KANNUR UNIVERSITY

M.Sc. ENVIRONMENTAL SCIENCE

SYLLABUS & SCHEME

(*Under Choice Based Credit & Semester System)*

2020 admission onwards

DEAPARTMENT OF ENVIRONMENTAL STUDIES
Kannur University
Mangattuparamba Campus,

KANNUR UNIVERSITY

Modified Regulations for Post Graduate Programmes under Choice Based Credit Semester System in the Departments / Schools Effective from 2020 Admission.

1. SCOPE

1.1. These Regulations shall apply to the Post Graduate programme in Environmental Science conducted by the Departments of Environmental Studies of Kannur University.

1.2. Choice based Credit Semester System presupposes academic autonomy, cafeteria approach in academic environment, semester system, course credits, alphabetical grading and interdepartmental academic collaboration. There shall be a Department Council consisting of all the Permanent/ Contract teachers of the Department. The Head of Department shall be responsible for admission to all the programmes offered by the Department including conduct of entrance tests, verification of records, admission and evaluation. The Department Council will deliberate on courses and specify the distribution of credits semester wise and course wise. For each course it will specify the number of credits for lectures, tutorials, practicals, etc.

1.3. These Regulations shall come into effect from 2020 admission onwards and supersede all other Regulations unless otherwise prescribed.

2. DEFINITIONS.

2.1. Curriculum Committee means the Committee constituted by the Vice-Chancellor under these Regulations to monitor the running of Choice based Credit Semester System. One of the senior Professors shall be the Convener of the Curriculum Committee co-ordinating the various academic activities.

2.2. Department/Centre/School means Department/Centre/School instituted in the University as per Kannur University Statutes.

2.3. **Academic Programme** means an entire course of study comprising its programme structure, course details, evaluation schemes etc. designed to be taught and evaluated in a teaching Department/Centre or jointly under more than one such Department/ Centre.

2.4. **Course** means a segment of a Programme limited to one semester in a subject.

2.5. **Programme Structure** means a list of courses (Core, Elective, Open Elective) that makes up an Academic Programme, specifying the syllabus, Credits, hours of teaching, evaluation and examination schemes, minimum number of credits required for successful completion of the programme etc. prepared in conformity with University Rules,

2.6. **Core Course** means a course that a student admitted to a particular programme must successfully complete to receive the degree and which cannot be substituted by any other course.

2.7. **Elective Course** means an optional course to be selected by a student out of such courses offered in the same or any other Department/Centre.

2.8. **Open Elective** means an elective course which is available for students of all programmes including students of same department. Students of other Department will opt these courses subject to fulfilling of eligibility of criteria as laid down by the Department offering the course.

2.9. **Credit** means the value assigned to a course which indicates the level of instruction; One-hour lecture per week equals 1 Credit, 2 hours practical class per week equals 1 credit. Credit for a practical could be proposed as part of a course or as a separate practical course.

2.10. **SGPA** means Semester Grade Point Average calculated for individual semester.

2.11. **CGPA** is Cumulative Grade Points Average calculated for all courses completed by the students in the last year of the course by clubbing together SGPA of four semesters.

3. ELIGIBILITY FOR ADMISSION

B.Sc. Degree in any of the subjects (Botany/ Zoology/ Chemistry/ Physics/Environmental Science/ Environmental Management/Microbiology/Biotechnology/Biochemistry/ Agriculture/ Horticulture/ Forestry/ any branch of Life Science/Geology/ Geography) with 50% marks or equivalent grade in core course Or an Engineering Degree in Civil/ Mechanical/Chemical/ Environmental branch with an aggregate of 55% marks in the optional.

4. ADMISSION

4.1. As per the Regulations prescribed by the University Departments for each Programme from time to time.

5. REGISTRATION

5.1. The Department shall have Permanent/ Contract faculty members as Student Advisors. Each student at the time of admission will be assigned to an advisor by the Department Council. He/she will advise the student about the academic Programme and counsel on the choice of courses depending on the student's academic background and objective. The student will then register for the courses she/he plans to take for the semester before the classes begin.

5.2. The Department offering any course shall prescribe the maximum number of students that can be admitted taking into consideration the facilities available. The Department Council will be the authority to fix the optional that can be offered for a Programme while ensuring that sufficient choice is given to each student in all semesters other than Semester 1..Elective courses for the next semester will be announced within 10 days of the end of the previous semester.

5.3 The student has to complete the prescribed prerequisites for the course before registration. The student within a maximum of 10 working days after the commencement of the classes can change the Optional Course with the consent of HoD. In consultation with the Advisor.

5.4. The Department shall make available to all students a bulletin listing all the courses offered in every Semester specifying the Credits, list of topics the course intends to cover, the name of the instructor, the timetable and examination schedule. This will be made available in the last week of each semester after it is approved by the Department Council, the Dean and the VC.

6. COURSE STRUCTURE

6.1. Three kinds of Courses are offered - Core, Elective and Open Elective Courses (including MOOC courses). Core Courses are offered by the Department conducting the Programme. Elective / Open Elective Courses are offered either by the Department conducting the Programme or by any other Department of the University or via MOOC**.**

6.2. Elective Courses are offered by the Department concerned. Open Elective Courses will be offered by other Departments/Centres/institutions as options. Open Courses can be opted in any of the Semesters during the entire Programme other than the first semester. The maximum students that can be admitted to an Open Course is limited to forty (40) except for MOOC courses.

6.3. Every Course offered by the University Department is identified by a unique course code.

Illustration:

MAENG01C02
Where first two letters denote Programme name (MA for Master of Arts, MS for Master of Science, MB for Master of Business Administration, MC for Master of Computer Applications, MJ for Master of Journalism, DP for Post graduate Diploma)

Next three letters denote subject. This is followed by semester number such s 01,02,03, 04. After semester number single alphabet stands for Core (C), Elective (E) and Open Elective course (O). The last two digits denote paper number. (English Language)
C stands for Core Course.
1 is the semester number (i.e.1/2/3/4)
01 is the serial number of the course in each the semester
MEL E I 01 - E stands for elective, that is, from within the discipline.

MEL O I01 - O stands for Open Elective.
Any course including a core course of one Department can be offered as an Open Elective to students of other Departments.

6.4. The minimum duration for completion of a two year PG Programme in Environmental Science subject is four Semesters. Example: The maximum period for completion is four years from the date of registration for a two year Programme, two years from the date of registration for a one year Programme.

