** | **30** |

**e. Components of External Evaluation (Internship)**

| Components | Weightage |
|---|---|
| Topic/Area | 1 |
| Experimentation/instrumentation | 4 |
| Importance/utility | 2 |
| Presentation | 4 |
| Reflections/experience | 3 |
| Conclusion | 1 |
| **Total** | **15** |

**f. Components of External Evaluation (viva voce)**

| Components | Weightage |
|---|---|
| Compilation | 3 |
| Presentation | 5 |
| Question-answer/Explanation | 5 |
| Mannerism | 2 |
| **Total** | **15** |

**The Board of studies of the respective subject is permitted to make changes, if necessary, with regard to the weightages for the components of Practical/Project/Internship/Field study/Viva Examinations (External and internal) without changing the total credits in each semester.**

4.8.6. **Project and Internship**

Each student in the IV$^{th}$ sem has to conduct a research project and undergo internship for a duration of 2 months (200 hrs) each. The guidelines for doing projects and undergoing internship are as follows:

i. Student can conduct the Project work and join internship in any institute / NGO/ company.

ii. Both Project work and internship shall be carried out under the supervision of a teacher in the concerned department (external supervisor) and a teacher from The Centre foe Environmental Studies( internal supervisor).

iii. The student has to send weekly report and monthly report during the time of research and internship.

iv. A candidate may, however, in special cases be permitted to work on the project and internship in the college itself if necessary.

v. There should be an internal assessment and external assessment for the project work in the ratio 1:3

vi. The external evaluation of the project work and internship consists of valuation of the reports (dissertation for project) followed by presentation of the work and viva voce.

## 4.9. PERFORMANCE GRADING

4.9.1. Students are graded based on their performance (GPA/SGPA/CGPA) at the examination on a 7 point scale as detailed below

| Range | Grade | Indicator |
|---|---|---|
| 4.50 to 5.00 | **A+** | **Outstanding** |
| 4.00 to 4.49 | **A** | **Excellent** |
| 3.50 to 3.99 | **B+** | **Very Good** |
| 3.00 to 3.49 | **B** | **Good (Average)** |
| 2.50 to 2.99 | **C+** | **Fair** |
| 2.00 to 2.49 | **C** | **Marginal (Pass)** |
| Up to 1.99 | **D** | **Deficient (Fail)** |

4.9.2. No **separate minimum** is required for internal evaluation for a pass, but a minimum a '**C'** grade is required for a pass in an external examination. However, a minimum '**C'** grade is required for pass in a course and the programme as well.

4.9.3. A student who fails to secure a minimum grade '**C'** for a pass in a course shall be permitted to write the examination along with the next batch.

4.9.4. **Improvement of GPA:** The candidates who wish to improve the GPA of the external examinations of a course/courses can do the same by appearing in the external examination of the semester concerned along with the immediate junior batch. The facility is restricted to first and second semesters of the programme.

4.9.5. **Computation of SGPA and CGPA:** For the successful completion of a semester, a student should pass all the courses and score at least the minimum SGPA grade **'C'**. After the successful completion of a semester, Semester Grade Point Average (**SGPA**) of a student in that semester is calculated as the ratio of the sum of the credit points of all courses taken by a student in the semester to the total credits of that semester.

Thus, **SGPA = TCP/TCr**, where **TCP** is **Total Credit Point of that semester ($\sum_{i=1}^{n} CP_i$ )** and **TCr is Total Credit of that semester ( $\sum_{i-1}^{n} Cr_i$ )** where '**n**' is the number of courses in that semester.

Cumulative Grade Point Average (**CGPA**) of a programme is calculated as the ratio of the sum of the credit points of all the courses of the programme to the total credits of the programme.

$$\mathbf{CGPA} = \frac{\sum(\mathbf{SGPA} \times \mathbf{TCr})}{\sum \mathbf{TCr}}$$

The SGPA/CGPA shall be rounded off to two decimal places.
For the successful completion of a programme, a student should pass all the courses and score at least the minimum CGPA grade **'C'**. However, a student is permitted to move to the next semester irrespective of her/his SGPA.

To ensure transparency of the evaluation process, the internal assessment grade awarded to the students in each course in a semester shall be published on the notice board/website at least one week before the commencement of external examination. There shall not be any chance for improvement for internal assessment grade.

The course teacher and the faculty advisor shall maintain the academic record of each student registered for the course which shall be forwarded to the controller of examinations through the Head of the Department and a copy should be kept in the department for at least two years for verification.

## 4.10. REGISTRATION FOR THE EXAMINATION

a. All students admitted in a programme with remittance of prescribed fee are eligible for the forthcoming semester examinations.
b. Online application for registration to the various End Semester Examinations shall be forwarded to the CE along with prescribed fee for each course in prescribed format.
c. The eligible candidates who secure the prescribed minimum attendance of the total duration of the course and possess other minimum qualification prescribed in the regulations for each course shall be issued the hall tickets. The hall ticket shall be downloaded by the students from the college website. The mode of fee remittance shall be through the prescribed bank.

## 4.11. SUPPLEMENTARY EXAMINATIONS

Candidates who failed in an examination can write the supplementary examination conducted by the College along with regular examinations.

## 4.12. PROMOTION TO THE NEXT HIGHER SEMESTER

A candidate shall be eligible for promotion from one semester to the next higher semester if,

a. He / she secures a minimum 75 % attendance and registered for the End Semester Examination of the programme for which he/she is studying.
b. His / her progress of study and conduct are satisfactory during the semester completed, as per the assessments recorded by the course teachers and the Head of the Department concerned.

## 4.13. CERTIFICATES

1. Diploma and Degree certificates are issued by the Mahatma Gandhi University, Kottayam as per the act and statues of the University on the submission of the consolidated mark / score cards of the students by the College.
2. A consolidated mark / scored card shall be issued to the candidates after the publication of the results of the final semester examination taken by the candidate.
3. A Course Completion Certificate with classification shall be issued to students till the provisional certificate is issued by the university.

## 4.14. RANK CERTIFICATE

Candidates shall be ranked in the order of merit based on the CGPA secured by them. Grace grade points awarded to the students shall not be counted for fixing the rank/positions. Rank certificates shall be issued to the candidates who secure positions from the first to the third in the order of merit. The position certificates shall be issued to the next seven candidates in the order of merit.

## 4.15. AWARD OF DEGREE

The successful completion of all the courses with **'C'** grade shall be the minimum requirement for the award of the degree.

## 4.16. MONITORING

There shall be a Monitoring Committee constituted by the Principal consisting of faculty advisors, HoD, a member from Teaching Learning Evaluation Committee (TLE) and the Deans to monitor the internal evaluations conducted by college. The course teacher, class teacher and the deans should keep all the records of the internal evaluation, for at least a period of two years, for verification.

Every programme conducted under Credit Semester System shall be monitored by the College Council under the guidance of IQAC Coordinator, Controller of Exams, Academic Deans and HoDs. An academic committee consisting of the vice principal, deans and teachers nominated by the Principal shall look after the day-to-day affairs of these regulations.

## 4.17. GRIEVANCE REDRESSAL MECHANISM

In order to address the grievance of students regarding Continuous Internal Assessment (CIA) a three-level grievance redressal mechanism is envisaged. A student can approach the upper level only if grievance is not addressed at the lower level.

**Level 1:** Level of the course teacher concerned

**Level 2**: Level of a department committee consisting of the Head of the Department, a coordinator of internal assessment for each programme nominated by the HoD and the course teacher concerned.

**Level 3**: A committee with the Principal as Chairman, Dean of the Faculty concerned, HOD of the department concerned and one member of the Academic Council nominated by the Principal every year as members

## 4.18. TRANSITORY PROVISION

Notwithstanding anything contained in these regulations, the Principal of the college has the power to make changes in these regulations, by due orders, that shall be applied to any programme with such modifications as may be necessary on the recommendations of the Board of Studies of the respective programme.

# 5. Program Structure

| Course Code | Course | Credit | Total Hours | Hours/ Week |
|---|---|---|---|---|
| **FIRST SEMESTER** | | | | |
| **21P1EVST01** | Fundamentals of Environmental Science | 4 | 90 | 5 |
| **21P1EVST02** | Research Methodology I | 4 | 90 | 5 |
| **21P1EVST03** | Research Methodology II | 4 | 90 | 5 |
| **21P1EVST04** | Techniques in Research | 4 | 90 | 5 |
| **21P1EVSP01** | **Practical I-** Water and soil Analysis, Computer Applications in Research, and Instrumentation | 2 | 54 | 3 |
| **21P1EVSP02** | **Field Study - Fresh water ecosystem** | 1 | 36 | 2 |
| **SECOND SEMESTER** | | | | |
| **21P2EVST05** | Earth and Atmosphere | 4 | 90 | 5 |
| **21P2EVST06** | Disaster Management | 4 | 90 | 5 |
| **21P2EVST07** | Remote Sensing and GIS | 4 | 90 | 5 |
| **21P2EVST08** | Environmental Impact Assessment | 4 | 90 | 5 |
| **21P2EVSP03** | **Practical II**- Soil Science, GIS and remote sensing , and Microbiology | 2 | 54 | 3 |
| **21P2EVSP04** | **Field Study - Marine Habitat** | 1 | 36 | 2 |
| **THIRD SEMESTER** | | | | |
| **21P3EVST09** | Environmental Pollution and Toxicology | 4 | 90 | 5 |
| **21P3EVST10** | Environmental monitoring and Management | 4 | 90 | 5 |
| **21P3EVST11** | Biodiversity, Conservation and Social Issues | 4 | 90 | 5 |
| **21P3EVSP05** | **Practical III**– Biodiversity and Ecosystem parameters | 3 | 72 | 4 |
| **21P3EVSP06** | **Practical IV** – Toxicity analysis of water and toxicology | 3 | 72 | 4 |
| **21P3EVSP07** | **Field study**-Wetland and Mangroves ecosystem | 1 | 36 | 2 |
| **FOURTH SEMESTER** | | | | |
| **20P4EVSP08** | **Dissertation** | 10 | 200 | - |
| **20P4EVSP09** | **Field Study- Forest ecosystem** | 3 | 50 | - |
| **20P4EVSIN** | **Internship** | 8 | 200 | - |
| **20P4EVSVV** | **Viva voce** | 2 | - | - |

# 6. SYLLABUS

# M.Sc Programme in ENVIRONMENTAL SCIENCE

## Postgraduate Programme Outcomes (POs)

**At the end of the programme the students are able to:**

**PO1**

Exercise their critical thinking in creating new knowledge leading to innovation, entrepreneurship and employability.

**PO2**

Effectively communicate the knowledge of their study and research in their respective disciplines to their stakeholders and to the society at large.

**PO3**

Make choices based on the values upheld by the institution, and have the readiness and know-how to preserve the environment and work towards sustainable growth and development.

**PO4**

Develop an ethical view of life and have a broader (global) perspective transcending the provincial outlook.

**PO5**

Explore new knowledge independently for the development of the nation and the world and are able to engage in a lifelong learning process.

