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
Centre for Environmental Studies
Sacred Heart College, Thevara, Kochi-13

Report of the Board of Studies:

A meeting of the Board comprising the following members was held on 26.07.2019

Dr. T. J. James, Chairman,

Dr. Manoj C N, Member,

Dr. Bright Singh, Member,

Dr. Joshy Cherian, Member,

Dr. Remya R, Member,

Dr. Anjana N S, Member

Dr. Anju S G, Member

Discussed the syllabus at length and approved as is in the attached format.

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SACRED HEART COLLEGE (AUTONOMOUS) THEVARA, KOCHI

REGULATIONS FOR POST GRADUATE PROGRAMME IN ENVIRONMENTAL SCIENCE UNDER CREDIT SEMESTER SYSTEM (CSS) – 2020

1. Title

These regulations shall be called '**REGULATIONS FOR POST GRADUATE PROGRAMMES UNDER CREDIT SEMESTER SYSTEM (CSS) – 2020'**

2. Scope

The objective of the course is to make the young students conscientious and inspire them and persuade them towards environmental protection and conservation, make them the future guardians of nature. To equip the students to use various tools and techniques for the study of 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. Definitions

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

ii. 'Duration **of Programme'** means the period of time required for the conduct of the programme. The duration of post-graduate programme shall be of 4 semesters and M Phil programmes shall be 2 semesters.

iii. **'Semester'** means a term consisting of a minimum of 90 working days, inclusive of examination, distributed over a minimum of 18 weeks of 5 working days, each with 5 contact hours of one hour duration

iv. **'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 needs.

v. **'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.

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

vii. '**Programme Credit'** means the total credits of the PG/M Phil Programmes. For PG programmes the total credits shall be 80 and for M.Phil. it shall be 40.

viii. **'Programme Elective course'**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.

ix. '**Programme Project'**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.

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

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

xii. '**Seminar'** 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.

xiii. '**Evaluation'** means every course shall be evaluated by 25% continuous (internal) assessment and 75% end course/end semester (external) assessment.

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

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

xvi. '**Department'** means any teaching Department offering a course of study approved by the college / Institute as per the Act or Statute of the University.

xvii. '**Department Council'** means the body of all teachers of a Department in a College.

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

xix. '**College Co-ordinator** means a teacher from the college nominated by the College Council to look into the matters relating to CSS-PG System.

xx. **'Letter Grade'** or simply '**Grade**' in a course is a letter symbol (O, A, B, C, D, etc.) which

indicates the broad level of performance of a student in a course.

xxi. Each letter grade is assigned a **'Grade point'** (GP) which is an integer indicating the numerical equivalent of the broad level of performance of a student in a course.

xxii. **'Credit point'** (CP) of a course is the value obtained by multiplying the grade point (GP) by the Credit (Cr) of the course CP=GP x Cr.

xxiii. '**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 taken by him/her in that semester . The grade points shall be rounded off to two decimal places. SGPA determines the overall performance of a student at the end of a semester.

xxiv. **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.

xxv. '**Grace Marks'** means marks awarded to course/s, as per the orders issued by the college from time to time, in recognition of meritorious achievements in NCC/NSS/Sports/Arts and cultural activities.

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.

i. **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.

ii. The hour related calculation in a course is meant for awarding marks for the course concerned, where applicable.

iii. **Late entry**: A student is supposed to be in time for the class. Late arrival related treatment is left to the discretion of the individual teacher. However, as a norm, a late arriving student may be permitted to the class, if it is not inconvenient or distraction to the class as such; though attendance MAY NOT BE GIVEN. Late arrival beyond 5 minutes is treated as ABSENCE; though the teacher may consider permitting the student to sit in the class.

iv. **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 other.

v. The student is supposed to report in prescribed format on the very next day of the absence; however, up to a week's time is permitted. Afterwards, the leave applications will not be considered.

vi. 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.

vii. **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 Head of the department, and submit it to the Vice Principal. The same will be forwarded by the Vice Principal for attendance entry. **SPORTS**: The approval of the Department of Physical Education and the class teacher is required. The time limit for submission mentioned above is applicable in the case of duty leave as well.

viii. **Condonation**: A student may have the privilege of condonation of attendance shortage (up to a maximum of 10 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.

ix. **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 council, 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.

As a condition for re-admission, the student should have cleared all academic arrears, or should have appeared for the exams in which he/she is having an arrear (if the results are not out), and should have fulfilled all academic assignments prescribed by the department for compensating for his lack of attendance.

x. **Unauthorised absence & removal from rolls**: A student absent from the classes continuously for 10 consecutive working days without intimation or permission, shall be removed from the rolls, and the matter intimated to the student concerned. On the basis of recommendation of the department concerned, re-admission process may be permitted by the Principal.

5. PROGRAMME REGISTRATION

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

ii. A PG student who registered for the programme shall complete the same within a period of 8 continuous semesters from the date of commencement of the programme.

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.

7. EXAMINATIONS

All the End Semester Examinations of the college will be conducted by the Controller of Examination. 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.

8. EVALUATION AND GRADING

The evaluation scheme for each course shall contain two parts;

a. **Continuous Internal Assessment (CIA) and**

b. **End Semester Examination (ESE).**

The internal to external assessment ratio shall be 1:3, for both courses with or without practical. For all courses except the courses offered by the school of communications, there shall be a maximum of 75 marks for external evaluation and maximum of 25 marks for internal evaluation. In the case of courses offered by the school of communications, the internal to external assessment ratio shall be 1:1. (In their cases, the components for evaluation and their respective marks shall be determined by their Board of Studies). Both internal and external evaluation shall be carried out in the mark system and the marks are to be rounded to the nearest integer.

a. **Continuous Internal Assessment (CIA)/ Continuous Assessment**: The internal evaluation shall be based on predetermined transparent system involving periodic written tests, assignments, seminars/viva/field study/industrial visits/study tour etc. with respect to theory courses and based on written tests, lab skill/records/viva voce etc. with respect to practical courses. The marks assigned to various components for internal evaluation as follows.

Components of Internal Evaluation (for theory)

	Components	Marks
i.	Assignments	5
ii	Seminar	5
iii	Quiz/Field study/Industrial Visit/Viva Voce/Study Tour/etc.	5

iv	Two Test papers(2x5)	10
	Total	25

i. **Assignments**: Every student shall submit one assignment as an internal component for every course.