6.5 No regular student shall register for more than 24 credits and less than 16 credits per Semester, subject to the provisions of the Programme concerned.

6.6 The total credits required for the successful completion of a four semester Programme will be between 72 to 80. Maximum credits assigned to Core Courses for non- science subjects should not exceed 50 percent of total required credits. For science subjects core credits should not exceed 70 per cent.

6.7. The total credits required for the successful completion of M.B.A/MCA/Education/Physical Education/ Law Programmes shall be governed by norms laid by regulating external bodies such as the Bar Council, AICTE, NCTE, etc.

6.8 The Department Council shall design Core, Elective and Open Courses including the detailed syllabus for each Programme offered by the Department. The Department Council shall have the freedom to introduce new courses and/or to modify/redesign existing Courses and replace any existing Course with a new Course to facilitate better exposure and training for the students, with the approval of the Faculty Council and the Academic Council.

7. EVALUATION

7.1. Evaluation of the students shall be done by the Faculty member who teaches the Course on the basis of Continuous Evaluation and an End Semester Examination. The proportion of the distribution of marks among End Semester Examination and Continuous Evaluation shall be 60:40. 10 percent of the scripts, subject to a minimum of 5 scripts per Course will be valued by an External Examiner. If there is an average difference of more than 15 per cent in the marks awarded by the Internal and External Examiner, the scripts will be valued by one Internal and one External examiner together.

7.2. Continuous Evaluation includes Assignments, Seminars, periodic written examinations etc.

7.3. The allocation of marks for each component under Continuous Evaluation shall be in the following proportions :

Component	Core/Elective/open elective course	Practical
Mid Semester Test1 or Tutorial with viva	20 (20%)	Record-20 (50%)
Mid-semester Test (2) or Tutorial with viva	20 (20%)	10 + 10 = 20 (50%)
Total Internal Marks	40 (40%)	40

Mode of assessment i.e. Administering of Test or Tutorial will be decided by individual departments.

7.5 A copy of all records of Continuous Evaluation shall be maintained in electronic format in the Department and shall be made available for verification by the University.

7.6 Performance of each student in an assessment shall be intimated to him/her within two weeks of the conduct of test/ submission of assignment/ report/ tutorial.

8 CONDUCT OF THE END SEMESTER EXAMINATIONS

8.1 The End Semester Examinations of each semester will be conducted by the Controller of Examinations. It will be the responsibility of the Department to maintain a sufficient balance of different levels of questions in the Question Bank. The tabulation registers of each Semester shall be prepared and maintained by the Examination Branch. There shall be a minimum of one external examiner to ensure transparency in the conduct of examinations. The external examiners will be faculty members appointed from other Colleges/Departments of this University or from other Universities. The duration of End Semester Examination shall be specified in the curriculum.

8.2 The Board of Examiners will function as the Pass Board and will be called the Subject Examination Board with the Head of the Department/ or a nominee of the VC when there is no University Department offering that Programme as its Chair.

9 ATTENDANCE

9.1 The minimum attendance required for each Course shall be 60% of the total number of classes conducted for that semester. Those who secure the minimum attendance in a semester alone will be allowed to register for the End Semester Examination. Condonation of attendance to a maximum of 10 days in a Semester subject to a maximum of two spells within a Programme will be granted by the Vice-Chancellor. Benefit of Condonation of attendance will be granted to the students on health grounds, for participating in University Union activities, meetings of the University Bodies and participation in extra-curricular activities on production of genuine supporting documents with the recommendation of the Head of the Department concerned . A student who is not eligible for Condonation shall repeat the Course along with the subsequent batch.

10 GRADING

10.1 An alphabetical Grading System shall be adopted for the assessment of a student's performance in a Course. The grade is based on a 6 point scale. The following table gives the range of marks %, grade points and alphabetical grade.

Range of Marks%	Grade Points	Alphabetical Grade
90-100	9	A+
80-89	8	A
70-79	7	B+
60-69	6	B
50-59	5	C
Below 50	0	F

10.2 A minimum of grade point 5 (Grade C) is needed for the successful completion of a Course. A student who has failed in a Course can reappear for the End Semester Examination of the same Course along with the next batch without taking re-admission or choose another Course in the subsequent Semesters of the same programmed to acquire the minimum credits needed for the completion of the Programmed. There shall not be provision for improvement of CE and ESE. A student can sit the ESE again if she/he has

successfully completed the CE requirements in a subsequent semester subject to the maximum durations permitted.

10.3 Performance of a student at the end of each Semester is indicated by the Semester Grade Point Average (SGPA) and is calculated by taking the weighted average of grade points of the Courses successfully completed. Following formula is used for the calculation. The average will be rounded off to two decimal places.

$$\text{CGPA} = \frac{\textit{Sum of (grade points in a course mutliplied by its credit)}}{\textit{Sum of credits of courses}}$$

10.4 At the end of the Programmed, the overall performance of a student is indicated by the Cumulative Grade Point Average (CGPA) and is calculated using the same formula given above.

10.5 Empirical formula for calculating the percentage of marks will be

% Marks = (CGPA x 10) + 5

10.6 Based on the CGPA overall letter grade of the student and classification shall be in the following way.

CGPA	Overall Letter Grade	Classification
8.5 and above	A+	First Class with Distinction
7.5 and above but less than 8.5	A	
6.5 and above but less than 7.5	B+	First Class
5.5 and above but less than 6.5	B	
5 and above but less than 5.5	C	Second Class

10.7 Appearance for Continuous Evaluation (CE) and End Semester Evaluation (ESE) are compulsory and no Grade shall be awarded to a candidate if he/she is absent for CE/ESE or both.

10.8 A student who fails to complete the Programme/Semester can repeat the full Programme / Semester once, if the Department Council permits to do so. Absence in an examination will be marked zero.

10.9 No student shall be allowed to take more than eight/twelve consecutive Semesters for completing a four/six Semester Programme from the date of enrolment.

11 GRADE CARD

11.1 The Controller of Examinations shall issue the grade cards of all semesters and the consolidated grade card and certificates on completion of the programme, based on the details submitted by the Heads of the Departments concerned. This will be in digital form only.

11.2 The Grade Card shall contain the following

(a) Title of the Courses taken as Core, Elective & Open Elective .

b) The credits associated with and grades awarded for each Course.

c) The number of credits (Core /Elective / Open) separately earned by the student and the SGPA.

d) The total credits (Core / Elective / Open) separately earned by a student till that Semester.