**Programme Specific Outcomes (PSOs)**

**At the end of the Programme a student should be able to:**

**PSO1** Possess a critical understanding of the significance of environment for the sustenance of the planet earth, the factors affecting the environment and a passion to protect and conserve it,

**PSO2:** Use the various tools and techniques for assessing the environment,

**PSO3:** Identify issues affecting the environment and develop strategies for effective intervention and mitigation,

**PO4:** Have a basic understanding of environmental disasters and the ability to devise strategies to mitigate them.

# SEMESTER I

## COURSE - I: FUNDAMENTALS OF ENVIRONMENTAL SCIENCE

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| **Course Code** | 21P1EVST01 |
| **Title of the course** | FUNDAMENTALS OF ENVIRONMENTAL SCIENCE |
| **Semester in which the course is to be taught** | Semester I |
| **No. of credits** | 4 |
| **No. of contact hours** | 90 |

### COURSE OUTCOMES

**At the end of the course the students are able to:**

- **CO1:** Recall core concepts and methods of ecological sciences and their application in environmental problem-solving.
- **CO2:** Explain the transnational character of environmental problems and ways of addressing them.
- **CO3:** Identify the primary environmental problems (e.g., invasive species, climate change, small populations, pollution) and the science behind those problems.
- **CO4:** Discover the inter-relationship between organism in population and communities (population ecology).
- **CO5**: Assess the biological productivity of nature and its relations with mankind.
- **CO6:** Develop skills required to research and analyze environmental issues scientifically

**COURSE DESIGN**

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|---|---|---|
| Module | I | 15 Hours |
| Module | II | 15 Hours |
| Module | III | 15 Hours |
| Module | IV | 10 Hours |
| Module | V | 15 Hours |
| Module | VI | 5 Hours |
| Module | VII | 5 Hours |
| Module | VIII | 5 Hours |
| Module | IX | 5 Hours |

**Module I. Concept of Ecosystem- 15 hrs.**

Concept of Homeostasis; Concept of habitats and niche (CO2), resource partitioning, character displacement; Cybernetic nature of ecosystem, stability through feedback control and through redundancy of components; resistance and resilience stability; Gaia hypothesis; Concept of limiting factors- Liebig's law, Shelford's law. Ecological indicators (CO3)

**Module II. Ecosystem -Structure and Function -15 hrs.**

Components of an ecosystem-Biotic and abiotic; Food chain, Food web, Trophic levels, Ecological pyramids (CO1, CO4); Energy in the environment: Laws of thermodynamics, energy flow in the ecosystem; Primary productivity, Biomass and productivity measurement (CO6);interactions- types, positive and negative, interspecific and intraspecific interactions; Biogeochemical cycles- patterns and types (Carbon, Nitrogen, phosphorus);Ecological succession- Development of the ecosystem, concept of climax; Types of ecosystems (Fresh water, Marine, Forest); Tropical versus Temperate Ecology (CO3)

**Module III. Population Ecology- 15 hrs.**

Population group properties, density and indices of relative abundance, Concept of rate, Natality and mortality, Population age structure, Growth forms and concept of carrying capacity (CO5),Population fluctuations, density dependent and density independent controls; Life history strategies, r & k selection; Population structure, aggregation, Allee's principle, isolation, dispersal and territoriality; Ecological and evolutionary effects of competition; Concept of metapopulation-Levin's model of metapopulation,

Comparison of Metapopulation and Logistic population model, Metapopulation structure (CO5).

**Module IV. Community Ecology- 10 hrs.**

Concept of community - community structure and attributes, ecotone and edge effect; Species diversity in community and it's measurement- Alpha diversity,Simpson's diversity index, Shannon index, Fisher's alpha, rarefaction. Beta diversity- Sorensen's similarity index, Whittaker's index, Evenness, Gamma diversity, Guild and its functioning in the community (CO7). Drivers of species diversity loss and conservation. Biological Invasions -Introduction, Hypotheses for invasion success: Elton's Hypothesis, Natural enemy hypothesis evolution of invasiveness hypothesis, empty niche hypothesis, novel weapon hypothesis, Invasive alien species of India (plants and animals), Impacts and management of invasions: impacts of exotics on biodiversity, productivity, nutrient cycling; Management: Bio-control programmes, mechanical and chemical control(CO7).

**Module V. Resource Ecology and ecosystem monitoring- 15 hrs.**

Classification of resources-Renewable and non-renewable; Types of soil, Mineral resources with reference to India; Impact of mining on environment; Forest resources, deforestation, forest scenario of India (CO3); Aquatic resources - Freshwater and water scarcity, water conservation measures: case studies from India; Wetlands and its importance, international initiatives for wetland conservation, Ramsar sites; Sand mining and its impacts(CO8); Wetland reclamation- causes and consequences; Depletion of resources and impacts on quality of life (CO3); Energy use pattern in different parts of the world, recent issues in energy production and utilization; Energy audit, Green technology and sustainable development; Ecosystem monitoring- GIS, Physics of remote sensing, role of remote sensing in ecology, GPS and its application, EIA- tools and techniques, Concept of Ecosystem Modelling (CO5).

**Module VI. Impacts on environment- 5 hrs.**

Environmental Pollution-types, causes and consequences. Concept of waste, types and sources of solid wastes including e-waste; Radiation Biology - natural and man-made sources of radioactive pollution; radioisotopes of ecological importance; effects of radioactive pollution; nuclear disasters (two case studies), Disposal of radioactive wastes (CO5). Toxicology- Principles, toxicants- types, dose and effects, toxicity of heavy metals. Global environmental problems and debates - past and present (CO9).

**ModuleVII. Climate change- 5 hrs**

Meteorological parameters – pressure, temperature, precipitation, humidity, mixing ratio, saturation mixing ratio, radiation and wind velocity, adiabatic lapse rate, environmental

lapse rate; Wind roses. Natural variables that influence climate; Global warming driven climate change; Climate change impact; Prevention and control of climate change.

**Module VIII. Environment and Disaster -5 hrs.**

Basic understanding of natural disasters; Types of disaster- Natural Disasters and Man Made Disaster; Concepts of Hazard, Vulnerability and /Risks; Disaster Management Cycle and Framework- Risk and Vulnerability Analysis, Disaster Preparedness and Response, Rehabilitation, Reconstruction and Recovery (CO9); Disaster Management Act 2005.

**Module IX. Conservation ecology -5 hrs.**

Environmental education and awareness; Environmental ethics; Principles and major approaches to conservation and environmental management; Role of UN- conventions, protocols; Role of UNFCC and IPCC; Restoration Ecology- need and policies, case studies and success stories - global and national; Participatory resource management, community reserves, sacred groves, biovillages; Role of Intergovernmental and Non-Governmental Organizations in conservation-IUCN, WCMC, WRI, WWF, CI and Green Peace, National and Local NGOs.

**REFERENCES**


1. Abbasi, S.A. and Ramasami, E.V.1998.Biotechnological Methods of Pollution Control. Oxford University Press, Hyderabad.
2. Arvind, K., and Pashupati, K,R. (2008), Environmental resource management: (critical issues) Astral International.
3. Benton, A.H. and Werner, W.E. 1976. Field Biology and Ecology. Tata McGraw Hill, New Delhi.
4. Biswas, A., and Cline, S.: Global warming: Impacts onWater and Food Security, Dehra dun, 1982.
5. Holling C.S. 1973. Resilience and stability of ecological systems. Annual Review of ecology and systematic 4: 1-23.
6. Boitani, L and T.K.Fuller.2000.Research Techniques in Animal Ecology. Columbia University Press, USA
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8. Dasman, R.F: (1972). Environmental conservation, New York, Wiley,
9. EmbardHaque C (2005) Mitigation of Natural Hazards and DisastersNatural
10. Ghosh G.K (2006), disaster management (vol2),KulbhushanNangia, APH Publishing Corporation, New Delhi.
11. McKinney, M. L., & Schoch, R. M. (2003). *Environmental science: systems and solutions*. Jones & Bartlett Learning
12. Mani,M.S. 1974Ecology and Biogeography in india.,

13. Misra, S P and Pandey S. N., 2009. Essential Environmental Studies. AneBooksPvt. Ltd.
14. Odum E P.,(1971), Fundamentals of Ecology, W B Saunders Company, Philadelphia
15. Odum E P.,1983), Basic Ecology, Saunders College Publishing, Philadelphia
16. SumitMalhotra,(2005) Natural Disaster Management. Aavishkas Publishing, Jaipur

# COURSE - II: RESEARCH METHODOLOGY I

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| **Course Code** | **21P1EVST02** |
| **Title of the course** | **RESEARCH METHODOLOGY I** |
| **Semester in which the course is to be taught** | Semester I |
| **No. of credits** | 4 |
| **No. of contact hours** | 90 |

## COURSE OUTCOMES

**At the end of the course the students are able to:**

- **CO1:** Calculate and apply measures of Central Tendency and measures of Dispersion: grouped and ungrouped data and for analysis of demographic data.
- **CO2:** Explain the importance of IT enabled services and challenges
- **CO3:** Identify the components of a computer system and demonstrate basic proficiency in commonly used applications
- **CO4:** Analyze the results of Regression and Correlation for forecasting.
- **CO5:** Estimate the basis for statistical tests and when necessary perform transformations of data
- **CO6:** Develop various IT web services for betterment of knowledge.
- **CO7:** Application of software for data management of environmental issues.

**COURSE DESIGN**

| | | |
|---|---|---|
| Module | I | 5 Hours |
| Module | II | 4 Hours |
| Module | III | 7 Hours |
| Module | IV | 4 Hours |
| Module | V | 4 Hours |
| Module | VI | 8Hours |
| Module | VII | 10 Hours |
| Module | VIII | 3 Hours |
| Module | IX | 15 Hours |
| Module | X | 10 Hours |
| Module | XI | 11 Hours |
| Module | XII | 9 Hours |

**Module 1.Basics of Biostatistics- 5 hrs.**

Steps in Statistical Investigation, Data and Variable (Collection, Types, Sources). Population, Sample, Sampling Methods (Random, Cluster, Stratified and Geographical) and Sampling Errors/Bias. Organization of Data - Editing, Classification, Tabulation (forming a frequency distribution from raw data and types and characteristics of a Frequency table). Presentation of Data - Graphs, Charts, Diagrams. ( CO1)

**Module II. Measures of Central Tendency- 4 hrs.**

Introduction, Characteristics, Merits and Demerits of Mean, Median and Mode. Calculations/Problems for different data (raw, frequency table). ( CO1)

**Module III. Measures of Dispersion, Skewness and Kurtosis - 7 hrs.**

Introduction, Characteristics, Merits and Demerits of Range, Quartile Deviation, Mean Deviation and Standard Deviation. Calculations/Problems for frequency table. Standard Error and Relative Measures of Dispersion. Measures of Skewness and Kurtosis

Approaches to development of environmental models; linear, sample and multiple regression models, validation and forecasting. Models of population growth and interactions: Lotka-Voltera model, Leslie's matrix model. ( CO1)

**Module IV. Correlation Analysis- 4 hrs.**

Correlation - types and methods of correlation analysis, Problems for Karl Pearson's correlation coefficient and Spearman's rank correlation( CO4)

**Module V. Regression Analysis 4 hrs.**

Regression and methods of regression analysis.. Probit Analysis, Use of softwares (Brief account only), Mathematical Models in Biology (Brief account only). Length - Weight Relationship. Von- Bertalanffy's Growth (VBG) Model. ( CO4)

**Module VI. Theory of Probability- 8 hrs.**

Probability and Theorems in Probability. Random variables and Probability distributions – Binomial, Poisson and Normal (Brief Account only). ( CO5)

**Module VII. Testing of Hypothesis- 10 hrs.**

Hypothesis and types, Errors in testing, significance levels and power. Test procedure, Critical value and P value. Z Test (Problem for large samples). Student's 't' test (Problem for small samples comparing mean of two variable). F-test, Chi- Square Test (Problem for 2×2 table only) and Analysis of Variance (ANOVA - One way) (Brief account only). ( CO5)

**Module VIII. Vital Statistics-3 hrs.**

Introduction, uses, records and system of classification of vital statistics.

Sample registration system, Sample design, Survey of causes of death and Age classification. Measures of Vital Statistics and Measures of Population (Mortality rates, Fertility rates). Life tables (Brief account only). ( CO1)

## INFORMATION TECHNOLOGY APPLICATIONS IN RESEARCH

**Module IX. Introduction to Computers-15 hrs**

Functions and components, Characteristics, Generations, Components and Organization of computers. Types of Computers, Hardware and Software. Memory- Classification and Types, Input, Output and Storage devices. ( CO2, CO3)

**Module X. Software-10 hrs**

Software types ,Application Software - MS Office, Statistical Software (MS Excel/ PH Stat/ SPSS). Computer languages-Classification and types. Programming Concepts - HTML.-Operating System - Windows, Linux and UNIX (Brief account only) ( CO2, CO7)

**Module XI. Basics of Computer Networks- 11 hrs**

Networking - Topology, Protocols; Virus and Antivirus (Brief account only); Internet Services, World Wide Web, Uploading, Downloading, Hosting, Portal, Search Engines, Firewall, Security. ( CO2, CO6)

**Module XII. Environmental Management System software 9hrs**

ERP systems-relevance, tutorial, application and advantages; Data Bases Management, Online Management System, Process Control Systems, Online Monitoring Systems (Brief account only) ( CO2, CO3, CO6, CO7)

**REFERENCES**


1. Anitha Goel.2010. Computer Fundamentals. Pearson Education India Pradeep Sinha and Priti
2. Bailey,N.T.J. 1994. Statistical Methods in Biology (3rdedn). Cambridge University Press.
3. Chap T.Le.2003.Introductory Biostatistics. John Wiley &Sons, NJ, USA.
4. Daniel, W.W. 2006. Biostatistics: A Foundation for Analysis in the Health Sciences (7th edn). John Wiley & Sons, New York.
5. Finney ,D.J. 1980.Statistics for Biologists. Chapman and Hall, London
6. Frank, Harry and Steven C. Althoen, 1995. Statistics: Concepts and Applications. Cambridge University Press
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8. Prabhakara ,G.N. 2006.Biostatistics.Jaypee Bro. New Delhi
9. Rajathi A. and P. Chandran, 2010. SPSS for You. MJP Publishers, Chennai.
10. Sinha.2010.Computer Fundamentals. BPB Publications, New DelhiSudipto Das.2010. A Complete Guide to Computer Fundamentals. Lakshmi Publishers (P) Ltd. New Delhi
11. SundarRao,P.S.S and J.Richard.2006.Introduction to Biostatistics and Research Methods (4th edn). Prentice Hall, New Delhi.
12. Zar, Jerrold H. 2008. Biostatistical Analysis (3rdedn.). Pearson Education Inc., New Delhi


## COURSE – III: RESEARCH METHODOLOGY II

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| **Course Code** | 21P1EVST03 |
| **Title of the course** | RESEARCH METHODOLOGY II |
| **Semester in which the course is to be taught** | Semester I |
| **No. of credits** | 4 |
| **No. of contact hours** | 90 |

## COURSE OUTCOMES

**At the end of the course the students are able to:**

- **CO1**: Understand the types and basic concepts of research and its methodologies
- **CO2:** Identify apt and relevant research topics
- **CO3**: Demonstrate research process.
- **CO4:** Define suitable research problem and its parameters
- **CO5:** Design, organize and conduct research (advanced project) appropriately.
- **CO6:** Create a research report and thesis
- **CO7:** Formulate research proposal for financial assistance.