Components	**Marks**
Punctuality	1
Content	2
Conclusion	1
Reference/Review	1
Total	**5**

ii. **Seminar**: The seminar lecture is expected to train the student in self-study, collection of relevant matter from the books and Internet resources, editing, document writing, typing and presentation.

Components	**Marks**
Content	2
Presentation	2
Reference/Review	1
Total	**5**

iii. A quiz or viva or field survey or any suitable method shall be used by the course teacher to assess the students and a maximum of 5 marks shall be awarded for this component

iv. **Class Tests**: Every student shall undergo two class tests as an internal component for every course.

Components of Internal Evaluation (for practical)

Components	**Marks**
Laboratory Involvement	5
Written/ Lab Test (2X5)	10
Record	5
Viva Voce	5
Total	25

b. End Semester Examination (ESE): The End Semester Examination in theory courses shall be

conducted by the college with question papers set by external experts/ question bank. The evaluation of the answer scripts shall be done by the examiners based on a well-defined scheme of evaluation given by the question paper setters/Prepared as per the direction of the Chairman, Board of Examiners. The evaluation of the End Semester Examinations shall be done immediately after the examination preferably through the centralised valuation.

c. **Project and Internship**

Each student in the IVth sem has to conduct a research project and undergo internship for a duration of 2 months 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.

vii. The mark and credit with grade awarded for the program project should be entered in the grade card issued by the college.

Components of Internal Evaluation for Projects

Components	**Marks**
Title	2
Introducing the topic	5
Reviewing literature	6
Experimentation/Data collection	8
Compilation and presentation of results	8
Interpretation and Discussion	18
Conclusion	5

Summary	7
Referencing	6
Punctuality-Regularity	10
Total	**75**

Vii **Components of External Evaluation for Projects**

Components	**Marks**
Topic/Area selected	5
Title	5
Introducing the topic	10
Reviewing literature	15
Hypothesis	25
Experimentation/Data collection	35
Compilation and presentation of results	30
Interpretation and Discussion	50
Conclusions/Findings/Theorising	20
Summary	15
Referencing	15
Total	**225**

Components of Internal Evaluation for internship

Components	**Marks**
Title/Topic/ Area Selected	1
Introducing the topic	2
Experimentation/instrumentation	7
Importance/utility	3
Presentation	5
Reflections/experience	3
Punctuality-Regularity	4
Total	**25**

Components of External Evaluation for internship

Components	**Marks**
Topic/Area selected	3
Title	2
Introducing the topic	8
Experimentation/instrumentation	25
Importance/utility	10
Presentation	10
Reflections/experience	10
Referencing	7
Total	**75**

d. Field Study

Student has to conduct a field study in every semester and a report has to be submitted.

Components of Internal Evaluation for Field study

Components	Marks
Introducing the topic	2
Reviewing literature	4
Analysis/Data collection	8
Compilation and presentation of results	9
Interpretation and Discussion	12
Reference	4
Punctuality-Regularity	5
Involvement	6
Total	**50**

Components of external Evaluation for Field Study

Components	Marks
Topic/Area selected	6
Title	4
Introducing the topic	12
Reviewing literature	16
Data collection/Compilation	20
Analysis and presentation of results	20
Interpretation and Discussion	30
Conclusion	14
Summary	14
Referencing	14
Total	**150**

e. **Comprehensive Viva-voce**

Comprehensive Viva-voce shall be conducted at the end of the programme, which covers questions from the projects and the internship.

Note: The Board of studies of the concerned subject is permitted to make changes, if necessary, in the credits and internal–external ratio for the projects, internship, field study and comprehensive viva-voce without changing the total credit 80.

f. Grade and Grade Points

For all courses (theory & practical), grade point are given on a 8-point scale based on the total percentage of marks, (CIA+ESE) as given below:-

Percentage of Marks	Grade P oint (GP)	Grade	Indicator
95 and above	10	***A+***	***Outstanding***
85 to below 95	9	***A***	***Excellent***
75 to below 85	8	***B+***	***Very Good***
65 to below 75	7	***B***	***Good***
55 to below 65	6	***C +***	***Fair***
45 to below 55	5	***C***	***Average***
40 to below 45	4	***D***	***Pass***
Below 40	0	***D***	***Defficient(Fail)***

Grades for the different semesters and overall programme are given based on the corresponding SGPA/CGPA as shown below:

SGPA/CGPA	Grade	Indicator
9.0 and above	A +	Outstanding
Equal to 8.0 and bel ow 9.0	A	Excellent
Equal to 7.0 and bel ow 8.0	B+	Very Good
Equal to 6.0 and bel ow 7.0	B	Good

Equal to 5.0 and bel ow 6.0	C +	Fair
Equal to 4.0 and elow 5.0	C	***Pass***
Below 4.0	*D*	***Deficient(Fail)***

A **separate minimum of 40% marks** required for a pass for both internal evaluation and external evaluation for every PG programme.

A candidate who has not secured minimum marks/credits in internal examinations can re-do the same registering along with the end semester examination for the same semester, subsequently.A student who fails to secure a minimum marks/grade for a pass in a course can be permitted to write the examination along with the next batch.

After the successful completion of a semester, Semester Grade Point Average (SGPA) of a student in that semester is calculated using the formula given below. For the successful completion of semester, a student should pass all 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.

Credit Point (CP) of a course is calculated using the formula

CP = Cr x GP, where Cr = Credit; GP = Grade point

Semester Grade Point Average (SGPA) of a Semester is calculated using the formula

SGPA = TCP/TCr, where

TCP = Total Credit Point of that semester $= \sum_1^n \mathrm{CPi}$**;**

TCr = Total Credit of that semester $= \sum_1^n \mathrm{Cri}$

Where n is the number of courses in that semester

Cumulative Grade Point Average (CGPA) of a Programme is calculated using the formula

CGPA $= \sum(\mathrm{SGPA} \times \mathrm{TCr}) \Big/ \sum \mathrm{TCr}$

SGPA/CGPA shall be round off to two decimal places

To ensure transparency of the evaluation process, the internal assessment marks 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 mark.

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.

9 Admission

The eligibility criteria for admission to all PG programmes shall be published by the college along with the notification for admission.

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.

d. The mode of fee remittance shall be through the prescribed bank.