11.3 The consolidated grade statement issued on completion of the Programme shall contain the name of the Programme, the Department/School offering the Programme, the title of the Courses taken, the credits associated with each Course, grades awarded, the total credits (Core /Elective/Open) separately earned by the student, the CGPA and the class in which the student is placed. Rank Certificates will be issued based on CGPA calculated at the end of the last semester of that Programme.

12 DEPARTMENT COUNCIL

12.1 All the Permanent and Contract teachers of the Department shall be the members of the Department Council.

12.2 The Department Council subject to these Regulations shall monitor every academic programme conducted in the Department.

12.3 Department Council shall prescribe the mode of conduct of courses, conduct of examinations and evaluation of the students.

13 CURRICULUM COMMITTEE

13.1 There shall be a Curriculum Committee constituted by the Vice Chancellor to monitor and co-ordinate the working of the Choice based Credit Semester System.

13.2 A senior professor nominated by the Vice Chancellor shall be the convener of the Curriculum Committee.

13.3 The Committee shall consist of:

a) Vice-Chancellor or person nominated by VC (Chairperson)

b) The Convener of the Curriculum Committee (A professor of the University nominated by the Vice-Chancellor)

c) The Registrar –Secretary

d) The Controller of Examinations

e) Deans

f) The Heads of Departments

13.4 The term of office of the Committee shall be two years, but the Committee once constituted shall continue in office until a reconstituted committee assumes office.

14 ACADEMIC GRIEVANCE REDRESSAL MECHANISM

14.1 Committees will be constituted at the Department and University levels to look into the written complaints regarding Continuous Evaluation (CE). Department Level Committee (DLC) will consist of the Department Council, and elected student representatives who is currently a student of that Programme of study. There will be one student representative for the post graduate programmes and one student representative for the doctoral programme.

14.2 University Level

14.3 Committee (ULC) will consist of the Convenor of the Curriculum Committee, the concerned Dean, and the concerned Head of the Department and a nominee of the Students' Union.

14.4 Department Level Committee will be presided over by the concerned Dean and include the concerned HOD, a senior teacher of the concerned Department and an elected representative of students belonging to the concerned class. Complaints will have to be submitted to the Department concerned within two weeks of publication of results of Continuous Evaluation (CE) and disposed of within two weeks of receipt of complaint. Appeals to University Level Committee should be made within two weeks of the

decisions taken by Department level Committee and disposed of within two weeks of the receipt of the complaint.

14.5 Complaints unsolved by the University level Grievance Committee shall be placed before the Vice Chancellor.

15 TRANSITORY PROVISION

15.1 Notwithstanding anything contained in these regulations, the Vice Chancellor shall for a period of one year (may be revised) from the date of coming into force of these regulations, have the power to provide by order that these regulations shall be applied to any Programme with such modifications as may be necessary.

16 REPEAL

16.1 The Regulations now in force in so far as they are applicable to programmes offered in the University Departments and to the extent they are inconsistent with these regulations are hereby repealed. In the case of any inconsistency between the implemented regulations of Choice based Credit Semester System and its application to any independent programme offered in a University Department, the former shall prevail.

Post Graduate Programme in Environmental Science

The M.Sc. course in Environmental Science is a multidisciplinary post-graduate programme in the frontier area of Environmental Sciences.

DURATION: 2 Years (4 semesters)

INTAKE: 21 Nos. (17 Merit + 3 Payment/N.R.I quota + 1- Lakshadweep)

OBJECTIVES OF THE COURSE:

1. To provide an integrated knowledge of diverse disciplines and training various theoretical and applied aspects of environmental science and management leading to Masters Degree.

2. To establish advance facilities and promote research and technology development to solve environmental issues and problems.

3. To undertake consultancy project in environment, disaster management, Environmental impact assessment (EIA), Remote Sensing (RS), Geographical Information System (GIS), Forest and Wild Life Management.

4. To establish good networking of academic collaboration with national and international organizations, institutions, industries and exchange of faculty and students.

5. To offer environmental information, education and communication services and offer.

6. Extension activities like environmental awareness programmes for school, college students and public.

7. The course contents will be abreast with the latest development in the area of study. The students have to do a full time institutional or industrial training/ project work for Six months, enabling them to have valuable hands on experience. The theory, practical, project work and training activities of this programmed prepare the student to acquire knowledge, skills and expertise on specified subjects along with the integrated knowledge of all relevant disciplines.

ELIGIBILITIES:

- B.Sc. Degree in any of the subjects (Environmental Science / Environmental Management Botany/Zoology/Chemistry/Physics/ Microbiology / Biotechnology / Biochemistry / Agriculture/ Horticulture/ Forestry/ any branch of Life Science/ Geology/ Geography) with 50% marks or an Equivalent examination or an engineering degree in Civil/ Mechanical/ Chemical/ Environmental branch with an aggregate of 55% marks in the optional.

ADMISSION:

- The selection of the candidate is mainly based on the marks secured in the Degree Course/Admission test.
- The admission test will cover environmental science at the undergraduate level.
- There are three NRI/Payment seat for students whose parents are NRI's. The students wish to avail NRI seat need to apply separately.

COURSE DETAILS:

A student must register for the required number of courses at the beginning of each semester. No students shall register for more than 24 credits and less than 16 credits per semester.

A total of 80 credits shall be the minimum for successful completion of the course in which a minimum of 60 credits for core course and 12 credits for electives are mandatory. Those who secure only minimum credit for core/ elective subjects has to supplement the deficiency for obtaining the minimum total credits required for successful completion of the programmed from the other divisions.

EVALUATION:

The faculty member who teaches the course shall do evaluation of the students for each course on the basis of Continuous Evaluation and End Semester Examination shall be evaluated by External Examiners. The proportion of the distribution of marks among the continuous evaluation and end semester examination shall be **40:60**.

Continuous Evaluation includes assignments, seminars, written examination and viva voce for each course. Weightage to the components of continuous evaluation shall be given

for all theory papers of the course as follows:

Components of CE	Minimum Number	Weightage	Marks	Practical Weightage	Marks
Test paper	2	40	16	50	20
Assignments	1	20	08	--	--
Seminar	1	20	08		--
Viva Voce	1	20	08		
Record	--	--	--	50	20

Test Paper: For each course there shall be at least two class tests during a semester.