## COURSE DESIGN

| | | |
|---|---|---|
| Module | I | 7 Hours |
| Module | II | 11 Hours |
| Module | III | 18 Hours |
| Module | IV | 15 Hours |
| Module | V | 9 Hours |
| Module | VI | 7 Hours |
| Module | VII | 13 Hours |
| Module | VIII | 10 Hours |

**Module I. Science and Life Sciences -7 hrs.**

Basic concepts - Knowledge, Information and Data - Science, Pseudoscience (CO1, CO2). Life Science - Definition, Laws, Characteristics. Scientific temper, Empiricism, Rationalism and Units of measurements(CO1, CO2).

**Module II. Concepts of Research- 11 hrs.**

Basic concepts of research -Meaning, Objectives, Motivation and Approaches (CO2). Types of Research (Descriptive/Analytical, Applied/ Fundamental, qualitative/Quantitative, Conceptual/Empirical. Serendipity, Research methods versus Methodology, Research and scientific method. Research Process (CO3).

**Module III. Research Formulation- 18 hrs.**

Research formulation -Observation and Facts, Prediction and explanation, Induction, Deduction. Defining and formulating the research problem, Selecting the problem and necessity of defining the problem(CO3). Literature review -Importance of literature

reviewing in defining a problem, Critical literature review, Identifying gap areas from literature review. Hypothesis -Null and alternate hypothesis and testing of hypothesis(CO4).

**Module IV. Research Designs 15 hrs.**

Research Design -Basic principles, Meaning, Need and features of good design, important concepts. Types of research designs. Development of a research plan - Exploration, Description, Diagnosis, Experimentation, determining experimental and sample designs. Important experimental designs (CO4).

**Module V**. **Sampling- 9 hrs.**

Definition, purpose, principle advantages of sampling. Unit of sampling, population: techniques, characteristics of good samples, Sampling errors and ways to reduce them (CO2, CO3).

**Module VI. Data Collection- 7 hrs.**

Experiments and surveys, Data collection techniques, collection of primary data, data through questionnairs, data through schedules, secondary data, selection of appropriate method for data collection, case study method (CO3, CO4)**.**

**Module VII. Scientific Documentation and Communication- 13 hrs.**

Research report writing (Thesis and dissertations, Research articles, Oral communications).Project proposal writing Presentation techniques - Assignment, Seminar, Debate, Workshop, Colloquium, Conference. Abstract, synopsis, summary. Referencing methods; research leading to production ( Start-up –brief note) (CO5)

**Module VIII. Information Science, Extension and Ethics -10 hrs.**

Sources of Information -Primary and secondary sources. Library - books, journals, periodicals, reference sources, abstracting and indexing sources, Reviews, Treatise, Monographs,. Internet -Search engines and software, online libraries, e-Books, e-Encyclopedia, TED Talk, Institutional Websites. Patents, Intellectual Property Rights (IPR) - Copy right, Designs, Trademarks, Geographical indications (CO4). Safety and precaution - ISO standards for safety, Lab protocols, Lab animal use, care and welfare, animal houses, Animal Ethical Committees and Constitution, radiation hazards. Extension: Lab to Field, Extension communication, Extension tools. Bioethics: Laws in India, Working with man and animals, Consent (Brief note) (CO5)

**REFERENCES**

1. Ahuja,V.K. 2010. *Law of Copy Rights and Neighbouring Rights: National and International*
2. *Perspectives*..LexisNexis- ButterworthsWadhwa, Nagpur
3. Ahuja,V.K. 2007. *Law Relating to Intellectual Property Rights*. Lexis Nexis-ButterworthsWardha,Nagpur.
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9. Paul Oliver.2005. *Writing Your Thesis*. VistaarPublications.New Delhi.
10. Peter Medawar.1979. *Advice to Young Scientist*. Harper and Row, London.
11. Phillippe Cullet.2005. *Intellectual Property Protection and Sustainable Development.* Lexis NexisButterworths, Wardha, Nagpur.

## COURSE - IV: TECHNIQUES IN RESEARCH

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|---|---|
| **Course Code** | 21P1EVST04 |
| **Title of the course** | TECHNIQUES IN RESEARCH |
| **Semester in which the course is to be taught** | Semester I |
| **No. of credits** | 4 |
| **No. of contact hours** | 90 |

**COURSE OUTCOMES**

**At the end of the course the students are able to:**

- **CO1**: Understand the basic concepts of various research techniques and its applications
- **CO2**: Interpret the working and use of the laboratory equipment.
- **CO3**: Demonstrate the theory and principle of laboratory equipment.
- **CO4**: Apply and use the laboratory equipment for research.
- **CO5**: Compare the equipment and select the appropriate one for research.
- **CO6**: Maximize acquaintance with state of art laboratory methods in research.

**COURSE DESIGN**

| | | |
|---|---|---|
| Module | I | 10 Hours |
| Module | II | 14 Hours |
| Module | III | 12 Hours |
| Module | IV | 14 Hours |
| Module | V | 6 Hours |
| Module | VI | 8 Hours |
| Module | VII | 4 Hours |
| Module | VIII | 7 Hours |
| Module | IX | 2 Hours |
| Module | X | 13 Hours |

**Module I. Microscopy- 10 hrs**

Differential Interference, contrast microscopy, Confocal microscope, Electron microscope – TEM, SEM, Scanning Tunnelling and Atomic Force Microscopes (CO1).

**Module II. Chromatography -14 hrs**

Course chromatography, Thin layer chromatography, Ion exchange chromatography. Gel permeation chromatography, Affinity chromatography, Gas chromatography High pressure liquid chromatography (HPLC) (CO2, CO3).

**Module III. Electrophoresis- 12 hrs**

Course electrophoresis, Gel electrophoresis, Polyacrylamide gel electrophoresis (PAGE) – SDS and non SDS , Agarose gel electrophoresis , Disc electrophoresis, High voltage electrophoresis, immunoelectrophoresis, isoelectric focusing (CO3).

**Module IV. Colorimetry, Spectrophotometry, Spectroscopy -14 hrs**

Principle and applications of colorimetry and spectrophotometry and spectroscopy. Flame emission spectroscopy, Atomic absorption spectroscopy, Nuclear Magnetic Resonance spectroscopy (NMR), Circular dichorism spectroscopy, ESR spectroscopy, Mass spectroscopy (CO3).

**Module V. Centrifugation- 6 hrs**

Basic principles of sedimentation, Types of centrifuges, Analytical and Preparative centrifugation, Differential and density gradient centrifugation (CO3).

**Module VI. Radioisotope Detection and Measurement- 8 hrs**

Dosimetry: Ionization chamber, GM counter, Solid and liquid scintillation counters, Autoradiography (CO3).

**Module VII. Nanotechnology- 4 hrs**

Introduction to Nanobiology. Nanosensors and Nanomedicines (CO2, CO3).

**Module VIII. Assays- 7 hrs**

Radio Immuno Assay, Enzyme Linked ImmunoSorbant Assay (ELISA)(CO4).

**Module IX. pH meter- 2 hrs**

Principle and working. Types of pH meters(CO5).

**Module X. Biological and Histological Techniques- 13 hrs**

Fixation, preparation of temporary and permanent slides, whole mounts, smears, squashes and sections. Specimen preparation for TEM, SEM, shadow casting, freeze fracturing, freeze etching, negativestaining. Microphotography. Cytochemical and histological methods- Microtome techniques, fixation, staining. Cytochemistry of nucleic acids, detection of carbohydrates, proteins and lipids (CO5, CO6).

**REFERENCES**

1. Ackerman, E. 1962. *Biophysical Science*. Prentice Hall Inc. NJ, USA
2. Alonso, A., and Arrondo, J.L.R.2006. *Advanced Techniques in Biophysics.*Springer,UK
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7. Ernster, L. (Ed.). 1985. *Bioenergetics*. Elsivier, NewYork,USA.
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# COURSE - V: PRACTICAL- I

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|---|---|
| **Course Code** | 21P1EVSP01 |
| **Title of the course** | Water and soil Analysis, Computer Applications in Research, and Instrumentation |
| **Semester in which the course is to be taught** | Semester I |
| **No. of credits** | 2 |
| **No. of contact hours** | 45 |

**COURSE OUTCOMES**

**At the end of the course the students are able to**

- **CO1:** Apply methods in studying ecosystem characteristics and ecology
- **CO2:** Get acquainted with water testing protocol and get a hands on training in water quality testing methods and reporting it.
- **CO3:** Apply computer software for data collection and interpretation
- **CO4:** Learn to identify fragile ecosystems, ecosystem damage and reporting it

**COURSE DESIGN**

**Water Quality Analysis**

Determination of pH, Electrical conductivity, Alkalinity, Salinity, Hardness, Nitrate, Determination of Total Dissolved Salts (TDS) and COD of polluted water

**Study of Pond/ wetland/ River ecosystem-**

- Food web and food chain (no museum specimen), Record the date, time, methodology, and observations in the record book.

- Qualitative and Quantitative study of marine/freshwater planktons.
- Estimation of primary productivity.

**Principles and application of the following instruments**: Rain Guage, Plankton Net, Secchi Disc, GPS.

**Instrumentation/Biological Techniques:** Principle and working of light microscope, phase contrast microscope, micro-photographic equipment. Micrometry- principle and measurement of microscopic objects: Low power and high power.

**Bioinformatics:** Data base search and data retrieval-using NCBI, , BLAST, SWISS-PROT, PDB, Protein structure visualization using RASMOL.

**Environmental management system tutorial** : ERP systems, data bases management, online management system, process control systems, online monitoring systems(any two)

**Activity ( Case study)**

Adoption of a damaged ecosystem- analysis of the extent of damage, soil, water, air parameter analysis, deviation from Standard Analysis, source of damage analysis, mitigation hypothesis. Make a report.

## COURSE - VI: FIELD STUDY-Fresh Water Ecosystem

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|---|---|
| **Course Code** | 21P1EVSP02 |
| **Title of the course** | Field Study - Fresh water ecosystem |
| **Semester in which the course is to be taught** | Semester I |
| **No. of credits** | 1 |
| **No. of contact hours** | 45 |

**COURSE OUTCOMES**

**At the end of the course the students are able to**

- **CO1:** Apply what was studied in the theory courses
- **CO2:** Acquaint themselves with the physical, chemical and biological factors *in-situ*
- **CO3:** Learn to observe the freshwater ecosystem and its diversity and record findings
- **CO4:** Identify ecologically fragile areas in the fresh water ecosystem and suggest mitigation measures
- **CO5**: Learn to work in a team and coordinate activities to achieve the aim

**COURSE DESIGN**

Students conduct a field study in any freshwater ecosystem, observe and study through experiments and experience *in-situ* the physico-chemical factors and biodiversity and write an exhaustive report embodying introduction, review of literature, methodology, results, discussion, conclusion and references.