11 Supplementary Examinations

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

12 Improvement of Examination

There will be no improvement examinations for PG programmes

13 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.

14. **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.

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.

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.

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: At the level of the concerned course teacher

Level 2: At the 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 eve

SYLLABUS
MSc. 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

Apply the concepts, tools and techniques for environmental protection, conservation and sustainability.

PSO2

Analyse, evaluate and evolve strategies for management, conservation of the environment and evolve solutions for environmental issues.

PSO3

To internalise attitude towards research on environmental management, conservation and sustainability.

SEMESTER I

COURSE- I FUNDAMENTALS OF ENVIRONMENTALSCIENCE

Course Code	**20P1EVST01**
Title of the course	**FUNDAMENTALS OF ENVIRONMENTAL STUDIES**
Semester in which the course is to be taught	Semester I
No. of credits	4
No. of contact hours	90

4.1. COURSE AIM/RATIONALE. Aimed at constructing a basis of environmental sciences

4.2. OBJECTIVES OF THE COURSE .

CO1: Acquire an awareness of the environment as a whole and its related problems.

CO2: Make knowledge on local and geographical distribution and abundance of organisms

CO3: Acquire an attitude of concern for the environment.

CO4: The inter-relationship between organism in population and communities (population ecology).

CO5: Develop the ability to evaluate measures for the improvement and protection of environment.

CO6: The biological productivity of nature and its relations with mankind.

CO7:The development of mathematical models to relate interaction of parameters and predict effects (systems analysis).

CO8:The conservation and management of natural resources and pollution.

CO9:Participate in improvement and protection of environment

CO10: To increase the knowledge and understanding of the disaster phenomenon, its different contextual aspects, impacts and public health consequences.

4.3. COURSE OUTCOME

- Understand core concepts and methods from ecological sciences and their application in environmental problem-solving.
- Understand the transnational character of environmental problems and ways of addressing them.
- Understand the primary environmental problems (e.g., invasive species, climate change, small populations, pollution) and the science behind those problems.
- Acquire specific skills necessary to achieve understanding of and solutions to environmental problems, including those necessary for assessment of environmental impact of human activity, and for monitoring of the health of environmental systems.
- Knowledge and skills needed to effectively manage human resources
- Learn skills required to research and analyze environmental issues scientifically and learn how to use those skills in situations that may involve environmental problems and/or issues.

4.4. COURSE DESIGN

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

Course- I FUNDAMENTALS OF ENVIRONMENTAL SCIENCE

Module I. Concept of Ecosystem15 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 (CO10); Disaster Management Act 2005.

Module IX. Conservational 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 Nongovernmental organizations in conservation-IUCN, WCMC, WRI, WWF, CI and Green Peace, National and Local NGOs.

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COURSE- II RESEARCH METHODOLOGY I

Course Code	**20P1EVST02**
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

4.1. COURSE AIM/RATIONALE. Aimed nurturing with state of art methods of statistical analysis

4.2. OBJECTIVES OF THE COURSE.

CO1: To equip them to do research applying statistics.
CO2: To apply discrete and continuous probability distributions to various problems
CO3: To learn, experiment and explore the computer applications in education
CO4: To give knowledge and skill of changing information technology

4.3. COURSE OUTCOME

- How to calculate and apply measures of Central Tendency and measures of dispersion -- grouped and ungrouped data
- Compute and interpret the results of Regression and Correlation Analysis, for forecasting
- Understand the importance of IT enabled services and challenges
- Identify the components of a computer system and demonstrate basic proficiency in commonly used applications
- Illustrate various IT web services for betterment of knowledge.

4.3. COURSE DESIGN

Module	I	5Hours
Module	II	8 Hours
Module	III	5 Hours
Module	IV	5Hours
Module	V	5 Hours
Module	VI	8Hours
Module	VII	9 Hours
Module	VIII	15 Hours
Module	IX	10 Hours
Module	X	11 Hours
Module	XI	9 Hours

COURSE- II RESEARCH METHODOLOGY I

BIOSTATISTICS

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 - Types and Characteristics of Tables and Visual aids – Graphs, Charts, Diagrams, Flow charts, Cartographs. Statistical Analysis Tools - Bivariate and Multivariate Analysis. Interpretation and Forecasting.

Module II. Measures of Central Tendency 6 hrs.

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

Module III. Measures of Dispersion 5 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

Module IV. Correlation Analysis 5 hrs.

Correlation - types and methods of correlation analysis, Problems for Karl Pearson’s correlation coefficient and Spearman’s rank correlation

Module V. Regression Analysis 5 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.

Module VI. Theory of Probability 5 hrs.

Measures of Probability and Theorems in Probability.Probability distributions – Binomial, Poisson and Normal (Brief Account only).

ModuleVII. Testing of Hypothesis 9 hrs.

Hypothesis and types, Sampling, Methods and Errors. Tests of significance (For large and small samples – Critical Ratio and P value). Z Test (Problem for small samples), Chi- Square Test (Problem for 2×2 table only). Student's 't' test (Problem for small samples comparing mean of two variable). F-test and Analysis of Variance (ANOVA - One way) (Brief account only).

INFORMATION TECHNOLGY APPLICATIONS IN RESEARCH

Module VIII. Introduction to Computers15 hrs

Functions and components, Characteristics, Generations, Components and Organization of computers.Types of Computers, HardwareandSoftware.Memory- Classification and Types, Input,Output and Storage devices.

Module IX. Software10 hrs

Softwaretypes ,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)

Module X. 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.

Module XI. 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)

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COURSE- III RESEARCH METHODOLOGY II

Course Code	**20P1EVST03**
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

4.1. COURSE AIM/RATIONALE. Aimed nurturing with state of art methods of research

4.2. OBJECTIVES OF THE COURSE.

CO1: To equip them to do research using various methods of research**.**
CO2:To impart the philosophy of science and scientific study
CO3: To give basic concept of research and its methodologies
CO4: To give knowledge in research types, process, design, sampling, data collection and report writing.
CO5: To train in project formulation of report writing presentation of research findings.