Assignments: Each student shall be required to do one assignment for each course.

Seminar: Students are required to present a seminar on a selected topic in each paper. The evaluation of the seminar shall be done by the concerned teacher handling the course.

Viva Voce – End semester theory Viva Voce examination will be conducted for each paper before the commencement of public examination.

Attendance: Minimum attendance required for each paper shall be 75% of the total number of classes conducted for that semester. Those who secured the minimum requirement of attendance only be allowed to register/appear for End Semester Examination.

Condonation of attendance to a maximum of 10 days in a semester subject to a maximum of two times during the whole period of the PG programmed may be granted by the university as per university rules.

Conduct of Examination:

The vice chancellor will approve the panel of examiners submitted by the Head of the Department. All the teachers of the Department will be the members of the Board of examiners with Head of the Department as the Chairperson. There shall be a minimum of two external examiners. The panel approved by the Vice-Chancellor will be entrusted with the setting of question papers, conduct and evaluation of examination.

Research Project:

The students have to complete a minor research project during IV Semester in collaboration with any of the authorized research institutions located within or outside the state or within the own Department.

Field Study:

Students are required to go for field study in research institutions, wildlife sanctuaries, different ecosystems, polluted areas or ecotourism sites and submit a report for the same.

In the case of any inconsistency between the implemented regulations of Choice Based Credit Semester System and its application to PG Programme in Environmental Studies offered in the University Department, the former shall prevailed.

SCHEME

FIRST SEMESTER								
Course Code	**Title of Paper**	**Contact Hours/Week**			**Marks**			
		L	**T/S**	**P**	**ESE**	**CE**	**Total**	**Credits**
Core Courses								
MSEVS01C01	Fundamentals of Ecology and Environment	4			60	40	100	4
MSEVS01C02	Environmental Pollution	4			60	40	100	4
MSEVS01C03	Environmental Chemistry	4			60	40	100	4
MSEVS01P01	Practical in Environmental Biology			8	60	40	100	4
Elective Courses								
MSEVS01E01 or MSEVS01E02	Biodiversity conservation or Green Technology	4	1		60	40	100	4
	Total				**300**	**200**	**500**	**20**
SECOND SEMESTER								
		Contact Hours/Week			**Marks**			
Course Code	**Title of Paper**	**L**	**T/S**	**P**	**ESE**	**CE**	**Total**	**Credits**
Core Courses								
MSEVS02C04	Environmental Engineering	4			60	40	100	4
MSEVS02C05	Environment of Physical Systems	4			60	40	100	4
MSEVS02C06	Environmental Toxicology, occupational health and safety	4			60	40	100	4
MSEVS02P02	Practical in Environmental Chemistry			8	60	40	100	4
MSEVS02F01	Field Work			4	60	40	100	2
Elective Courses								
MSEVS02E03 or MSEVS02E04	Environment and Climate change or Hydrology and Water Management	4	1		60	40	100	4
	Total				360	240	600	22
THIRD SEMESTER								
		Contact Hours/Week			**Marks**			
Course Code	**Title of Paper**	**L**	**T/S**	**P**	**ESE**	**CE**	**Total**	**Credits**
Core Courses								

MSEVS03C07	EIA & Environmental Management	4			60	40	100	4
MSEVS03C08	Bio statistics, Research Methods and Computer Application	4			60	40	100	3
MSEVS03C09	Disaster management	4			60	40	100	3
MSEVS03P03	Practical in Environmental Geology			8	60	40	100	4
Elective Courses								
MSEVS03E05 or MSEVS03E06	Natural Resource and their conservation or Application of Remote sensing and GIS	4			60	40	100	4
MSEVS03E07 or MSEVS03E08	Nano Technology and Environmental Applications or Environmental Microbiology and Biotechnology	4			60	40	100	4
	Total				360	240	600	22
FOURTH SEMESTER								
		Contact Hours/Week			**Marks**			
Course Code	**Title of Paper**	**L**	**T/S**	**P**	**ESE**	**CE**	**Total**	**Credits**
Core Courses								
MSEVS04P04	Project work			18	120	80	200	8
Elective Courses								
MSEVS04E09 or MSEVS04E10	Industrial Process and Waste Management or Sustainable Development	3	1		60	40	100	3
MSEVS04E11 or MSEVS04E12	General Viva or Industry Visit	3			60	40	100	2
OPEN ELECTIVE FOR THE STUDENTS OF OTHER PROGRAMMES								
MSEVS04O01	Fundamentals of Environmental Science	3	1		60	40	100	3
Total					300	200	500	16
Grand Total for all Semesters					**1320**	**880**	**2200**	**80**

Note: - ENS - Environmental Science, C - Core paper, E - Elective Paper, L - Lecture, T - Tutorial, S-Seminar and P – Practical/Project and F – Field Work

KANNUR UNIVERSITY

DEPARTMENT OF ENVIRONMENTAL STUDIES

VISION

To provide an outstanding and innovative environmental education and research

MISSION

To develop technologies which are environmental friendly, economically sound and community need based for sustainable development.

PROGRAMME EDUCATIONAL OBJECTIVES

PEO 1 : Demonstrate ability to adapt to a rapidly changing environment by having learned and applied new skills and new competencies**.**

PEO 2 : Acquire the spirit of compassion, kinship and commitment for National Harmony

PEO 3 : Progressively adopt and learn continuously through ICT modules

PEO 4 : Inculcate the environmental and human values in students

PEO 5 : Continue and strengthen the environmental protection measures through technological innovations and activities

PROGRAMME OUTCOMES

PO 1 : Become knowledgeable in the subject of Environmental Science and apply the principles of the same to the needs of the Employer/Institution /own Business or Enterprise.