# SEMESTER II

## COURSE – VII: EARTH AND ATMOSPHERE

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|---|---|
| **Course Code** | 21P2EVST05 |
| **Title of the course** | EARTH AND ATMOSPHERE |
| **Semester in which the course is to be taught** | Semester II |
| **No. of credits** | 4 |
| **No. of contact hours** | 90 |

**COURSE OUTCOMES:**

**At the end of the course the students are able to:**

- **CO 1:** Outline the concept of life and life supporting systems
- **CO 2:** Formulate plans for ecological assessment of landscape for vegetation and habitats
- **CO 3:** Identify the importance of weather and climatic patterns
- **CO 4:** Examine the effect of climate change on ecosystems and human welfare
- **CO 5:** Summarize the climatic regions of India with special reference to tropical monsoon climate
- **CO 6:** Develop knowledge on how to effectively manage the various water resources

**COURSE DESIGN**

| | | |
|---|---|---|
| Module | I | 8 Hours |
| Module | II | 8Hours |
| Module | III | 26 Hours |
| Module | IV | 18 Hours |
| Module | V | 14 Hours |
| Module | VI | 16Hours |

**Module I-Earth System and Biosphere- 8hrs**

Concept of life and life supporting systems; The origin and structure of earth; primary differentiation and formation of core, mantle, crust, atmosphere and hydrosphere (CO 1);

**Module II –Landscape ecology- 8hrs**

Human dimensions and Land Use in agro-ecosystems, urban ecosystems, rangelands, riparian and wetland systems, coastal and estuarine systems (CO 2); Concept of ecological land degradation, desertification, water logging, salinisation and soil erosion; Ecological assessment of landscape for vegetation and habitats (CO 2).

**Module III. The Physical Environment - 26hrs**

Atmosphere -Physico-chemical characteristics, divisions, composition and significance of atmospheric components (CO 1).

Hydrosphere -Visible and invisible hydrosphere; Range of aquatic habitats; water cycles between earth and the atmosphere; Global water balance; ice sheets, origin and composition of sea water; sea level changes; River basins and watershed; Physico-chemical characteristics of water- diffusion of oxygen from the atmosphere to surface waters; Influence of pH, turbidity and light on aquatic life (CO 1 ).

Lithosphere - Weathering and soil formation, soil colloids, physical and chemical properties of soil; adsorption and exchange of anions and cations; role of microbes in soil; types of soil; soil profile; classification of rocks, folds, faults and dykes and other geological formations and their environmental significance; Rock cycle; Mineralogy and texture of major rocks; Geomorphological processes-plate tectonics, sea floor spreading, mountain building, evolution of continents and structural deformation (CO 4).

**Module IV. Weather and Climate- 18 hrs**

Definitions and scope of climatology; weather and climate; components of climate system; earth's thermal environment; earth intercepts solar radiation (CO 3); seasonal variation in intercepted solar radiation; air temperature in relation to altitude; global pattern of precipitation; influence of topography on regional pattern of precipitation; classification of climate-Koeppen's classification and Thornthwaite's scheme (CO 3); climatic types and zones; Global climatic phenomena-*El Nino* and *La Nina* (CO 3); Climatic regions of India; tropical monsoon climate-onset, rain bearing systems, break in the monsoon, retreat of monsoon; Monsoon in Kerala; oceanic and continental influence (CO 3).

**Module V: Geomorphology - 14 hrs**

Geomorphology- an introduction (CO 6); River -River formation, erosion, transportation and deposition; Slope process –Flows, Fall, Slides, Subsidence (CO 6); Coastal Geo-morphomology -Formation of lakes, Backwaters, Estuaries (CO 6);

Geomorphology of India and Kerala (CO 5), Water -Hydrological cycle, Global water balance; Types of water -The surface water, Relationship of surface and ground water; An overview of water resources of Kerala; Ground water -Origin, Movement and Storage (CO 7); Hydrological classification of water bearing formations -Interaction of rivers and lakes with surface and ground water (CO 6).

**Module VI : Oceanography- 16hrs**

Oceans: an introduction-Chemistry of Oceans- Ocean circulation, (CO 8), Coastal processes -Waves and Currents -Coast line: types and classification -beaches -Beach drift and shore line processes (Erosion, Accretion and Depositional) (CO 8), -Erosion and depositional features with reference to Kerala, Tides and tidal environment -Tidal inlets -Bays -Lagoons Estuaries- (CO 8); Marine resources; Influence of environmental changes in sea level rise,(CO 8) Coastal protection methods (Conventional & environment friendly) (CO 9)

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# COURSE- VIII: DISASTER MANAGEMENT

| | |
|---|---|
| **COURSE CODE** | 21P2EVST06 |
| **Title of the course** | DISASTER MANAGEMENT |
| **Semester in which the course is to be taught** | Semester II |
| **No. of credits** | 4 |
| **No. of contact hours** | 90 |

**COURSE OUTCOMES:**

**At the end of the course the students are able to:**

**CO1:** Define terms disaster management, its components and structure and relate to manage the Public Health aspects of the disasters.

**CO2:** Demonstrate to describe, analyze and evaluate the environmental, social, cultural, economic, legal and organizational aspects influencing vulnerabilities and capacities to face disasters.

**CO3:** Choose to design and perform research on the different aspects of the emergencies and disaster events while demonstrating insight into the potential and

limitations of science, its role in society and people's responsibility for how it is used.

**CO4:** Categorize the various pathways, tools and entry points for integrating CCA-DRR and sustainability concerns into developmental planning across sectors, national, subnational and local plans and actions of DM.

**CO5:** Adapt the Sustainable Development Goals (SDG) for disaster risk reduction.

**COURSE DESIGN**

| | | |
|---|---|---|
| Module | I | 5 Hours |
| Module | II | 15 Hours |
| Module | III | 5 Hours |
| Module | IV | 25 Hours |
| Module | V | 10 Hours |
| Module | VI | 20 Hours |
| Module | VII | 10 Hours |

**Module I: Introduction- 5 hrs**

Introduction to Disaster Management (Concepts and definitions of Disaster, Hazard, Vulnerability, Risk, DRR, CCA, resilience and Capacity – Disaster and Development, and disaster management); Distinguishing between an emergency and a disaster situation **[CO1]**; Types of disasters (*Geological, Hydro-meteorological, Biological, Technological and Man - made Disaster*), Global Disaster Trends - Emerging Risks of Disaster - Climate Change and Urban Disasters; Implications of disasters on environment, Environmental Planning and management for environmental hazards **[CO1]**.

**Module II: Disaster Management Cycle- 15 Hrs**

Introduction, Disaster Management Cycle, Disaster Mitigation, Mitigation strategies, Hazard identification and vulnerability analysis, Mitigation measures**[CO1,CO2];**Disaster Preparedness, Response and Recovery Introduction, Disaster Preparedness, Disaster Risk Reduction (DRR), the Emergency Operation Plan (EOP) Disaster Response and Recovery, Modern methods of disaster response, The

Recovery Plan. Disaster Management Act (2005), Disaster Management Policy (2009), Organizational Framework for disaster management in India **[CO2]**.

**Module III**: **Hazard Mitigation- 5 hrs**

Identification of hazard prone belts, hazard zonation and risk assessment; risk reduction in vulnerable areas, developing warning systems, forecasting, emergency preparedness, education and training activities, planning for rescue and relief works**[CO1,CO3]**

**Module IV: Disaster Education and Public Awareness- 25 Hrs**

Community-based Initiatives, Stakeholders' Roles and Responsibilities; Categories of stakeholders, Government, Non-Government Organisations (NGOs); Regional and International Organizations / Donor Agencies, Island Councils / Local Government, Community Workers, National and Local Disaster Managers, Trainers, Policy Makers and Grass-roots people; Advantages and Disadvantages of the Community-Based Approach; Duties of Response Personnel, Pre-Disaster Mitigation Plan, Hazardous Materials, Ways of storing and safely handling hazardous materials; Opportunities and regional planning for hazard management, Empowerment through Disaster Risk Management **[CO3, CO4]**.

**Module V: The Role of Technology in Disaster Management- 10hrs**

Introduction to various ecosystem based tools and approaches for reducing DR {(RS, GIS, GPS and RS) Disaster Communication System (Early Warning and Its Dissemination)};Integrated Water Resources Management/River basin Management/Coastal Zone Management; Managing ecosystems for urban risk reduction; Community-based Ecosystem and Disaster Risk Management; The Role of Media in Disaster Management **[CO3, CO4]**.

**Module IV: Physical and Socio-Economic Impacts of Disasters- 20 Hrs**

Physical and Socio-economic Impacts of Disasters; Disaster Associated Health Issues; Emergency Health Services in Disasters; Infrastructure and procedures in accessing emergency situations; Communicable diseases common in disaster situations; Monitoring and Evaluation of Communicable Diseases Control; Programme Disaster and Development; The impact of disasters on development programmes, Vulnerabilities caused by development; Macroeconomic effects of natural and man-made disasters; Economics for disaster recovery and reconstruction; Economic costs of disasters losses – who pays for disasters. Investing in natural disaster risk reduction **[CO1, CO3, CO4]**.

**MODULE VII: Disaster Preparedness Plan and DRR Case Studies- 10hrs**

Preparing disaster preparedness plans for an ecosystem-based project for increasing resilience and reducing DRR: Hazard mapping of vulnerable areas, Vulnerability

assessment (physical, social, organizational, economical and technological), Risk mitigation planning for vulnerable areas; Different case studies and its impact on gender: Bhopal Disaster: Industrial/Chemical Disaster; Disaster Risks; Tsunami: With no warning, the Indian Ocean was exposed; Disaster Communication**[CO1, CO3, CO4].**

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# COURSE – IX: REMOTE SENSING AND GIS

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|---|---|
| **Course Code** | 21P2EVST07 |
| **Title of the course** | REMOTE SENSING AND GIS |
| **Semester in which the course is to be taught** | Semester II |
| **No. of credits** | 4 |
| **No. of contact hours** | 90 |

## COURSE OUTCOMES

**At the end of the course the students are able to:**

- **CO1:** Define basic level fundamental physical principle of remote sensing and GIS
- **CO2:** Explain Remote Sensing Systems and programmes (sensors, platforms, etc.) and demonstrate its potential to spatial analysis.
- **CO3:** Make use of basic computational properties of remote sensing data acquisition, storage, and processing.
- **CO4:** Analyse geographical information and address problems and/or research questions.
- **CO5:** Compare different types of remote sensing data products and analysis techniques and select the more appropriate to solve a real-world problem
- **CO6:**Develop critical thinking skills in solving geospatial problems

## COURSE DESIGN

| | | |
|---|---|---|
| Module | I | 23 Hours |
| Module | II | 7Hours |
| Module | III | 21 Hours |
| Module | IV | 14 Hours |
| Module | V | 15 Hours |
| Module | IV | 10 Hours |

**Module I: Fundamentals of Environmental Appraisal Tools - 23hrs**

Maps-Definition and classification; Topographical Maps, Cadestral maps, Toposheets (Interpretation and studies);Map conversions; Grids, Contours, Isobars; Measurements of area and distance (Square and Plannimeter Methods) (CO3); Preparation of maps (Basics of cartography);Map projection; Scales- Definition, Types of scales, Representation and conversion (introduction only) (CO1); Surveying - Definition and classification, Survey instruments (Introduction to Compass, Theodolite, Clinometer, Abeny Level, Cartographic equipments)(CO3, CO1)

**Module II**: **Remote Sensing: Introduction - 7hrs**

Remote Sensing-Definition, History and Scope of Remote Sensing; Principles and concepts of Remote Sensing (CO2, CO1); Scope of remote Sensing; Indian Remote sensing Programmes (CO1);Electromagnetic Spectrum- Electromagnetic spectrum in remote sensing,Spectral characteristics of surface features (rocks, soils, vegetations, water) (CO1);Sensors and Platforms-Sensors in remote sensing, Satellites and their sensors,Types of platforms, (CO3, CO2); Scanners and data products Image processing; Applications of remote Sesing (CO6)

**Module III**: **Remote Sensing: Application - 21hrs**

**Photogrammetry -** Definition and types (Aerial and terrestrial photographs), Method and equipments used in Aerial Photo Interpretation (Introduction only)(CO2, CO5);**Image-interpretation -**Space Imaging Landsat, SPOT, IRS, NOAA, Seasat, ERS, RADARSAT, INSAT,Indian Remote sensing Programmes (CO3, CO4)**;Digital image processing technique-**Image statistical analysis,Image restoration, Image enhancement, Information extraction (Image classification: Supervised and unsupervised), Image manipulation, Accuracy assessment (CO5)

**Module IV**: **Geographical Information System-Introduction (GIS) – I 14hrs**

History and Development, Concepts, Components and Organization of GIS,Fundamentals of computing GIS,Theory of GIS (CO3)

**Module V: Geographical Information System (GIS) – II 15hrs**

Spatial Data concepts, Raster and vector data, Topology creation,Overlay analysis; Software used in GIS Surveying, Leveling, Triangulation, Geodetic survey (CO6).