4.3. COURSE OUTCOME

- understand some basic concepts of research and its methodologies
- identify appropriate research topics
- select and define appropriate research problem and parameters
- prepare a project proposal (to undertake a project)
- organize and conduct research (advanced project) in a more appropriate manner
- write a research report and thesis
- write a research proposal (grants)

4.4. 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

Course III RESEARCH METHODOLOGY II

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 writingPresentation 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)

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COURSE- IV TECHNIQUES IN RESEARCH

Course Code	**20P1EVST04**
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

4.1. COURSE AIM/RATIONALE. Aimed nurturing with state of art laboratory methods in research

4.2. OBJECTIVES OF THE COURSE.

CO1: To acquaint with state of art laboratory methods in research
CO2: To equip them to do research using various techniques of research.
CO3: To equip them to join without training and confidently in any research institute or firm where these equipment have to be operated as an employee.

4.3. COURSE OUTCOME

- Students get familiarized with various equipment and techniques used in Experimental research.
- Understand Principle and working of the equipment.
- Can join without training and confidently in any research institute or firm where these equipment have to be operated as an employee.

4.4. 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

Course VI- TECHNIQUES IN RESEARCH

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,Affinitychromatography,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)(CO1).

Module IX. pH meter 2 hrs.

Principle and working. Types of pH meters(CO3).

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 (CO1, CO3).

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PRACTICAL I (20P1EVSP01)

Water Quality Analysis

Determination pH, Electrical conductivity, Alkalinity, Salinity, Hardness, Nitrate, Phosphate and Silica, Determination of total dissolved salts (TDS), Estimation of BOD 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.

Biophysics/Instrumentation/Biological Techniques: Micrometry- principle and measurement of microscopic objects: Low power and high power.

Bioinformatics: Data base search and data retrieval-using NCBI, SWISS-PROT,
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

Adoption of a damaged ecosystem- analysis of the extent of damage, soil, water, air parameter analysis, deviation from standards analysis, source of damage analysis, mitigation hypothesis

COURSE V (20P1EVSP02)- FIELD STUDY

Study of fresh water ecosystem. On the spot study and make a report.

SEMESTER II

COURSE VI- EARTH AND ATMOSPHERE

Course Code	**20P2EVST05**
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

4.1. COURSE AIM/RATIONALE. Understanding earth and atmosphere

4.2. OBJECTIVES OF THE COURSE.

CO 1 To know about the earth, atmosphere, hydrosphere and lithosphere at depth.
CO 2 To get an understanding of landscape ecosystem
CO 3 To have an in-depth knowledge on the weather and climatic patterns
CO 4 To understand the various geological processes
CO 5 To gain knowledge regarding the geomorphology
CO 6 Understand the various factors governing the distribution of surface water and ground water
CO 7 To get an overall assessment of various water resources of Kerala
CO 8 To get a basic knowledge on the chemistry and resources of oceans
CO 9 To get an awareness regarding coastal protection methods.

4.3. COURSE OUTCOMES:

- Explain the composition and structure of the atmosphere.
- Explain the hydrologic cycle and theory of plate tectonics as related to natural hazards and earth resources; and
- Learn more on geologic time scale and its relevance
- Acquire knowledge on climatic regime shifts
- Develop a knowledge on how to effectively manage the various water resources
- Get knowledge to be involved in various measures on coastal protection activities

4.4 . COURSE DESIGN

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

Course VII- EARTH AND ATMOSPHERE

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- VII DISASTER MANAGEMENT

COURSE CODE	**20P2EVST06**
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

4.1. COURSE AIM/RATIONALE. Equip students with knowledge of various natural as well as manmade calamities and aware them the methods to overcome or rectify it.

4.2. OBJECTIVES OF THE COURSE.

CO1: Understanding of different types of disasters and its causes and impacts on the society,

region and environment.

CO2: Learning and analyzing the vulnerability, its implications and the practical processes
involved in, the management of disasters at various levels.

CO3: Assessing the challenges and limitations involved in the response and recovery during and
post disasters.

CO4: It will generate more interdisciplinary interest and knowledge products in due course.

4.3 Course Outcomes:

- Learning disaster management, its components and structure
- Incorporating disaster management into public policy and planning based on the vulnerability of places and communities;
- Learn to develop emergency operations plan (EOP); Understanding the significance of the Community-Based Approach to education and public awareness in tackling disasters.
- Emergency Management Systems (EMS); and how the EMS assists in hazardous material management, emergency medical services, and response and recovery operations;
- the role of Global Information Systems (GIS), Global Positioning Systems (GPS) and Information and Communication Technology (ICT) technology in all phases of the disaster management cycle;
- Identifying main communicable diseases common in disaster situations; the risk factors that increase the likelihood of an outbreak and ways of preventing/minimising such outbreaks;
- Explain the importance of water sources and the minimum standards for water quality and quantity;
- Studying the impacts of a disaster on society; Assess the impacts of disaster on people's income, earning capacity and overall social welfare
- Identifying the stages of disaster recovery and associated problems; vulnerable groups in disaster and post-disaster times.

4.4. 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

COURSE- VII DISASTER MANAGEMENT

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 VIII- REMOTE SENSING AND GIS

Course Code	**20P2EVST07**
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

4.1. COURSE AIM/RATIONALE. Students are known to the use of remote sensing and GPS in studying environment and environmental changes.

4.2. OBJECTIVES OF THE COURSE

CO1: To understand the principles, applications, trends, and pertinent issues of geographical information systems and sciences, including remote sensing (RS), Photogrammetry, cartography, and global positioning systems (GPS).

CO2: To develop technical skills and competence in data and information acquisition, extraction, management and analysis; spatial modelling; mapping and visualization.

CO3: To increase awareness of GIS and modelling tools.

CO4: To describe how geographical information is used, managed, and marketed globally.

CO5: To gain an understanding of how to manipulate and apply vector and raster spatial data, particularly with regard to local/state/national issues.

CO6: To develop applications of environmental remote sensing and GIS which can directly enhance service delivery on land use management, ground water management/prospects, agriculture, forestry, food and water security, disaster management, etc.