PO 2 : Gain Analytical skills in the field/area of Environmental Science

PO 3 : Understand and appreciate professional ethics, community living and Nation Building initiatives

PO 4 : Competency in applying acquired knowledge and skills to manage Problems associated with environment

PO 5 : Apply decision making methodologies to evaluate solutions for Efficiency, effectiveness and environmental sustainability

PO 6 : Analyze issues and problems of local, national and international Concerns pertain to environment domain and act aptly

PO 7 : Apply effective, creative and innovative solutions, both independently and cooperatively, to present and future environmental problems

PO 8 : Initiative to create social consciousness on various environmental Problems

PROGRAMME SPECIFIC OUTCOME

PSO 1 : Apply the knowledge of **interdisciplinary sciences** in the domain of Environmental Science

PSO 2 : Solve the complex problems in the field of **Environmental Science** with an understanding of the societal, legal and cultural impacts of the solution

PSO 3 : Initiate technocratic, ecofriendly and sustainable developments

PSO 4 : Form a part of member in a team with right attitudes

FIRST SEMESTER MSc. ENVIRONMENTAL SCIENCE PROGRAMME

CORE COURSE

Course Code & Title	**MSEVS01C01 - FUNDAMENTALS OF ECOLOGY AND ENVIRONMENT**		
Class	M.Sc. Environmental Science	**Semester**	I
Course Objectives	The Course aims • To know about various ecosystems • To understand the dependency between biological and non-biological components • To study the interaction between species • To explore the role of ecological communities and its interaction • To create awareness and importance of biological diversity.		
	SYLLABUS		

Modules	Content	No. of Hours
Module I: Fundamentals and Components of the Environment	**Definition**, **Scope and Importance of Environmental Science**, Definition; Multidisciplinary nature of the environmental Science; Scope and importance; Need of Environmental awareness, Ecology, Interrelationship of ecology with other disciplines. Introduction to global environmental problems. **a).The atmosphere or the air:** Layers of Atmosphere , Composition of air; importance of atmosphere, meteorological conditions and air circulation. **b).The hydrosphere or water:** Importance of water, distribution of fresh water at global, national and state level. Hydrological cycle. **c).Lithosphere or the rock and the soil:** Elementary composition of rocks in the earth crust. Types of rocks; Process of soil formation: Physical weathering, Chemical and biological weathering of rocks; Role of soil in shaping the biosphere	20
Module II: Environmental Factors and Ecological adaptations	**a) Climatic Factors** - Light, Temperature of Air (atmospheric temperature), Rainfall (precipitation), Humidity of air, atmosphere (gases and wind), fire. **b) Topographic Factors:** height of mountains, direction of mountains and valleys, steepness of slope and exposure of slope **c) Edaphic factors:** Soil-soil formation, soil profile, soil erosion, soil conservation **d) Biotic factors:** Intraspecific interactions; Interspecific interactions: Neutralism, Commensalism, Mutualism, proto co-operation, Parasitism, Predation; **Ecological adaptations of plants** (Hydrophytes, mesophytes, xerophytes, and halophytes) **and animals** (aquatic conditions-	20

	hydrocoles; amphibious conditions or sec. hydrocoles) and **Terrestrial** (mesocoles and xerocoles)	
Module III: Ecosystem and its type	**Definition; Components of ecosystem;** Abiotic components: Light, Temperature, Pressure, Water, Wind, Soil; Biotic components: Energy flow in an ecosystem: Primary production, Secondary production; Food chain: Grazing food chain, Detritus food chain; Ecological pyramids: Pyramid of number, Pyramid of biomass, Pyramid of energy; Food web; Ecological indicators. Biogeochemical cycles : a) Gaseous cycles: Oxygen cycle, Carbon cycle and Nitrogen cycle. b) Sedimentary cycles: Phosphorus cycle, Sulphur cycle. **Terrestrial Ecosystem-**Forest,grass land,arid, Crop land, Wet land- Ponds, Lakes, Rivers, Oceans, Estuaries	20
Module IV: Population Ecology and Community Ecology & Applied Ecology	**Population characteristics-** Population growth and its dynamics; natality, mortality, growth patterns; Age distribution, Malthus theory; Community structure, Species diversity, Ecological dominance, Ecotone, Edge effect, Ecological equivalent, Succession and Climax **Vegetation Analysis** – Quadrat, Transect and Point quadrate method of saplings - Determination, of quadrat size and quadrat number (Wiegerts's and Hendricks Methods) **Species diversity measures** – Species richness – Species heterogeneity (Simpson' Indices, Shannon – Wiener Indices) Girth class and Height class measurement. **Museology** – Plants and Animals – Collection and Preservation. Major Herbaria's and Museums. Taxonomy and Biosystematics Biomass and Productivity estimation techniques.	20

Reference Books:

1. Fundamentals of Ecology Eugene P. Odum, (Natraj Publishers, Dehradun.)
2. Principles of Ecology P. S. Verma, V. K. Agarwal (S. Chand and Co. New Delhi)
3. Environmental Biology P. D. sharma (Rastogi Publications, Meerut)
4. Ecology and Environment P. D. sharma (Rastogi Publications, Meerut)
5. Principles of Environmental Biology P. K. G. Nair (Himalaya Publishing House, New Delhi)
6. Environmental Biology M. P. Arora (Himalaya Publishing House, New Delhi)
7. Environmental Science Enger Smith, Smith, W. M. C.Brown (Company Publishing)
8. Principles of Soil Science Watt K. E. F. (1973), (McGraw Hill Book Company, New Delhi)
9. Introduction to Environmental Studies Turk & Turk
10. Ecology and Field Biology Robert Leo Smith (Harper Collins college publication)

11. General Ecology H. D. Kumar (Vikas Publishing house, New Delhi)
12. Elements of Ecology Brijgopal, N. Bharadwaj (Vikas Publishing house, New Delhi)
13. Fundamentals of Environmental Science G. S. Dahliwal,G. S. Sangha P. K.ralhan (Kalyani Publishers, New Delhi)
14. Environmental Ecology Bill Freedman (Academic Press, New York)
15. Concepts of Ecology N. Arumugam (Saras Publication, Kottar, Dist. Kanyakumari)
16. Plant Ecology P. L. Kochhar
17. A text book of Environmental Studies.D.K.Asthana,Meera Asthana (S.Chand&Co.)
18. Essential Environmental Studies.S.P.Misra,S.N.Pandey,(Ane Books Pvt.Ltd,Chennai)
19. Environmental Education – A Conceptual Analysis. P.Kelu,university of Calicut publication
20. Environmental Science. V.K.Ahluwalia,Sunita Malhotra(Ane Books Pvt.Ltd,Chennai.

Course Outcomes	**On completion of the course, students should be able to**
	CO1: Understand various ecosystem's structure, function and characteristics **CO2:** Acquired knowledge on species inter and intraspecies interaction **CO3:** Know Charactersation of community and its dominance as well as co-existing with other community **CO4**: Realise the importance of protection and conservation of biodiversity **CO5:** Differentiate various habitats and its salient feature

CORE COURSE

Course Code & Title	MSEVS01C02 - ENVIRONMENTAL POLLUTION		
Class	M.Sc. Environmental Science	**Semester**	I
Course Objectives	The Course aims • To gain knowledge on atmosphere and its composition • To understand the type and sources of air pollution • To study the air quality monitoring methods • To acquire knowledge on air pollution control measures • To know various polices and laws intended for air pollution prevention and control.		