**Module VI: Global Positioning System (GPS) 10 hrs**

Basic principles, components , Applications to environmental studies (CO1)

**REFERENCE**


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25. Schowengerdt, Robert A. (2007). Remote sensing: models and methods for image Processing (3rd ed.). Academic Press

## COURSE - X: ENVIRONMENTAL IMPACT ASSESSMENT

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|---|---|
| **Course Code** | 21P2EVST08 |
| **Title of the course** | ENVIRONMENTAL IMPACT ASSESSMENT |
| **Semester in which the course is to be taught** | Semester II |
| **No. of credits** | 4 |
| **No. of contact hours** | 90 |

### COURSE OUTCOMES

**At the end of the course the students are able to**

**CO1**: Define the purpose and role of EIA in the decision-making process related to development project.

**CO2**: Explain the strengths & limitations of environmental management.

**CO3**: Identify critical impacts of developmental project on people and environment.

**CO4**: Analyze developing project for their impacts on various environmental matrices
**CO5:** Assess the potential of environmental audit as a tool for Impact Assessment to address environmental concerns.

**CO6**: Discuss the implications of current jurisdictional and institutional arrangements in relation to environmental impact assessment

**COURSE DESIGN**

| | | |
|---|---|---|
| Module | I | 15 Hours |
| Module | II | 20 Hours |
| Module | III | 20 Hours |
| Module | IV | 15 Hours |
| Module | V | 10 Hours |
| Module | VI | 10 Hours |

**Module I: General Introduction - 15 hrs**

Definition, purpose and characteristics of EIA; global evolution of EIA; participants in EIA process, stages of EIA, types of EIA. EIA regulations in India. National Policy on EIA and Regulatory Framework [CO1]: Environmental Impact Assessment Notification 2006 and Coastal Zone Notification1991; Environmental Clearance Process in India; Legislative requirements (discharge requirements and area restrictions); [CO2]. Risk Assessment v/s Environmental Impact Assessment. Life cycles Assessment. Environmental Impact Statement (EIS) and Environmental Management Plan (EMP) [CO1, CO2].

**Module II: Methods of EIA - 20 hrs**

Stages- Screening, Scoping, Impact Identification ( Adhoc method, Checklist Method, Werner Prestroit study, Smith study, Interaction Matrices- Network and overlays approach). Baseline data on EIA- environmental data, project data and project alternative data. Measurement of impact– physical, social, economic, natural, evaluation and mitigation, Public participation in environmental decision making; Framework of Environmental Assessment; and Environmental Impact Statement Process – Preparing EIS [CO3,CO4].

**Module III: EIA Process - 20 hrs**

Methods for preparing EIA, Socio-economic aspects- Environmental inventories. Sampling and Data process. Impact Prediction- Positive and negative impacts. Primary and secondary impacts. Impact on physical, social and biotic environments – Environmental Management Plan (EMP) [CO4]. Criteria and standards for assessing significant Impact. Cost- Benefit Analysis and valuation of Environmental Impacts. Public Participation, presentation and review. EIA monitoring and auditing [CO5]. Environmental Clearance Process in India; Legislative requirements (discharge

requirements and area restrictions); Environmental Appraisal procedure for mining, industrial , thermal power, nuclear power and multipurpose river valley projects; Central and state pollution control boards for environmental protection [CO3,CO4,CO5].

**Module IV: EIA Practice - 15hrs**

Air quality Assessment; Water Impact Assessment; Social Impact Assessment; Ecological Impact Assessment; Landscape and visual Impact Assessment; Environmental Impact of surface and underground mining of metals, minerals and fossil fuels. Cumulative Effects Assessment. Issues and problems in environmental assessment [CO5, CO6]

**Module V: Guidelines for Environmental Audit - 10 hrs**

Notification – 1994, 2006 and amendments. Public Participation, Regional and Sectoral Impact Assessment, Major limitations of Environmental Impact Assessment. Status of EIA in India – EIA regulations in India – TOR for hydropower projects. ISO Certification [CO1,CO5,CO6].

**Module VI: EIA Case Studies - 10 hrs**

Land Clearing Projects – Dam sites – EIA for Aquaculture, Steel, Mines, Hydel, Thermal, Nuclear, Oil and Gas based Power Plants – Highways projects – Industrial Projects [CO6].

**REFERENCES**

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2. Environmental Impact Statements, Bregman, J. I. (1999), Lewis Publishers, London.
3. Environmental Assessment, Singleton R, Castle, P and Sort, D. (1999), Thomas Telford Publishing, London.
4. Effective Environmental Assessment, Eccleston, C. H. (2000), Lewis Publishers, London.
5. Environmental Impact Assessment- A Comprehensive Guide to Project and Strategic Planning, Eccleston, C. H. (2000), John Wiley and Sons.
6. A guide book for Integrated Ecological Assessments, Jensen,M. E. and Bourgeron, P. S. (2001), Springer-VerlagInc., New York.
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## COURSE-XI: PRACTICAL-II - Soil Science, GIS and remote sensing and Microbiology

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|---|---|
| **Course Code** | 21P2EVSP03 |
| **Title of the course** | PRACTICAL II- Soil Science, GIS and remote sensing , and Microbiology |
| **Semester in which the course is to be taught** | Semester II |
| **No. of credits** | 2 |
| **No. of contact hours** | 45 |

**COURSE OUTCOMES**

**At the end of the course, the students are able to**

- **CO1:** Apply GIS and Remote sensing software in studying Earth and ecosystems
- **CO2:** Learn techniques in studying the physico-chemical nature of soil, soil texture and soil biodiversity
- **CO3:** Learn to prepare Disaster Management Preparedness plan and setting deliverable parameters that lead to disaster mitigation

**COURSE DESIGN**

**GIS and Remote Sensing**

- Remote sensing and GIS: Georeferencing, map projection, digitization (land use classification of given map), Map conversions- vector to raster
- Measurements of area and distance (Square and Planimeter Methods).
- Camera Lucida drawing with magnification and scale, Planimetry

**Soil study**

- Study of soil profile.
- Study of soil types.
- Soil texture.
- Study of soil micrometry.
- Separation and identification of soil arthropods using Berlese funnel.

**Soil Analysis**

- Determination of Organic Carbon, Chloride, Calcium, Magnesium and Phosphorous and conductivity.
- Soil texture using micrometry from two different sites.
- Determination of soil moisture content.
- Determination of soil pH from at least three different locations and correlate it with the soil type.
- Determination of soil organic carbon and chlorides.
- Enumeration of microorganisms in soil (TBC or TMC).
- Bacteriological quality testing of water and wastewater (Presumptive coliform test (MPN)

**Activity ( case study)**

- Identify a vulnerable area/effected area and prepare a Disaster Management (DM) preparedness plan preparation with data collected from adopted area, set deliverable parameters, create resources, material, manpower management protocols; use disaster mitigation and management tools; use GIS to forecast a topographical variance and projection. Make a report.

## COURSE - XII: FIELD STUDY- Marine Habitat

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|---|---|
| **Course Code** | 21P2EVSP04 |
| **Title of the course** | Field Study - Marine Habitat |
| **Semester in which the course is to be taught** | Semester II |
| **No. of credits** | 1 |
| **No. of contact hours** | 45 |

**COURSE OUTCOMES**

**At the end of the course the students are able to**

- **CO1:** Apply what was studied in the theory courses
- **CO2:** Acquaint themselves with the physical, chemical and biological factors *in-situ*
- **CO3:** Learn to observe the marine ecosystem and its diversity and record findings
- **CO4:** Identify ecologically fragile areas in the Marine ecosystem and suggest mitigation measures
- **CO5**: Learn to work in a team and coordinate activities to achieve the aim

**COURSE DESIGN**

Students conduct a field study in Marine ecosytem, observe and study through experiments and experience *in-situ* the physico-chemical factors and biodiversity and write an exhaustive report embodying introduction, review of literature, methodology, results, discussion, conclusion and references.

# SEMESTER III

# COURSE XIII: ENVIRONMENTAL POLLUTION AND TOXICOLOGY

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|---|---|
| **Course Code** | 21P3EVST09 |
| **Title of the course** | ENVIRONMENTAL POLLUTION ANDTOXICOLOGY |
| **Semester in which the course is to be taught** | Semester III |
| **No. of credits** | 4 |
| **No. of contact hours** | 90 |

**COURSE OUTCOMES:**

**At the end of course the students are able to**

**CO1:** Identify the sources of pollution.

**CO2:** Understand the concepts involved in pollution control technologies.

**CO3:** Evaluate methods of regulating, controlling and attenuating pollution.

**CO4:** Develop knowledge of the environmental toxicants and their effects

**CO5:** Illustrate methods of purification of sewage water and recycling / reuse of solid waste.

**COURSE DESIGN**

| | | |
|---|---|---|
| Module | I | 3 Hours |
| Module | II | 12 Hours |
| Module | III | 15 Hours |
| Module | IV | 10 Hours |
| Module | V | 15 Hours |
| Module | VI | 7 Hours |
| Module | VII | 8 Hours |
| Module | VIII | 20 Hours |

**Module I. Introduction -3 hrs.**

Brief history of human civilization, industrialization and urbanization. Definition of pollution. Different types of pollution- Air, Water and soil and their local, regional and global aspects (CO1, CO2).

**Module II. Air Pollution -12 hrs.**

Sources and classification of air pollution; particulates and gaseous pollutants in the atmosphere.Primary and secondary pollutants. Effects of air pollutants on human health, animals, vegetation, materials and structures. Air pollution monitoring - methods, air quality standards; ISI, EPA.Sampling and measurement of particulate matters (SPM) - gaseous pollutants, $CO_2$, CO, NOx, $SO_2$, $H_2S$, oxidants, ozone and hydrogen fluoride.

Control of gaseous emission: adsorption by liquids, adsorption by solids, combustion and condensation. Control of $SO_2$, NOx, CO, $CO_2$ and hydrocarbons (CO3).

**Module III. Water Pollution -15 hrs.**

Sources of water pollution-Domestic (municipal sewage), industrial and agricultural. Health effects of water pollution. Water borne and water related diseases. Effects of water pollution on aquatic system. Water quality standard for potability - Pollution parameters, BOD, COD, Coliform bacteria. Treatment of water for potable purpose (mixing, sedimentation, coagulation, filtration and disinfection) Primary and secondary treatment. Sludge disposal. Biological treatment: Kinetics of Biological growth - activated sludge treatment - trickling filters - anaerobic digestion, combined aerobic and anaerobic treatment process, aerobic process. Advanced waste water treatment - removal of dissolved organics and inorganic - precipitation, iron exchange, reverse osmosis, electro dialysis, adsorption and oxidation. Removal of nutrients. Removal of heavy metals - overall waste water treatment for sewage water. Water pollution treatment using constructed wetlands Bioremediation; traditional water purification techniques( CO1, CO3).

**Module IV. Soil Pollution -10 hrs.**

Sources of soil pollution; - agricultural, industrial and domestic. Hazardous waste compounds, formulations and classes of substances, chemical classification of hazardous waste. Soil factors affected by pollution – physico-chemical and biological impacts. Case studies on soil pollution in wetland and Highland soils in Kerala. Control of soil pollution. Soil quality parameters and test methods (CO3).

**Module V. Solid Waste Management -15 hrs**

Municipal solid wastes (MSW) - quantities and characteristics, waste collection and transport, waste processing and resources recovery and recycling. Aerobic and anaerobic systems- composting, vermicomposting; Biodigesters (Biogas plants); incineration,

pyrolysis, plasma pyrolysis; sanitary landfills and open dumping yards. Management of plastic and e-waste. Better management strategies (any two model case studies). Treatment process for unsegregated waste, fixation of hazardous solid waste prior to disposal, hazardous waste in land fill. Hazardous waste (Management and Handling) Rules 1989 - the Manufacture Storage and Import of Hazardous Chemicals Rules 1989 - Biomedical Waste (Management and Handling) Rules 1998 - Plastic Act 1999. Extended producer responsibility( CO3).