4.3. COURSE OUTCOME

- Students will be able to recognize and explain at a basic level fundamental physical principle of remote sensing

- Know about main Remote Sensing Systems and programs (sensors, platforms, etc.) and assess its potential to spatial analysis.
- Able to decide which remote sensing techniques suite your specific needs.
- Students will be able to recognize and explain basic computational properties of remote sensing data acquisition, storage, and processing.
- Demonstrate competency with the ArcMap software to enhance and interpret data
- Apply GIS analysis to address geospatial problems and/or research questions.
- Develop a strategy to implement an effective GIS
- Develop critical thinking skills in solving geospatial problems

4.4. 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

Course VIII REMOTE SENSING AND GIS

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) (CO4); 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, (CO1, CO2); Scanners and data products Image processing; Applications of remote Sesing (CO10)

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, CO6);**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 (CO7, CO8)

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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Course IX ENVIRONMENTAL IMPACT ASSESSMENT

Course Code	**20P2EVST08**
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

4.1. COURSE AIM/RATIONALE. Students are known to the use of remote sensing and GPS in studying environment and environmental changes.

4.2. OBJECTIVES OF THE COURSE:

CO1: Appreciate the purpose and role of EIA in the decision-making process;
CO2: Understand strengths & limitations of environmental management;
CO3: Know procedures.
CO4: Understand screening & scoping processes Interpret options for evaluating environmental and social impacts;
CO5: Know formats of EIA Report (Environmental Impact Statement, or Environmental Statement);
CO6: Understand the purpose of developing follow-up procedures, and options for designing these procedures.

4.3. COURSE OUTCOME

- The students would have understood about the importance of EIA in a development project.
- The students will be able to analyse a developing project for their impacts on various environmental matrices by employing various methods.
- The students would have understood the importance of public participation in EIA process, thereby will be able to provide suggestions for mitigation of impacts.
- The students will be able to participate in EIA report preparation.
- Basic knowledge and skills to practice a number of selected methods used in Environmental impact assessments.
- Become familiar in making an EIA Report (Environmental Impact Statement, Environmental Statement)

- Evaluate the applications of environmental assessment through critical reflection and dialogue of case material and readings.
- Discuss the potential of environmental audit as a tool for Impact Assessment to identify, assess and address environmental concerns; conduct/co-ordinate an environmental audit and critically evaluate its outcomes.
- Through case studies, students will learn to present and explain the components and decision making processes involved in environmental assessment

4.4. COURSE DESIGN

Module	I	15
Module	II	20
Module	III	20
Module	IV	15
Module	V	10
Module	VI	10

Course IX: ENVIRONMENTAL IMPACT ASSESSMEN

MODULE 1: 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 2: 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 3: 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 4: EIAPRACTICE **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 5: 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 6: 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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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.
7. Environmental impact statements-Bregman, J.I. and Mackenthum, K.M. 1992.

PRACTICAL II (20P2EVSP03)

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).

Separation and identification of soil arthropods using Berlese funnel.

Camera Lucida drawing with magnification and scale, Planimetry

Soil study

Study of soil profile.

Study of soil types.

Study of soil micrometry.

Soil Analysis

Determination of Chloride, Calcium, Magnesium, Potassium and Phosphorous
Separation and identification of soil arthropods using Berlese funnel.
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.

Principle and working of phase contrast microscope, micro-photographic equipment.

Enumeration of microorganisms in soil (TBC or TMC).

Bacteriological quality testing of water and wastewater (Presumptive coliform test (MPN)

Activity

Identify a vulnerable area/effected area and prepare a 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.

COURSE X (20P2EVSP04) - FIELD STUDY

Study of marine ecosystem. On the spot study and make a report.

SEMESTER III

Course XI: ENVIRONMENTAL POLLUTION AND TOXICOLOGY

Course Code	**20P3EVST09**
Title of the course	**POLLUTION AND ENVIRONMENTAL TOXICOLOGY**
Semester in which the course is to be taught	Semester III
No. of credits	4
No. of contact hours	90

4.1. COURSE AIM/RATIONALE Impart students with knowledge of various environmental pollution and toxicology and make aware them the methods to overcome or rectify it.

4.2. OBJECTIVES OF THE COURSE.

CO1: To create and disseminate knowledge to the students about environmental problems at local, regional and global scale.
CO2: To sensitize students towards environmental concerns and issues, and make them able to apply their knowledge for sustainable development.

CO3:To provide intensive practical training on modern instrumentation and analytical techniques for environmental analyses.
CO4: To orient the students towards efficient environmental decision-making and management.

4.3. COURSE OUTCOME:

- Identify the sources of pollution
- Understand the concepts involved in control technologies
- Understand the technical aspects of regulating and controlling pollution.
- Know about the environmental toxicants and their effects.
- Able to understand how minimize pollution due solid waste and how to reclaim waste land.

4.4. 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

Course XI: ENVIRONMENTAL POLLUTION AND TOXICOLOGY

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, C02, CO, NOx, S02, H2S, oxidants, ozone and hydrogen fluoride.

Control of gaseous emission: adsorption by liquids, adsorption by solids, combustion and condensation. Control of S02, NOx, CO, CO2 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, CO4).

REFERENCES

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12. Oehme, W.F. 1989. *Toxicity of Heavy Metals in Environment.* Marcel Dakkar Inc., New York.
13. Purnima,B.b., A.K.Janin and Arun.K.Jain.2011.*Waste Water Engineering Including Air Pollution*.
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Course XII- ENVIRONMENTAL MONITORING AND MANAGEMENT

Course Code	**20P3EVST10**
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

4.1. COURSE AIM/RATIONALE. Impart students with knowledge of various environmental monitoring and management methods.

4.2. OBJECTIVES OF THE COURSE. To prevent and solve environmental problems, and establish limits.

CO1: To suggest measures for resource conservation.
CO2: To develop, implement, monitor and maintain environmental strategies, policies, programmes and systems that promote sustainable development.
CO3: To oversee the environmental performance including compliance with environmental legislation across to the organisation, and coordinating all aspects of pollution control, waste management, environmental health and conservation.
CO4: To lead the implementation of environmental policies and practices and raise awareness, at all levels of an organisation, about the emerging environmental issues.
CO5:To develop a strategy for the improvement of quality of life.

4.3. COURSE OUTCOME:

- Understand the environmental, social and economic framework in which environmental management decisions are made.
- Anticipate, recognize, evaluate, and control environmental issues in a variety of sectors and industries.
- Utilize quantitative knowledge and skills and modern tools and technologies to assess, analyze, plan, and implement environmental management systems .
- Identify, analyze, and develop environment management systems and formulate solutions that are technically sound, economically feasible, and socially acceptable.
- Prepare, review, and update environmental monitoring and assessment reports and Monitor progress of environmental improvement programs.
- Find professional level employment or pursue higher studies and pursue research for contributing to the betterment of humanity and in shaping a sustainable society.