SYLLABUS

Modules	Content	No. of Hours
Module I : Environmental Pollution - Air pollution-Sources, effects and control measures.	**Introduction to Environment - Environmental factors** - Segments of Environment - Man- Environment relationship, anthropogenic effects on the natural environment, Environmental degradation. Environmental pollution – Definition, causes of environmental pollution – population, urbanization, industrialization, resource consumption, deforestation, agriculture and transportation. **Definition - Air pollutants - Sources of air pollutants** - Types of air pollutants - primary and secondary air pollutant- Gaseous, solid and biopollutants. -Movements and reactions of pollutants in the atmosphere. -Reactions of pollutants in the air to form smog and PAN. -Acid rain , ozone depletion, green house effect and global warming. - Factors affecting air pollutants and their mode of actions: climate, temperature, humidity and wind currents Impacts of air pollution on - Human being - Animals - Plants - Materials, buildings and climate Control measures of Air pollution.	25
Module II: Water pollution - Sources, effects and control measures	Definition and significance Types of water pollution - Point and non point source of water pollution- surface and ground water pollution. Sources of water pollution - Domestic, Industrial , Agricultural and Natural sources Impact of water pollution on human being, animals, plants and environment. Control measures of water pollution.	15

Module III: Soil / Land pollution - Sources, effects and control measures, Noise pollution	**Sources of soil pollution** Natural sources - Natural calamities. Anthropogenic sources - Agricultural practices, Industrial and Municipal discharges - Municipal solid waste dumping - Land fill leachates - Plastics - Radioactive leakage - Mining activities and Electronic wastes. Impact of soil / land pollution - Soil fertility - Soil micro organisms - Effects on plants and animals. Control measures. **Definition and concept of Noise pollution**. Sources of noise pollution - Indoor and outdoor noise pollution Natural and Anthropogenic sources. Impact of noise pollution - Impacts on palnts and animals.	20
Module IV: Radioactive Pollution, Thermal and Marine Pollution	**Radioactive pollution -** Definition - Scope of the study. Types and sources of Radioactivity Natural and manmade radioactivity Radioactive pollution episodes Precautions and control measures. **Thermal and nuclear power plants as source of thermal pollution.** Impacts of thermal pollution on aquatic fauna and flora. Controlling measures of Thermal pollution. **Marine pollution** - Definition Sources of Marine pollution - Natural and Anthropogenic sources Control measures of marine pollution. Pollution status of coastal and ocean waters. Oil pollution - Sources - effects and control measures.	20
References	**Reference:** 1. B.K Sharma – Environmental chemistry –Goel publication. 2. A.K. De - Environmental Chemistry 3. Tyagi and Mehra - Environmental Chemistry 4. Trivedi P.R & Raj Gurdeo - Environmental water and soil Analysis, Akasdeep Pub. House, New Delhi. 5. V.K.Alhuwalia, Environmental Chemistry Ahe books, India 6. S.P. Misra and S.N. Pandey – Essential Environmental studies-Ane books Pvt. Ltd. 7. Abbasi.S.A. 1998. Environmental pollution and its control. Cogent International, Pondichery. 8. Gosh. Environmental Pollution 9. Rajvaidya. Environmental pollution control. 10. Agarwal. Water pollution.	

	11. Salpeker. Air Pollution. 12. Agarwal. Noise Pollution. 13. Khopkar. Environmental Pollution. 14. Pepper. Environmental and pollution science.\ 15. Misra. Assessment of water pollution 16. J.N.B.Bell . Air Pollution and Plant life. 17. Daneil.A.Vallero. Environmental contamination Assessment and control 18. A.K.tripathi, S.N.Pandey, Water Pollution 19. A.K.Srivastheva, Air Pollution
Course Outcomes	**On completion of the course, students should be able to** **CO1:** Gain knowledge on atmospheric layer and its importance **CO2:** Acquired the details about source, types and impacts of air pollution **CO3:** Know the sampling and analysis of the air pollutants of ambient environment **CO4:** Understand the various air pollution control measures **CO5:** Aware of various polices related to air pollution prevention and control

CORE COURSE

Course Code & Title	MSEVS01C03 - ENVIRONMENTAL CHEMISTRY		
Class	I M.Sc. Environmental Science	**Semester**	I
Course Objectives	The Course aims • To study the basics of environmental chemistry, chemical reactions involved in water and electro kinetic properties. • To understand the meaning of environmental chemistry • To define atmospheric pollution, list reasons for global warming. greenhouse effect and acid rain • To describe causes of all pollution		

SYLLABUS

Modules	Content	No. of Hours
Module I : Fundamentals of Chemistry	1.1. Concepts and scope of environmental chemistry 1.2. Principles of Bio-geochemical cycle N,C, P,S, Water 1.3. Stochiometry 1.4. Chemical Kinetics- Control of reactions, First, second and zero order reactions 1.5. Chemical Equilibria 1.6. Thermodynamics -Energy, Entropy, Enthalpy, Gibb's energy and Chemical potential 1.7. Acid-Base reactions 1.8. Solubility Products 1.9. Unsaturated and Saturated Hydrocarbons 1.10. Radio nuclides	15
Module II: Transformation of Refractory Organic compounds in the Environment	2.1. Synthetic detergent (Surfactant) - cationic , anionic and non-ionic detergents, Modified detergents 2.2. Pesticides and Fertilizers -Classification, Degradation and Analysis of pesticides, - Pollution due to pesticides, DDT, Endosulphan and its molecules, Types of synthetic fertilizers. 2.3. Synthetic polymers. 2.4. Petroleum products.	10
Module III: Chemistry of Environmental components	**Chemistry of Atmosphere** 3.1. History and evolution of the earth's atmosphere. 3.2. Structure and composition of atmosphere. 3.3. Chemical composition of atmosphere. 3. 3. a – Classification of elements in the atmosphere. 3.3. b – Water, Co_2, NOx, SOx, O_2, Ozone, Chemical speciation, Particles, ions, and radicles in the atmosphere, Chemical processes for the formation of Inorganic and Organic Particulate matter, Thermochemical and photo chemical reactions in the atmosphere. Temperature inversions, Atmospheric lapse rate, Adiabatic lapse rate, wet and dry adiabatic lapse rate, Photochemical smog, Origin and	30