**Module VI. Noise, Thermal and Oil Pollution -7 hrs.**

Properties of sound and noise. Effects of noise on People and ecosystem. Basic principles of noise control. National and International Standards. Assessment and measurement of sound. Thermal Pollution-causes and consequences Oil pollution – causes and consequences (any two case studies) (CO3, CO4).

**Module VII. Radiation Pollution - 8 hrs.**

Radiation pollution- Definition, Radioactivity, Radionuclide, Radiation emissions, sources, Radioactive decay and buildup. Biological effects of radiation. Radioactive pollution impacts on ecosystem. Nuclear reactor disasters (Any two case studies), safety standards(CO4).

**Module VIII. Toxicology - 20 hrs.**

Definition, scope and history of toxicology, Acute and chronic toxicity, selective toxicity, dose, synergism and antagonism. Dose – Response relationships – Graded response, quantal response, Time action curves, Threshold Limit value (TLV); LC50; Margin of safety; Toxicity curves; Cumulative toxicity and LD50 and CTF. Toxic chemicals in the Environment – Biochemical aspects of As, Cd, Pb, Hg, Cu, O3, PAN, pesticides, MIC and other carcinogens. Bio accumulation and biomagnification. Occupational toxicology- hazardous chemicals, disorders from chemical exposure at work, assessment of occupational hazards. Toxicity testing; Bioassay – Definition, purpose, criteria for selection of test organism, methodology, estimation of LC50, Limitation and importance of bioassay, acute toxicity (single); sub-acute toxicity; chronic toxicity; teratogenicity, carcinogenicity and mutagenicity. Bio-monitoring of toxic chemicals - objectives, programs and parameters, concepts of bio indicators. Bio-transformation of Xenobiotics (Selective Toxicity)(CO1, CO5).

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# COURSE - XIV: ENVIRONMENTAL MONITORING AND MANAGEMENT

| | |
|---|---|
| **Course Code** | 21P3EVST10 |
| **Title of the course** | ENVIRONMENTAL MONITORING AND MANAGEMENT |
| **Semester in which the course is to be taught** | Semester II |
| **No. of credits** | 4 |
| **No. of contact hours** | 90 |

**COURSE OUTCOMES:**

**At the end of the course the students are able to:**

- **CO1:** Find professional level employment and pursue research for contributing to the betterment of humanity and in shaping a sustainable society.
- **CO2:** Explain the environmental, social and economic framework in which environmental management decisions are made.
- **CO3:** Develop environmental strategies, policies, programmes and systems that promote sustainable development.
- **CO4:** Analyze environment management systems and formulate solutions that are technically sound, economically feasible, and socially acceptable.
- **CO5:** Decide measures for resource conservation.
- **CO6:** Formulate environmental monitoring and assessment reports and monitor progress of environmental improvement programs.

**COURSE DESIGN**

| | | |
|---|---|---|
| Module | I | 15 Hours |
| Module | II | 15Hours |
| Module | III | 25Hours |
| Module | IV | 15 Hours |
| Module | V | 20 Hours |

**Module I. Introduction to Environmental Management - 15 hrs.**

Basic principles: Management of physical, social, and economic environment. Concepts and scope of environmental planning,regional planning and management. Cost-benefit analysis and Resource economics. Environmental modeling- simulation modeling, input-output modeling, Linear programming, Software and resource management (CO1).

**Module II. Environmental Auditing - 15 hrs**

Tool box for environmental management – An over view of Ecological foot prints,SEA, Ecological Economics, conflict resolution strategies. Eco funds. Environmental auditing , green auditing,and standards Eco labeling and certification, accreditation – need, objectives and benefits; Corporate social responsibility and Corporate environmental responsibility, ISO standards for environmental management systems (EMS) ISO 14000, 14001 and 26001; OHSAS 18001. Life Cycle Assessment (LCA) and its significance. Green auditing (CO5, CO2).

**Module III. Ecosystem Management -25 hrs.**

An overview Population, Resources and ecosystem management Exponential growth in human numbers and the implications. Major management concepts and methodologies The five basic laws of Ecology and their relevance for ecosystems management; paradigm shifts in the management of Ecosystems- influence of economics in ecology (CO3,CO6).

Management practices for various ecosystems: grasslands, forests, mountains, wetlands and coastal areas. Environmental planning and management of – waste lands, reclaimed lands, mining areas, human settlements, Industrial lands and agricultural lands. Eco restoration/remediation; local knowledge and management systems; environmentally sound management of Biotechnologies; the common property resources and their management (CO3, CO4).

**Module IV. Environment Vs Development -15hrs**

Dominance of Man on earth. Limits of growth. Industrial revolution and resource utilization, environmental consequences. Modern agriculture and green Revolution-environmental impacts. Conflicts of interest - environment and development. Tragedy of the commons (CO3).

**Module V. Sustainable Development - 20hrs**

Our common future and the idea of Sustainable Development - concepts and dimensions. Basic needs- Imperatives relating to sustainable development.(CO3) Johannesberg Conference 2002 and follow up Conference on sustainable development. Securing Sustainable futures Millennium Development Goals and Strategies (MDG & S); the earth charter; need and scope for evolving participatory, community based environmental management strategies. Value added products. Education for sustainability. Building sustainable societies and lifestyles. Ecological Foot Print analysis and its significance. Environmental concerns in traditional societies, Gandhian environmentalism( CO2).

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26. www,moef.gov.in (of Ministry of Environment and Forests, Govt. of India)
27. www.millenniumassesment.org. (for Millennium Ecosystem Assessment Synthesis Reports) www.unep.org

# COURSE - XV: BIODIVERSITY, CONSERVATON AND SOCIAL ISSUES

| | |
|---|---|
| **Course Code** | 21P3EVST11 |
| **Title of the course** | BIODIVERSITY CONSERVATION AND SOCIAL ISSUES |
| **Semester in which the course is to be taught** | Semester II |
| **No. of credits** | 4 |
| **No. of contact hours** | 90 |

## COURSE OUTCOMES

**At the end of the course the students are able to:**

- **CO1:** Select plans for biodiversity conservation in various committees pertaining to the same
- **CO2:** Explain factors detrimental to biodiversity
- **CO3:** Apply various methods of water conservation techniques around their locality
- **CO4:** Examine man-wildlife conflicts
- **CO5:** Estimate the biodiversity of an ecosystem
- **CO6:** Develop a sense of conservation attitude

## COURSE DESIGN

| | | |
|---|---|---|
| Module | I | 15 Hours |
| Module | II | 10 Hours |
| Module | III | 15 Hours |
| Module | IV | 25 Hours |
| Module | V | 25 Hours |

**Module I Biodiversity - 15 hrs**

Introduction – Definition: genetic, species and ecosystem diversity (CO1); Biogeographical classification of India; Value of biodiversity- consumptive use, productive use, social, ethical aesthetic and option values (CO1); Biodiversity at global, national and local levels (CO 1); India as a mega-diversity nation; Hot-spots of biodiversity; threats to biodiversity- habitat loss, river death, poaching of wildlife, man wildlife conflicts (CO1, 2); Endangered, endemic and threatened species of India. (CO1).

**Module II Concepts and Patterns of Biodiversity - 10 hrs**

Biodiversity-Types of biodiversity-wild biodiversity, agro-biodiversity, domesticated biodiversity (CO 1); ecosystem functions and biodiversity; mobile links; redundancy and rivet hypothesis (CO 1); valuating ecosystem services (CO 3); Drivers of biodiversity loss (CO 2);Tools and techniques for biodiversity estimation- biodiversity indices (CO 4).

**Module III Conservation Biology - 15 hrs**

Introduction-Origin, concepts and definition of conservation biology (CO 1, CO 3); Fitness and Viability of Population- Minimum Viable Population; Heterozygocity and Fitness; Pattern of Diversity and Rarity-Endemism; Habitat Fragmentation and its effects; Community processes, Community Stability and Structure(CO1, CO2); Co-adaptation and co-evolution (plant and animal interactions-basic, concepts only); Keystone Species and Dominant species; Infectious diseases and conservation biology, (CO4 ); Conservation of Habitats (CO1); Threats and management of habitats (CO2); Theory and practice of conservation (basics only); Restoration, reclamation (Waste land reclamation) and regeneration of habitats (measures and steps introduction only) (CO1 , CO 2).

**Module IV Conservation strategies - 25 hrs**

*In-situ* conservation- sanctuaries, biospheres reserves, national parks, nature reserves, preservation plots (CO4); *Ex-situ* conservation-botanical gardens, zoos, aquaria, homestead garden, herbarium (CO4); *In-vitro* Conservation-germplasm and gene bank, tissue culture- pollen and spore bank, DNA bank (CO 4); GEF-World Bank initiatives; Biodiversity hotspots and their characteristics, global distribution (CO4); CBD; IPR; National and international programmes for biodiversity conservation- CITES and TRAFFIC; National Board of Biodiversity, State Board of Biodiversity; Ecosystem people and traditional conservation strategies; People's participation in conservation-PFM, community reserve and People's Biodiversity Register (PBR); Biodiversity Management Committee (BMC) (CO 4); Wildlife values and eco-tourism; wildlife distribution in India; Problems in wildlife protection-Policies and programme (CO5, CO 6).

**Module V Environmental Issues and Society - 25 hrs**

From unsustainable to sustainable development (CO6); Urban problems related to energy ; Water conservation- rain water harvesting, watershed management ; Resettlement and rehabilitation of people-its problems and concerns, Case studies ; Environmental ethics- Issues and possible solutions; Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, Case studies. (CO 6); Disasters-Natural and man-made; Psycho-social response to disasters; Logistic management ; Consumerism and waste products; Wildlife Protection Act 1972, amended 1991; Forest Conservation Act, 1980, Amended 1988; Air (Prevention and Control of Pollution) Act, 1981 (CO 6); Water (Prevention and Control of Pollution) Act, 1974, amended 1988; The Environment Protection Act, 1986 and Rules, 1991; The Biological Diversity Act, 2002, Rules 2004; Forest Rights Act, 2006 ; Issues involved in enforcement of environmental legislation; Public awareness.

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# COURSE - XVI: PRACTICAL -III - Biodiversity and Ecosystem parameters

| | |
|---|---|
| **Course Code** | 21P3EVSP05 |
| **Title of the course** | PRACTICAL III– Biodiversity and Ecosystem parameters |
| **Semester in which the course is to be taught** | Semester III |
| **No. of credits** | 3 |
| **No. of contact hours** | 63 |

## COURSE OUTCOMES

**At the end of the course the students are able to**

- **CO1:** Learn to estimate ecosystem parameters
- **CO2:** Learn to study and assess biodiversity in an ecosystem using scientific methods
- **CO3:** Learn to identify trophic level of an animal scientifically

## COURSE DESIGN

- Determination of Calcium Carbonate in Egg shell- (Three different types of egg; calculate the mean value and the standard deviation, and compare it with the standard values).
- Estimation of primary productivity in two different aquatic ecosystems and interpretation of the results. Compare the results of Dark and Light bottle method and Chlorophyll method.
- Identification of trophic level by gut analysis (Fish or insect)
- Study of biodiversity in Forest/Grass land and Pond/River and report the species richness, abundance and animal interactions. Calculate frequency, abundance, eveness and diversity indices

# COURSE –XVII: PRACTICAL-IV- Toxicity analysis of water and toxicology

| | |
|---|---|
| **Course Code** | 21P3EVSP06 |
| **Title of the course** | PRACTICAL IV – Toxicity analysis of water and toxicology |
| **Semester in which the course is to be taught** | Semester III |
| **No. of credits** | 3 |
| **No. of contact hours** | 63 |

## COURSE OUTCOMES

**At the end of the course the students are able to**

- **CO1:** Get acquainted with the toxicity analysis methods and protocols
- **CO2:** Learn to estimate toxicity of water, lethal concentration and toxicity to animals
- **CO3:** Create lab scale solutions for the issues found in the adopted area using various tools and to make a report on it

## COURSE DESIGN

**Toxicity analysis of water and toxicology**

- Toxicity Analysis of Water: For Chlorine, $H_2S$, Ammonia, Copper and Chromium
- Determination of LC50 for fish (pesticide) using Probit analysis (use of appropriate software is Suggested to find out the value)
- Study of histo-pathological changes in any two of the tissues (Liver/ Kidney/ Gonad) using CCl4 or $NH_3$ (five stained permanent slides [normal and affected] to be submitted for the examination).