4.4. COURSE DESIGN

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

Course XII ENVIRONMENTAL MONITORING AND MANAGEMENT

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).

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. 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).

REFERENCES

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Course XIII BIODIVERSITY, CONSERVATON AND SOCIAL ISSUES

Course Code	**20P3EVST11**
Title of the course	**CONSERVATON AND BIODIVERSITY , SOCIAL ISSUES**
Semester in which the course is to be taught	Semester II
No. of credits	4
No. of contact hours	90

4.1. COURSE AIM/RATIONALE. Impart students with knowledge of various natural animal resources and the need of their conservation and conservation methods.

4.2. OBJECTIVES OF THE COURSE.

CO 1 To understand biodiversity at various levels and be knowledgeable on conservation aspects

CO 2 Understand factors detrimental to biodiversity

CO 3 To develop knowledge and be proficient in methods on valuating ecosystem services and understand the techniques involved in biodiversity estimation.

CO 4 To gain knowledge regarding various conservation strategies to protect biodiversity

CO 5 Be aware of the policies and programmes related with biodiversity conservation.

CO 6 Get involved in various social issues and thereby contribute to sustainable development.

CO 7 Be instrumental in preparing biodiversity register at local and national level.

CO 8 To understand about urbanization and associated problems related to it.

CO 9 Gain knowledge to deal with mental trauma and other associated issues of humans affected with disasters

CO 10 To study the various legislations and issues enacted to conserve biodiversity.

4.3.COURSE OUTCOMES

- Learning biodiversity at local, national and global levels.
- Students develop a sense of conservation attitude towards environment.
- The students are equipped to deal with various social issues related to environment and to study them in a scientific manner.
- To become a part of legislation and policy building team related to biodiversity conservation.

4.4. COURSE DESIGN

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

Course XIII BIODIVERSITY, CONSERVATON AND SOCIAL ISSUES

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. (CO 1).

Module II Concepts and Patterns of Biodiversity 10

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

Introduction-Origin, concepts and definition of conservation biology (CO 1, CO 5); 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

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, CO 7); Wildlife values and eco-tourism; wildlife distribution in India; Problems in wildlife protection-Policies and programme (CO1, CO 4).

Module V Environmental Issues and Society 25hrs

From unsustainable to sustainable development (CO6); Urban problems related to energy (CO 8); Water conservation- rain water harvesting, watershed management ; Resettlement and rehabilitation of people-its problems and concerns, Case studies (CO8); 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 (CO 9); 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 10); Water (Prevention and Control of Pollution) Act, 1974, amended 1988; (CO10), The Environment Protection Act, 1986 and Rules, 1991; The Biological Diversity Act, 2002, Rules 2004; Forest Rights Act, 2006 (CO10); Issues involved in enforcement of environmental legislation; Public awareness (CO10).

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PRACTICAL –III (20P3EVSP05): Biodiversity and Ecosystem parameters

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 levels from 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

PRACTICAL-IV (20P3EVSP06): Toxicity analysis of water and toxicology

Toxicity Analysis of Water: For Chlorine, H2 S, 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 NH3 (five stained permanent slides [normal and affected] to be submitted for the examination).

Activity

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 deliverable in ground.

COURSE XIV(20P3EVSP07)-FIELD STUDY

Study of wetland and mangroves ecosystem. On the spot study and make a report.

Semester IV

Course XV(20P4EVSP08) –DISSERTATION: Major Research Project
Course XVI (20P4EVSP09) - FIELD STUDY– Forest Ecosystem
Course XVII (20P4EVSVV) - VIVA VOCE
Course XVIII(20P4EVSIN)- INTERNSHIP

SACRED HEART COLLEGE (AUTONOMOUS), THEVARA,KOCHI

MSc in Environmental Science

SYLLABUS

Semester I

Course I- FUNDAMENTALS OF ENVIRONMENTALSCIENCE
Course II - RESEARCH METHODOLOGY I
Course III- RESEARCH METHODOLOGY II
Course IV -TECHNIQUES IN RESEARCH
Course V- FIELD STUDY-Fresh water Ecosystem
PRACTICAL I

Semester II

Course VI -EARTH AND ATMOSPHERE
Course VII- DISASTER MANAGEMENT
Course VIII REMOTE SENSING AND GIS
Course IX - ENVIRONMENTAL IMPACT ASSESSMENT

Course X-FIELD STUDY – Marine Ecosystem
PRACTICAL II

Semester III

Course XI - ENVIRONMENTAL POLLUTION AND TOXICOLOGY
Course XII - ENVIRONMENTAL MONITORING AND MANAGEMENT
Course XIII - BIODIVERSITY, CONSERVATON AND SOCIAL ISSUES
Course XIV-FIELD STUDY – Wetland and Mangrove Ecosystem
PRACTICAL III
PRACTICAL IV

Semester IV

Course XV -DISSERTATION: Major Research Project
Course XVI- FIELD STUDY – Forest Ecosystem
Course XVII - VIVA VOCE
Course XVII- INTERNSHIP

Abstract of the Programme

	Code	Course	Hours/ Week	Marks		Total Hours	Credit
				Internal	External		
SEMESTEr I		Fundamentals of Environmental Science	5	25	75	90	4
		Research Methodology I	5	25	75	90	4
		Research Methodology II	5	25	75	90	4
		Techniques in Research	5	25	75	90	4
		Practical I- Water and soil Analysis, Computer Applications in Research, and Instrumentation	2.5	25	75	45	2
		Field Study - Fresh water ecosystem	2.5	25	75	45	1
		Total	**25**	**150**	**450**	**450**	**19**