	occurrence. Oxidising and Reducing smog. Ecological effects. Oxygen and Ozone chemistry. Ozone layer. Chemistry of ozone layer. Ozone depletion Mitigation of ozone depletion. Eco friendly coolants. Chemistry of atmospheric pollutants. Acid rain and its ecological effects. **Chemistry of Lithosphere** 3.4. Structure and composition of lithosphere, Chemical properties of important rocks and minerals. Chemical characteristics of soil, Organic and inorganic components of soil, Soil horizon, Formation of soil, Soil forming processes, Weathering and pedogenesis, Soil pollution, Fate of chemicals in soil, Soil erosion **Chemistry of Hydrosphere** 3.5. Hydrological cycles, Composition and structure of pure water, Physico chemical properties of water and aqueous solution , Solubility of solids, liquids, and gases in water, Chemical reaction and equilibrium in water , Carbonate equilibrium, Metal ion equilibrium, Redox equilibrium Natural organic components in water.	
Module IV: Analytical Techniques	**4.1. Gravimetry** 4.1.1. Principles and applications of gravimetric methods with examples **4. 2.Volumetric methods** 4.2.1. Acidimetry and alkalimetry - Standardization of Reagent - Permanganometry - Dichrometry - Iodometry and Iodimetry - Argentometry - Complexometry - Colourimetry - Cerimetry(ferrous). **4.3.Instrumental methods** 4.3.1. pH meter - glass and reference electrodes - Ion selective electrodes 4.3.2. Conductometry - Electrical conductivity measurement – Potentiometry - Nephelometry - Turbidimetry - Sulphide determination 4.3.3. Spectro photometry - Beer-Lambert's law - Deviation from Beer – Lambert's law - U.V visible Spectrophotometer - Mass spectrophotometers - Flame photometry - Determination of Metals (Na, K) - Atomic absorption spectrophotometry application - Atomic emission spectrophotometry - 4.3.4. Dosimetry - Geiger Muller counter - Scintillation counter – Electrophoresis - Gel Electrophoresis - Immune electrophoresis, (ELISA, blotting technique, RFLP etc)	20
References	1. Stanely E. Manahan, Willard grant press, boston, Massachusetts, 1978 2. Environmental chemistry B.K Sharma – Environmental chemistry – Goel publication. 3. Chemistry of the Environment, R.A Bailey et al..,Academic press, New York,1993.	

	4. Chemistry and biology of water, Air, Soil, ed. J. Tolgyessy, Elsevier, 5. Amsterdam, 1993 6. A.K. De - Environmental Chemistry 7. Tyagi and Mehra - Environmental Chemistry 8. Trivedi P.R & Raj Gurdeo - Environmental water and soil Analysis Akasdeep Pub. House, New Delhi. 9. V.K.Alhuwalia, Environmental Chemistry Ahe books, India 10. S.P. Misra and S.N. Pandey – Essential Environmental studies – Ane books Pvt. Ltd. 11. P.L. Soni - Physical Chemistry 12. Rangwala, Water supply and Sanitory Engineering 13. Vogel - Analytical Chemistry 14. D.A. Skoog and J.J. Leary, Principles of instrumental analysis, i. 4th ed., Saunders college Publishing, fortworth, 1992. 15. H.H. Rump,H.Krist,Laboratory Manual for the water, wastewater and soil, VCH Publishers, New York, 1988. 16. Standard methods for the Examination of water and wastewater, APHA, 21st Ed, Washington DC 17. Lain. Marr and Malcolm S Cresser, Environmental Chemical Analysis, International textbook company…(pub), New York, 1983. 18. A.K. De - Environmental Chemistry 19. Tyagi and Mehra - Environmental Chemistry 20. Trivedi P.R & Raj Gurdeo - Environmental water and soil Analysis Akasdeep Pub. House, New Delhi. 21. V.K.Alhuwalia, Environmental Chemistry Ahe books, India 22. S.P. Misra and S.N. Pandey – Essential Environmental studies-Ane books Pvt. Ltd. 23. P.L. Soni - Physical Chemistry 24. Vogel - Analytical Chemistry 25. Khopkar, S.M., Basic concepts of Analytical Chemistry , Wiley Eastern Ltd.,NewDelhi. 26. Daniel C. Harris, Quantitative Chemical Analysis, 4th Ed.., W.H.Free man and Company, New York, 1995.
Course Outcomes	**On completion of the course, students should be able to** **CO1:** an insight into the chemical reactions in water, air and soil environment. **CO2**: the ability to apply chemistry principles in analysing pollution of water, air and soil environment. **CO3:** an understanding on the fate of chemicals on the environment and suggest relevant interventions. **CO4: U**nderstand the analytical techniques with applications **CO5:** Gain information about working mechanism of instruments **CO6:** Acquire knowledge on qualitative and quantitative techniques

ELECTIVE COURSE

Course Code & Title	**MSEVS01E01 - BIODIVERSITY CONSERVATION**		
Class	I M.Sc. Environmental Science	**Semester**	**I**
Course Objectives	The Course aims • To gain knowledge of fundamental concepts within conservation and biodiversity • To understand the main threats to biological diversity and the ability to evaluate the effects of human influences such as habitat fragmentation, climate changes and invasive species on biodiversity • To understand the relationships and conflicts between social development and conservation of ecosystems; as well as moral and ethical issues • To analyze information generated from scientific investigations and use findings to address conservation and biodiversity issues.		