**Activity (Case study)**

- Field visit: Visit to any waste water treatment plant or solid waste management site. Create lab scale solutions for the issues found in the adopted area, use the analytical, information technology tools to create measurable and deliverable solutions in ground. Make a report.

## **COURSE – XVIII: FIELD STUDY-** Wetland and Mangroves Ecosystem

| | |
|---|---|
| **Course Code** | 21P3EVSP07 |
| **Title of the course** | FIELD STUDY-Wetland and Mangroves Ecosystem |
| **Semester in which the course is to be taught** | Semester III |
| **No. of credits** | 1 |
| **No. of contact hours** | 54 |

**COURSE OUTCOMES**

**At the end of the course the students are able to**

- **CO1:** Apply what was studied in the theory courses
- **CO2:** Acquaint themselves with the physical, chemical and biological factors *in-situ*
- **CO3:** Learn to observe nature and its diversity and record findings
- **CO4:** Identify ecologically fragile areas in the mangrove ecosystem and suggest mitigation measures
- **CO5**: Learn to work in a team and coordinate activities to achieve the aim

**COURSE DESIGN**

Students conduct a field study in any mangrove area, observe, and study through experiments and experience, *in-situ* the physico-chemical factors and biodiversity and write an exhaustive report embodying introduction, review of literature, methodology, results, discussion, conclusion and references.

# SEMESTER IV

## COURSE - XIX: DISSERTATION- Major Research Project

| | |
|---|---|
| **Course Code** | 20P4EVSP08 |
| **Title of the course** | DISSERTATION |
| **Semester in which the course is to be taught** | Semester IV |
| **No. of credits** | 10 |
| **No. of contact hours** | 200 |

**COURSE OUTCOMES**

**At the end of the course the students are able to**

- **CO1:**Learn to implement and execute research project and write reports
- **CO2:**Experimentally prove what was studied in the theory Courses
- **CO3:**Unravel new or existing environmental problem and suggest mitigation measures
- **CO4:** Learn to prepare manuscript of research papers prepared on the basis of the project and to get published
- **CO5:** Gain the intellectual flexibility necessary to view environmental issues from multiple perspectives
- **CO6:** Assemble knowledge and formulate strategy to solve environmental issues scientifically
- **CO7:** Make a tangible decision on a career in environmental management

**COURSE DESIGN**

Students conduct a research project spanning a duration of 200 hours in any reputed research institute in the country or elsewhere as detailed in the Section 4.8.6 of Regulations.

# COURSE – XX: FIELD STUDY– Forest Ecosystem

| | |
|---|---|
| **Course Code** | 20P4EVSP09 |
| **Title of the course** | FIELD STUDY- Forest ecosystem |
| **Semester in which the course is to be taught** | Semester IV |
| **No. of credits** | 3 |
| **No. of contact hours** | 50 |

## COURSE OUTCOMES

**At the end of the course the students are able to**

- **CO1:** Apply what was studied in the theory courses
- **CO2:** Acquaint themselves with the physical, chemical and biological factors *in-situ*
- **CO3:** Learn to observe nature and its diversity and record findings
- **CO4:** Identify ecologically fragile areas in the forest ecosystem and suggest mitigation measures
- **CO5**: Learn to work in a team and coordinate activities to achieve the aim

## COURSE DESIGN

Students conduct a field study in any forest area, observe, and study through experiments and experience, in-situ the physico-chemical factors and biodiversity and write an exhaustive report embodying introduction, review of literature, methodology, results, discussion, conclusion and references.

# COURSE - XXI: INTERNSHIP

| | |
|---|---|
| **Course Code** | 20P4EVSIN |
| **Title of the course** | INTERNSHIP |
| **Semester in which the course is to be taught** | Semester IV |
| **No. of credits** | 8 |
| **No. of contact hours** | 200 |

## COURSE OUTCOMES

**At the end of the course the students are able to**

- **CO1:** Acquire hands on practical knowledge in research techniques, tools and equipments
- **CO2:** Learn to execute environmentally related projects and methodologies and earn hands on experience on it.

## COURSE DESIGN

Students undergo practical hands on training in reputed research institutes to get acquainted with the recent technologies, equipments and methodologies and learn to execute environmental related projects and methodologies and earn experience as detailed in Section 4.8.6 Regulation.

# COURSE- XXII: VIVA VOCE

| | |
|---|---|
| **Course Code** | 20P4EVSVV |
| **Title of the course** | VIVA VOCE |
| **Semester in which the course is to be taught** | Semester IV |
| **No. of credits** | 2 |

## COURSE DESIGN

A viva-voce is conducted at the end of the semester on the basis of their research project, internship and field study.

**SACRED HEART COLLEGE (AUTONOMOUS), THEVARA, KOCHI**

# M.Sc in Environmental Science

# SYLLABUS

## Semester I

**Course I- 21P1EVST01: FUNDAMENTALS OF ENVIRONMENTAL**SCIENCE
**Course II - 21P1EVST02: RESEARCH METHODOLOGY I**
**Course III- 21P1EVST03: RESEARCH METHODOLOGY II**
**Course IV -21P1EVST04: TECHNIQUES IN RESEARCH**
**Course V- 21P1EVSP01: PRACTICAL I**
**Course VI- 21P1EVSP02: FIELD STUDY- Fresh water Ecosystem**

## Semester II

**Course VII -21P2EVST05: EARTH AND ATMOSPHERE**
**Course VIII- 21P2EVST06: DISASTER MANAGEMENT**
**Course IX- 21P2EVST07: REMOTE SENSING AND GIS**
**Course X -21P2EVST08: ENVIRONMENTAL IMPACT ASSESSMENT**
**Course XI- 21P2EVSP03: PRACTICAL II**
**Course XII- 21P2EVSP04: FIELD STUDY– Marine Ecosystem**

## Semester III

**Course XII - 21P3EVST09: ENVIRONMENTAL POLLUTION AND TOXICOLOGY**
**Course XIV - 21P3EVST10: ENVIRONMENTAL MONITORING AND MANAGEMENT**
**Course XV - 21P3EVST11: BIODIVERSITY CONSERVATON AND SOCIAL ISSUES**
**Course XVI- 21P3EVSP05: PRACTICAL III**
**Course XVII-21P3EVSP06: PRACTICAL IV**
**Course XVIII-21P3EVSP07: FIELD STUDY –- Wetland and Mangrove Ecosystem**

## Semester IV

**Course XIX-20P4EVSP08: DISSERTATION- Major Research Project**
**Course XX -20P4EVSP09: FIELD STUDY– Forest Ecosystem**
**Course XXI-20P4EVSIN: INTERNSHIP**
**Course XXII- 20P4EVSVV: VIVA VOCE**

# 7. MODEL QUESTION PAPER

**QP Code** **Reg. No. …..**

**Name ……**

**M Sc Degree Examination, ……**

First Semester

Faculty of Environmental studies

**Course I- 21P1EVST01: FUNDAMENTALS OF ENVIRONMENTALSCIENCE**

Time: Three hours Max. Weight: 30

**Section- A**

(Answer any **eight** questions. Each question carries a weight of 1)

1. Define Gaia hypothesis.
2. Explain Alpha diversity.
3. What is carrying capacity?
4. What are ecological indicators?
5. What is green ecology?
6. What is relative humidity?
7. Define energy audit.
8. What are the types of disaster?
9. Identify the significance of red data book.
10. What is biological invasion?

**(8 x 1 = 8)**

**Section B**

(Answer any **six** questions. Each question carries a weight of 2)

11. Evaluate Sorensen's similarity index.
12. Write brief notes on biogas as an ecofriendly fuel.
13. Explain climate change.
14. What is participatory resource management? Explain with examples.
15. Describe briefly the meteorological parameters.
16. Explain density dependent and density independent factors population.
17. Summarize briefly on energy resources.
18. Explain the concept of metapopulation.

**(6 x 2 = 12)**

## Section C

(Answer any **two** questions. Each question carries a weight of 5)

19. What is primary productivity? Describe the productivity measurement methods.
20. Write a detailed account on ecological pyramids.
21. What are resources? Give examples and discuss the challenges
22. Explain the importance of wetlands and international initiatives for wetland conservation

**(2 x 5 = 10)**

**QP Code** **Reg. No. …..**
**Name ……**

**M Sc Degree Examination, ……**

First Semester

Faculty of Environmental Science

**Course II - 21P1EVST02:RESEARCH METHODOLOGY I**

Time: Three hours Max. Weight: 30

## Section- A

(Answer any **eight** questions. Each question carries a weight of 1)

Explain the following

1. Non parametric tests
2. Probit analysis.
3. Skeweness
4. Cartogram.
5. Range.
6. Define any three input devices and any three output devices.
7. Discuss about formatting.
8. Define GUI and its advantages.
9. Explain the terms Hardware, Software and Firmware.
10. What is modem and gateway?

**(8 x 1 = 8)**

## Section B

(Answer any **six** questions. Each question carries a weight of 2)

11. Calculate arithmetic mean for the following data

| 0-10 | 10-20 | 20-30 | 30-40 | 40-50 | 50-60 | 60-70 | 70-80 |
|---|---|---|---|---|---|---|---|
| 4 | 6 | 5 | 10 | 5 | 5 | 10 | 20 |

12. Find the regression of X on Y from the following data

    $\Sigma x=24$ $\Sigma y=44$ $\Sigma xy=306$ $\Sigma x2=164$ $\Sigma y2=574$ $N=4$

    Also, find the value of x when y=6

13. Determine the equation of a straight line which best fits the data.

| X: | 10 | 12 | 13 | 14 | 17 | 20 | 25 |
|---|---|---|---|---|---|---|---|
| Y : | 10 | 22 | 24 | 27 | 29 | 33 | 37 |

14. What are the similarities and differences between RAM, ROM, and hard drives?
15. Illustrate the functional diagram of computer and explain the functions of each components.
16. What is application software? Explain briefly about different types of application software.
17. Explain the applications of ERP
18. Distinguish LAN, MAN and WAN.

**(6 x 2 = 12)**

## Section C

(Answer any **two** questions. Each question carries a weight of 5)

19. (a)Explain the term correlation between two variables? What are the properties correlations? Define Karl Pearson correlation coefficient?

(b)Calculate Karl Pearson's coeffieient of correlation.

| Fertilizer used (X) | 15 | 18 | 20 | 24 | 30 | 35 | 40 | 50 |
|---|---|---|---|---|---|---|---|---|
| Productivity(Y ) | 85 | 93 | 95 | 105 | 120 | 130 | 150 | 160 |

20. (a) Explain Chi square test

(b) A certain drug was administered to 500 people out of a total of 800 to test the efficacy against typhoid. The results are given below

| | Typhoid | No Typhoid |
|---|---|---|
| Drug | 200 | 300 |
| No Drug | 280 | 20 |

On the basis of the data, can it be concluded that the drug is effective in preventing typhoid. (Given $\chi^2_{0.05} = 3.84$)

21. Distinguish between system software and operating system. What are the functions of OS and give different types of OS available?

22. Explain computer language, its classification and types. Define the language HTML, C and Java with codes.

**(2 x 5 = 10)**

**QP Code** **Reg. No. …..**

**Name ……**

**M Sc Degree Examination, ……**

First Semester

Faculty of Environmental Science

**Course III- 21P1EVST03: RESEARCH METHODOLOGY II**

Time: Three hours Max. Weight: 30

## Section- A

(Answer any **eight** questions. Each question carries a weight of 1)

1. Comment on workshop, colloquium and seminar.
2. Write short notes on science and scientific temper.
3. What is randomized block design?
4. What is null hypothesis?
5. Differentiate basic and applied research.
6. What is empirical research and serendipity?
7. Write the importance of on line library in research.
8. Comment on sampling errors.
9. Differentiate abstract and synopsis.
10. What is trade mark?

**(8 x 1 = 8)**

## Section B

(Answer any **six** questions. Each question carries a weight of 2)

11. Discuss formulation of hypothesis? Explain different types of hypothesis and testing of hypothesis.
12. Explain the importance of literature reviewing in research. What are the sources of literature?
13. What are the different presentation techniques? Explain.
14. What are the different methods of referencing? Write its importance in research publications.
15. What is data collection ? Analyse briefly the different techniques in data collection.
16. What is sampling? Evaluate the characteristics of a good sampling method?
17. What is research publication? Explain the different types research publications.
18. Discuss briefly the different types of research.