SEMESTER II		Earth and Atmosphere	5	25	75	90	4
		Disaster Management	5	25	75	90	4
		Remote Sensing and GIS	5	25	75	90	4
		Environmental Impact Assessment	5	25	75	90	4
		Practical II- Soil Science, GIS and remote sensing , and Microbiology	2.5	25	75	45	2
		Field Study - Marine Habitat	2.5	25	75	45	1
		Total	**25**	**150**	**450**	**450**	**19**
SEMESTER III		Environmental Pollution and Toxicology	5	25	75	90	4
		Environmental monitoring and Management	5	25	75	90	4
		Biodiversity, Conservation and Social Issues	5	25	75	90	4
		Practical III– Biodiversity and Ecosystem parameters	4	25	75	60	3
		Practical IV – Toxicity analysis of water and toxicology	4	25	75	60	3
		Field study-Wetland and Mangroves ecosystem	2	25	75	60	1
		Total	**25**	**150**	**450**	**450**	**19**
SEMESTER IV		**Dissertation**	-	75	225	300	12
		Field Study- Forest ecosystem	-	50	150	75	4
		Viva voce	-	25	75	-	3
		Internship	-	25	75	75	4
		Total	**25**	**175**	**525**	**450**	**23**
		Grand Total		**625**	**1875**		**80**

PATTERN OF QUESTIONS

Questions shall be set to assess knowledge acquired, standard application of knowledge, application of knowledge in new situations, critical evaluation of knowledge and the ability to synthesize knowledge. The question setter shall ensure that questions covering all skills are set. He/She shall also submit a detailed scheme of evaluation along with the question paper.

A question paper shall be a judicious mix of short answer type, short essay type /problem solving type and long essay type questions.

Pattern of questions for external examination for theory paper without practical.

	Total no. of questions	Number of questions to be answered	Marks of each question	Total marks
	12	10	2	20
	8	5	5	25
	4	2	15	30
TOTAL	**24**	**17**	x	**75**

MODEL QUESTION PAPER

Course I- FUNDAMENTALS OF ENVIRONMENTAL STUDIES

Total Hours: 3 **Total Marks: 75**

Section A Answer any ten (2 marks each)

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

Section B Answer any five (5 marks each)

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

Section B Answer any two (15 marks each)

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

Course II- RESEARCH METHODOLOGY I

Total Hours: 3 **Total Marks: 75**

Section A
Answer any ten (2 marks each)

Explain the following

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

Section B
Answer any five (5 marks each)

13. 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

14. 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

15. 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

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

Section C
Answer any two (15 marks each)

21. (a)Explain the term correlation between two variables? What are the properties of correlation. 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

22. (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 $\chi^2_{0.05} = 3.84$)

23. Differentiate between system software and operating system. What are the functions of OS and give different types of OS available?
24. Explain computer language, its classification and types. Define the language HTML, C and Java with codes.

Course III- RESEARCH METHODOLOGY II

Total Hours: 3 **Total Marks: 75**

Section A Answer any ten (2 marks each)

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. What is cohort study?
8. Comment on animal ethics in research.
9. Write the importance of on line library in research.
10. Comment on sampling errors.
11. Differentiate abstract and synopsis.
12. What is trade mark?

Section B Answer any five (5 marks each)

13. What is hypothesis? Explain different types of hypothesis. And testing of hypothesis.
14. Explain the importance of literature reviewing in research. What are the sources of literature?
15. What are the different presentation techniques? Expalin.
16. What are the different methods of referencing? Write its importance in research publications.

17. What is data collection ? Explain briefly the different techniques in data collection.
18. What is sampling? What are the characteristics of good sample?
19. What is research publication? Explain the different types research publications.
20. Explain briefly the different types of research.

Section C
Answer any two (15 marks each)

21. What is research design? Explain in detail the types of research design.
22. Explain research process.
23. What is the importance of funding in research? Explain project proposal construction.
24.

Course VI- TECHNIQUES IN RESEARCH

Total Hours: 3 **Total Marks: 75**

Section A
Answer any ten (2 marks each)

1. Define paper chromatography.
2. Expalin 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?
11. What is meant by Alizarin preparation?

12. Write the Applications of autoradiography.

Section B
Answer any five (5 marks each)

13. Explain the instrumentation and application of camera lucida. Write the principle and application of electron microscopy.
14. What are the advantages and disadvantages of liquid scintillation counter?
15. Write the principle and working of spectrophotometer.
16. What is RIA? Explain the process in brief.
17. Discuss the cytochemical methods for the detection of lipids.
18. Write notes on Polyacrylamide gel electrophores.
19. Explain the principle of ion exchange chromatography
20.

Section C
Answer any two (15 marks each)

21. Explain GM counter, its working applications.
22. Describe the principle, procedure and applications of HPLC technique.
23. What technique will you choose to separate protein molecule of molecular weight of ten thousand Daltons. Explain the proceduresinvolved in the technique.
24.

Course VI- EARTH AND ATMOSPHERE

Total Hours: 3 **Total Marks: 75**

Section A

Answer any ten (2 marks each)

1. What is weathering?
2. Define climatology.
3. Differentiate weather and climate.
4. What are soil colloids?
5. Differentiate river basin and water sheds.
6. Comment on *El nino* and *La nina.*
7. Explain the characteristics of stratosphere.
8. Define geomorphology.
9. Mention two roles of microbes in soil.
10. What is soil profile? How does it vary?
11. What is gleization?
12. What is microclimate?

Section B

Answer any five (5 marks each)

13. Write notes on urban climatology.
14. Explain the process of soil formation.
15. Explain the effect of climate change on ecosystem.
16. Describe the physicochemical characteristics of estuaries.
17. Explain the structure of atmosphere.
18. What is wetland system? Briefly explain importance and types of wetlands.
19. What are the chemical properties of soil?
20. Give an overview of the water resources of Kerala.

Section C

Answer any two (15 marks each)

21. Explain classification of climate with special reference to Koeppen's and Thornthwaite's shemes.
22. Explain the physicochemical characteristics of lithosphere and hydrosphere.

23. Describe human dimensions and land use in agrosystem, urban ecosystems and range lands.
24. Comment on continental drift theory and evolution of continents. Give different evidences to support this theory.

Course VII- DISASTER MANAGEMENT

Total Hours: 3 **Total Marks: 75**

Section A
Answer any ten (2 marks each)

1. What is disaster management?
2. What is disaster management cycle?
3. What are hazardous materials? Give two examples.
4. What is the role of community workers in disaster management?
5. Enumerate the natural disasters.
6. Name infrastructure in accessing emergency situation.
7. Write notes on the vulnerabilities caused by development.
8. What is disaster preparedness?
9. What is disaster risk reduction (DRR)?
10. What are the disadvantages of the community based approach in disaster education?
11. What are disaster associated health issues?
12. What are the physical socioeconomic impacts of disaster?

Section B
Answer any five (5 marks each)

13. What are the implications of disasters of environment?
14. Explain modern methods of disaster response and recovery.
15. Explain the various methods of disaster education.
16. Discuss the role of media in disaster management.

17. Explain opportunities and regional planning for hazard management.
18. Explain pre-disaster mitigation plan.
19. Evaluate emergency health services in disaster.
20. Enumerate the duties of response personnel in disaster management.

Section C
Answer any two (15 marks each)

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

Course VIII - REMOTE SENSING AND GIS

Total Hours: 3 **Total Marks: 75**

Section A
Answer any ten (2 marks each)

1. Define scales.
2. What are Cadastral maps?
3. What is plannimeter?
4. Write notes on clinometers.
5. What are the types of photogrammetry?
6. What are sensor and platform?
7. Write notes on SPOT.
8. What is digital image processing?
9. What is leveling.
10. What is Abeny level?
11. What is cartography?

12. What is the significance of aerial photography?

Section B
Answer any five (5 marks each)

13. Define and classify survey instruments.
14. Explain scope of remote sensing.
15. Write notes on Indian remote sensing programme.
16. Explain topographical maps and toposheets.
17. What is map conversion? Explain grids and contours.
18. Describe briefly the methods and equipments used in aerial photo interpretation.
19. Write the principle and concepts of remote sensing.
20. Explain the applications of remote sensing in environmental monitoring and disaster management.

Section C
Answer any two (15 marks each)

21. Describe the interaction of EMR with earth's surface helping remote sensing.
22. Explain the various stages of image analyzing.
23. Describe the application of remote sensing with examples.
24. Explain Supervised and unsupervised classification

Course IX– ENVIRONMENTAL IMPACT ASSESSMENT

Total Hours: 3 **Total Marks: 75**

Section A

Answer any ten (2 marks each)

1. What is an Environmental Impact Assessment?
2. Explain the scope and objective of EIA.
3. Comment on Environmental Impact Assessment Notification 2006
4. Write notes on ISO Certification.
5. Explain Environmental Impact statement.
6. What is meant by adhoc method and checklist method?
7. Explain the principles of EIA.
8. Explain matrix method.

9. Explain the fame work of EIA.
10. What types of EIA?
11. What is meant by Cumulative Effects Assessment?
12. Write note EMP.

Section B

Answer any five (5 marks each)

13. Explain the significance of land use and geographic date in an EIA study.
14. Broadly explain any three methods of impact assessment.
15. Explain the need for conducting EIA.
16. With the reference to latest EIA notification which are the stages of the Environmental Clearance process.
17. Discuss the step by step process for conducting EIA.
18. What are the advantage and disadvantage of public participation?
19. Explain the limitation of EIA.
20. Enumerate the silent features of the project activity and environmental parameter relationship.

Section C

Answer any two (15 marks each)

21. Outline the EIA aspect of the following projects (a) Highway projects (b) Industrial project.
22. Explain the prediction and assessment of impact on the following attributes (i) Air, (ii) Water and (iii) Land Ecology.
23. Explain any case study of EIA in detail with an example.
24. Broadly explain each step involved in preparing an EIA report.

Course XI -ENVIRONMENTAL POLLUTION AND TOXICOLOGY

Total Hours: 3 **Total Marks: 75**

Section A
Answer any ten (2 marks each)

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

Section B
Answer any five (5 marks each)

13. Write down the method of assessment of noise pollution. Comment on national and international standards of noise pollution.
14. What is bioremediation? Describe briefly on biodegration of pesticides.
15. What is suspended particulate matter? Write down the methods to its removal and control.
16. What is bioindicator of pollution? Explain with examples.
17. Describe the methods forbiological treatment of air pollution.
18. How do surfactants work to reduce pollution?
19. Write notes on biodegradable plastics.
20. Describe stack sampling technique.

Section C
Answer any two (15 marks each)

21. Describe the biochemical aspects of As, Cd, Pb,Hg,Cu,O3, PAN, Pesicides and MIC.
22. Write an essay on modern techniques and equipments in water quality monitoring.
23. Give an account of four basic operations of sewage treatment plants
24. Explain how nuclear waste is disposed and the risks involved.

Course XII- ENVIRONMENTAL MONITORING AND MANAGEMENT

Total Hours: 3 **Total Marks: 75**

Section A
Answer any ten (2 marks each)

1. What is environmental modeling?
2. What is ecofunds?
3. What is ISO standards for environmental management system?
4. What are the five basic laws of ecology?
5. What is ecorestoration?
6. Write the significance of ecological foot print analysis.
7. What is common property resourse?
8. Write notes on corporate environment responsibility.
9. What is education for sustainability?
10. What is the scope of environmental palnning?
11. What is SEA?
12. What is Ecological economics?

Section B
Answer any five (2 marks each)

13. Describe environmental planning and management of waste land and reclaimed land.
14. Write notes on various environmental modeling.
15. Comment on Environmental auditing and standards responsibility.
16. Comment on the environmental of modern agriculture and green revolution.
17. Write notes on Gandhian environmentalism.

18. Explain the role of state and central pollution control boards.
19. Explain the risk assessment and disaster management programme.
20. How does industrial revolution affect environment and development?

Section C
Answer any two (15 marks each)

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

Course XIII- BIODIVERSITY, CONSERVATON AND SOCIAL ISSUES

Total Hours: 3 **Total Marks: 75**

Section A

Answer any ten (2 marks each)

1. What are biological hot spots?
2. What is habitat loss?
3. What are endemic and cosmopolitan animals?
4. Differentiate endangered and threatened animals.
5. What are biodiversity indices?
6. What are key stone species?
7. What is CBD?
8. Comment on peoples biodiversity register (PBR).
9. What is ecotourism? Why is it called so?
10. Differentiate reclamation restoration.
11. Why is India called megadiversity nation?
12. What are drivers of biodiversity loss?

Section B
Answer any five (5 marks each)

13. Comment on legal measures in biodiversity control.
14. Explain ex-situ conservation of biodiversity and its advantages.
15. Comment on the ethics of environmental conservation practices.
16. Write notes on urban forestry programme.
17. Write a short note on Participatory Forest Management.
18. World war III will be fought over water. Discuss the statement.
19. Write down the objectives of environmental audit.
20. Explain resource economics.

Section C
Answer any two (15 marks each)

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