**(6 x 2 = 12)**

## Section C

(Answer any **two** questions. Each question carries a weight of 5)

19. What is research design? Discuss in detail the types of research design.
20. Explain and analyse research process.
21. What is the importance of funding in research? Explain project proposal construction.
22. Discuss various sources of information. Analyse the importance of literature review and the method of information gathering.

**(2 x 5 = 10)**

**QP Code** **Reg. No. …..**
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First Semester

Faculty of Environmental Science

**Course IV -21P1EVST04: TECHNIQUES IN RESEARCH**

Time: Three hours Max. Weight: 30

## Section- A

(Answer any **eight** questions. Each question carries a weight of 1)

1. Define paper chromatography.
2. Explain the term electrophoretic mobility.
3. Write the principle of flame photometry.
4. Write notes on beam spectrometry.
5. Explain preservation .
6. What is ELIZA?
7. Comment on micrometry.
8. What is dosimetry?
9. What is disc electrophoresis?
10. What is shadow casting?

**(8 x 1 = 8)**

## Section B

(Answer any **six** questions. Each question carries a weight of 2)

11. Discuss the instrumentation and application of camera lucida. Write the principle and application of electron microscopy.
12. Analyze the advantages and disadvantages of liquid scintillation counter?
13. Write the principle and working of spectrophotometer.
14. What is RIA? Explain the process in brief.
15. Discuss the cytochemical methods for the detection of lipids.
16. Write notes on Polyacrylamide gel electrophores.
17. Explain the principle of ion exchange chromatography
18. Compare chromatography and electrophoresis in separation technique.

**(6 x 2 = 12)**

## Section C

(Answer any **two** questions. Each question carries a weight of 5)

19. Explain GM counter and discuss its working and applications.
20. Describe the principle, procedure and applications of HPLC technique.
21. What technique will you choose to separate protein molecule of molecular weight of ten thousand Daltons? Explain the procedures involved in the technique.
22. Describe the principle, procedure and applications of ELISA technique.

**(2 x 5 = 10)**

**QP Code** **Reg. No. …..**
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Second Semester

Faculty of Environmental Science

**Course VII -21P2EVST05: EARTH AND ATMOSPHERE**

Time: Three hours Max. Weight: 30

## Section- A

(Answer any **eight** questions. Each question carries a weight of 1)

1. What is weathering?
2. Define climatology.
3. Distinguish between weather and climate.
4. What are soil colloids?
5. Differentiate river basin and water sheds.
6. List the difference between *El nino* and *La nina.*
7. Explain the characteristics of stratosphere.
8. Define geomorphology.
9. What is soil profile? How does it vary?
10. Define microclimate?

**(8 x 1 = 8)**

## Section B

(Answer any **six** questions. Each question carries a weight of 2)

11. Elaborate on urban climatology.
12. Explain the process of soil formation.
13. Explain the effect of climate change on ecosystem.
14. Describe the physicochemical characteristics of estuaries.
15. Explain the structure of atmosphere.
16. What is wetland system? Briefly explain importance and types of wetlands.
17. What are the chemical properties of soil?
18. List and explain the water resources of Kerala.

**(6 x 2 = 12)**

## Section C

(Answer any **two** questions. Each question carries a weight of 5)

19. Explain classification of climate with special reference to Koeppen's and Thornthwaite's schemes.
20. Explain the physicochemical characteristics of lithosphere and hydrosphere.
21. Identify the human dimensions and land use in agro ecosystem, urban ecosystems and range lands.
22. Elaborate on continental drift theory and evolution of continents. Give different evidences to support this theory.

**(2 x 5 =10)**

**QP Code** **Reg. No. …..**
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Second Semester

Faculty of Environmental Science

**Course VIII- 21P2EVST06: DISASTER MANAGEMENT**

Time: Three hours Max. Weight: 30

## Section- A

(Answer any **eight** questions. Each question carries a weight of 1)

1. What is disaster management?
2. Outline disaster management cycle?
3. Define hazardous materials? Give two examples.

4. What is the role of community workers in disaster management?
5. Name infrastructure in accessing emergency situation.
6. Identify the vulnerabilities caused by development.
7. What is disaster preparedness?
8. Elaborate DRR
9. What are disaster associated health issues?
10. List out the physical socioeconomic impacts of disaster?

**(8 x 1 = 8)**

## Section B

(Answer any **six** questions. Each question carries a weight of 2)

11. What are the implications of disasters of environment?
12. Explain modern methods of disaster response and recovery.
13. Explain the various methods of disaster education.
14. Discuss the role of media in disaster management.
15. Explain opportunities and regional planning for hazard management.
16. Explain pre-disaster mitigation plan.
17. Evaluate emergency health services in disaster.
18. List out the duties of response personnel in disaster management.

**(6 x 2 = 12)**

## Section C

(Answer any **two** questions. Each question carries a weight of 5)

19. Discuss the various types of natural and non natural disasters, implications and environmental planning.
20. Explain the role of disaster education and public awareness in mitigating managing disasters.
21. Discuss the communicable diseases common in disaster situation and its management.
22. Explain the role of social scientist in pre-disaster management

**(2 x 5 = 10)**

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Second Semester

Faculty of Environmental Science

**Course IX- 21P2EVST07: REMOTE SENSING AND GIS**

Time: Three hours Max. Weight: 30

## Section- A

(Answer any **eight** questions. Each question carries a weight of 1)

1. Define Map scales.
2. What is Cadastral map?
3. What is plannimeter?
4. What are the types of photogrammetry?
5. Distingush sensor and platform?
6. What is digital image processing?
7. What is leveling.
8. What is Abeny level?
9. What is cartography?
10. List the significance of aerial photography?

**(8 x 1 = 8)**

## Section B

(Answer any **six** questions. Each question carries a weight of 2)

11. Define and classify survey instruments.
12. Explain scope of remote sensing.
13. Summarize Indian remote sensing programme.
14. Compare topographical map and toposheet.
15. What is map conversion? Explain grids and contours.
16. Elaborate the methods and equipments used in aerial photo interpretation.
17. Explain the principle and concepts of remote sensing.
18. Identify the applications of remote sensing in environmental monitoring and disaster management.

**(6 x 2 = 12)**

## Section C

(Answer any **two** questions. Each question carries a weight of 5)

19. Formulate the interaction of EMR with earth's surface helping remote sensing.
20. Explain the various stages of image analyzing.
21. Summarize the application of remote sensing with examples.
22. Distinguish Supervised and unsupervised classification

**(2 x 5 = 10)**

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Second Semester

Faculty of Environmental Science

**Course X -21P2EVST08: ENVIRONMENTAL IMPACT ASSESSMENT**

Time: Three hours Max. Weight: 30

## Section- A

(Answer any **eight** questions. Each question carries a weight of 1)

1. What is an Environmental Impact Assessment?
2. Explain the scope and objective of EIA.
3. Discuss Environmental Impact Assessment Notification 2006
4. What is ISO Certification?
5. Explain Environmental Impact statement.
6. Distinguish adhoc method and checklist method?
7. Explain the principles of EIA.
8. Explain matrix method.
9. What is meant by Cumulative Effects Assessment?
10. Define EMP.

**(8 x 1 = 8)**

## Section B

(Answer any **six** questions. Each question carries a weight of 2)

11. Explain the significance of land use and geographic date in an EIA study.
12. List out any three methods of impact assessment.
13. What is the need of conducting EIA?
14. Summarize the role of SPCB and CPCB in environmental management
15. Discuss the step by step process for conducting EIA.
16. What are the advantage and disadvantage of public participation?
17. Explain the limitation of EIA.
18. Find out the silent features of the project activity and environmental parameter relationship.

**(6 x 2 = 12)**

## Section C

(Answer any **two** questions. Each question carries a weight of 5)

19. Outline the EIA aspect of the following projects (a) Highway projects (b) Industrial project.
20. Explain the prediction and assessment of impact on the following attributes (i) Air, (ii) Water and (iii) Land Ecology.
21. Explain any case study of EIA in detail with an example.
22. Summarize the components of preparing an EIA report.

**(2 x 5 = 10)**

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Third Semester

Faculty of Environmental Science

**Course XIII - 21P3EVST09: ENVIRONMENTAL POLLUTION AND TOXICOLOGY**

Time: Three hours Max. Weight: 30

## Section- A

(Answer any **eight** questions. Each question carries a weight of 1)

1. What is bioventing?
2. What are trickling filters?
3. Define Biopesticides?
4. What is the unit of radiation?
5. What is NAMP?
6. Define fluorosis?
7. What is indicator organism?
8. What is PAN?
9. What is pyrosis?
10. Distinguish acute and chronic toxicity.

**(8 x 1 = 8)**

## Section B

(Answer any **six** questions. Each question carries a weight of 2)

11. List out the method of assessment of noise pollution. Comment on national and international standards of noise pollution.
12. What is bioremediation? Describe briefly on biodegration of pesticides.
13. What is suspended particulate matter? Find out the methods to its removal and control.
14. What is bioindicator of pollution? Explain with examples.
15. Name and explain the methods for biological treatment of air pollution.
16. How do surfactants work to reduce pollution?
17. Explain biodegradable plastics.

18. Describe stack sampling technique.

**(6 x 2 = 12)**

## Section C

(Answer any **two** questions. Each question carries a weight of 5)

19. Describe the biochemical aspects of As, Cd, Pb,Hg,Cu,O3, PAN, Pesicides and MIC.
20. Summarize the modern techniques and equipments in water quality monitoring.
21. Classify four basic operations of sewage treatment plants
22. Explain how nuclear waste is disposed and the risks involved.

**(2 x 5 = 10)**

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Third Semester

Faculty of Environmental Science

**Course XIV - 21P3EVST10: ENVIRONMENTAL MONITORING AND MANAGEMENT**

Time: Three hours Max. Weight: 30

## Section- A

(Answer any **eight** questions. Each question carries a weight of 1)

1. What is environmental modeling?
2. Define Ecofunds?
3. Name the five basic laws of ecology.
4. What is ecorestoration?
5. List out the significance of ecological foot print analysis.
6. What is common property resource?
7. Discuss corporate environment responsibility.
8. What is the need of education for sustainability?
9. Define SEA
10. What is Ecological economics?

**(8 x 1 = 8)**

## Section B

(Answer any **six** questions. Each question carries a weight of 2)

11. Identify environmental management process of reclaimed land.
12. Formulate various environmental modeling techniques.
13. Elaborate Environmental auditing process.
14. Evaluate modern agriculture practices and green revolution.
15. Summarize Gandhian environmentalism.
16. Explain the role of state and central pollution control boards.
17. Explain the risk assessment and disaster management programme.
18. How does industrial revolution affect environment and development?

**(6 x 2 = 12)**

## Section C

(Answer any **two** questions. Each question carries a weight of 5)

19. What is sustainable development? What are the goals and strategies of a sustainable future?
20. What are the positive and negative impacts of Green Revolution on Environment?.
21. Discuss conflicts of interests in development and environmental protection.
22. Explain wetlands, its importance, and international initiatives for wetland conservation

**(2 x 5 = 10)**

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Third Semester

Faculty of Environmental Science

**Course XV - 21P3EVST11: BIODIVERSITY, CONSERVATON AND SOCIAL ISSUES**

Time: Three hours Max. Weight: 30

## Section- A

(Answer any **eight** questions. Each question carries a weight of 1)

1. What are biological hot spots?
2. What is habitat loss?
3. What are endemic and cosmopolitan animals?
4. Distinguish between endangered and threatened animals.
5. List any two biodiversity indices?
6. What are key stone species?
7. What is CBD?
8. What is ecotourism? Why is it called so?
9. Distinguish between reclamation and restoration.
10. What are drivers of biodiversity loss?

**(8 x 1 = 8)**

## Section B

(Answer any **six** questions. Each question carries a weight of 2)

11. Classify the legal measures in biodiversity control.
12. Explain ex-situ conservation of biodiversity and its advantages.
13. Examine the ethics of environmental conservation practices.
14. Discuss on urban forestry programme.
15. Summarize Participatory Forest Management.
16. Discuss the statement on "World war III will be fought over water".
17. List the objectives of environmental audit.
18. Explain resource economics.

**(6 x 2 = 12)**

## Section C

(Answer any **two** questions. Each question carries a weight of 5)

19. Discuss the causes of depletion of biodiversity in India and the national action plan to preserve biodiversity.
20. Evaluate the methods and strategies of conservation of biodiversity.
21. Explain the social issues emanating with the climate change and mitigation.
22. Discuss briefly on various Acts meant to protect the environment

**(2 x 5 = 10)**