SYLLABUS

Modules	Content	No. of Hours
Module I: Biodiversity and its Conservation	**1. Introduction** Definition, Types of biodiversity such as genetic, species and ecosystem biodiversity; Biodiversity at Global, National and local levels; The mega-diversity countries of the world; Biogeographical classification of India. Importance and value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values **2. Measurement of Biodiversity** Species richness, species diversity, Simpson Index, Shannon Wiener Index, Alpha, Beta and Gamma Diversity **3.Threats to biodiversity** Habitat loss and degradation, poaching of wildlife, introduction of exotic species, genetic pollution, climate change, man wildlife conflict; Endangered and endemic species of India; extinction of species, key stone species **4 Hot spots of biodiversity**	**20**
Module II: Biodiversity conservation	Insitu conservation–protected areas-National parks, Wildlife sanctuaries, Biosphere reserves, Definition, concept and short description of and importance of major reserves; Nilgiri Biosphere Reserve, Agasthyamalai Biosphere Reserve, Sunderban, Andaman and Nicobar, Gulf of Mannar. Project Tiger, Project Elephant, sacred groves with special reference to Kerala, Documenting traditional knowledge. Exsitu conservation-Botanical gardens, zoos, aquaria, National Bureau of Plant Genetic Resources (NBPGR), National Bureau of Animal Genetic	**20**

	Resources (NBAGR), Documenting traditional knowledge.	
Module III: Global strategy for conservation	Important International Conferences for Conservation (CBD, Earth Summit, Stockholm conference, Nairobi Conference, Montreal Protocol, London, Rio Declaration 1992, Berlin Mandate, Geneva Convention, Kyoto Protocol 1996, Johannesberg Conference, UNFCCC etc.)	**20**
Module IV: People's movement for environmental conservation in India	Bishnoi Movement, Chipko Movement, Narmada Bachao Andolan, Apikko movement, Silent Valley Movement, Baliyapal	**20**
References	**Reference Books:** 1. A Text Book of Environmental Sciences, S. S. Purohit, Q. J. Shammi and A. K. Agarwal, Student Edition (Agrobios), Jodhpur. 2. A Text Book of Environmental Studies, D. K. Asthana and Meera Asthana, S. Chand & Co., New Delhi. 3. Air Pollution, M.N. Rao and H.V.N. Rao, Tata McGraw Hill, New Delhi. 4. An Introduction to Air Pollution, R. K. Trivedy and P. K. Goel, B. S. Publications, Hyderabad. 5. Aerial Photography and Image Interpretation for Resource Management, Paine, D.P., John Wiley and Sons. 6. Chemical & Biological Methods for Water Pollution Studies, R.K. Trivedy and P. K. Goel, Environmental Publications, Karad. 7. Disaster Management in Hills, Dr. Satendra, Concept Publishing Co., New Delhi. 8. Ecology and Environment, P.D. Sharma, Rastogi Pub., New Delhi. 9. Environmental Science, S.C. Santara, New Central Book Agency (P) Ltd., Kolkota. 10. Ecology: Principles and Applications, J. L. Chapman and M.J. Reiss, Cambridge University Press, U.K. 11. Environment: Problems and Solutions, D.K. Asthana and Meera Asthana, S. Chand & Co., New Delhi. 12. Environmental Biotechnology, M. H. Fulekar, Oxford & IBH PublishingCo. Pvt. Ltd., New Delhi. 13. Environmental Chemistry, A.K. Dey, New Age International Publishers, New Delhi. 14. Environmental Concerns and Strategies, T. N. Khoshoo, Ashish Publishing House, New Delhi. 15. Environmental Geography, Savindra Singh, Prayag Pustak Bhavan, Allahabad. 16. Fundamentals of Ecology, E.P. Odum, W.B. Saunders Co., Philadelphia. 17. Handbook of Environmental Laws, Acts, Rules, Guidelines,	

	Compliances and Standards, Vol. I and II, BS Publications, Hyderabad. 18. Handbook of Methods in Environmental Studies, Vol. 1 & 2, S. K. Maiti, ABD Publishers, Jaipur. 19. Law on Protection of Environment and Prevention of Pollution (Central and States), R. G. Chaturvedy and M.M. Chaturvedy, The Law Book Co. (Pvt.) Ltd., Allahabad. 20. Natural Disasters, Lee Davis, Checkmark Books, New York. 21. Practical Methods in Ecology and Environmental Science, R. K. Trivedy and P.K. Goel, EnviroMedia, Karad. 22. Standard Methods for the Examination of Water and Wastewaters, American Public Health Association, Washington, DC. 23. State of India's Environment: A Citizen's Report, Arvind Agarwal, Centre for Science and Environment, New Delhi. 24. Water Pollution: Causes, Effects and Control, P. K. Goel, New Age International Publishers, New Delhi. 25. Environmental Biology, P.S. Verma and V.K. Agarwal, S.Chand & Co., New Delhi.
Course Outcomes	**On completion of the course, students should be able to** **CO1:** Identify interactions among ecological and sociocultural variables in the context of conservation issues. **CO2:** be able to outline different concepts of biodiversity and discuss spatial and temporal aspects of biodiversity **CO3:** be able to outline the biodiversity and ecosystem services concepts and their relevance for management of natural resources and a sustainable development **CO4:** Appreciate how different global impacts can interact to affect ecosystems.

ELECTIVE COURSE

Course Code & Title	MSEVS01E02 - GREEN TECHNOLOGY		
Class	I M.Sc. Environmental Science	**Semester**	**I**
Course Objectives	The Course aims • To familiarize the green chemistry • To learn about the control and remedial measures of green house effect • To know about the various analytical green methods • To understand the toxic effect of various pollutants • The understand the biological methods of determining the water pollution • To know the soil and thermal pollution		

SYLLABUS

Modules	Content	No. of Hours
Module I: Soaps and detergents	Soaps, detergents and detergent builders-preparation. Difference between soap and detergents. Cleansing action of soaps and detergents. Soaps and detergents as pollutants. Shampoo and toilet soap preparation	**20**
Module II: Food poisoning	Food poisoning-food poisoning caused by chemicals, poisonous plants and microorganisms, Food hygiene in the prevention of food poisoning	**20**
Module III: Green Chemistry	Green Chemistry-Principles of Green Chemistry, Design of Green Synthesis, prevention of waste and byproducts, Atom Economy, prevention of chemical accidents, microwave assisted green synthesis, Diels Alder reaction	**20**
Module IV: Water Analysis and Solid wastes management	**Water Analysis**-Water quality monitoring-sampling-analysis of water-physico-chemical and biological parameters of water-water quality standards-WHO, BIS - Eutrophication. **Solid wastes management**-Solid wastes- Types, disposal methods-sanitary land filling, incineration, recycling, composting-composting methods-indoor and Bangalore method, Windros method. Vermicomposting	**20**
References	**Reference Books:** 1. Ahuluwalia, V.K. Green Chemistry 2. Ahuluwalia, V.K. and M.Kidwai. New trends in Green Chemistry 3. Misra,S.P. and S.N.Pandey,2009. Essential Environmental Studies, Ane Books Pvt.Ltd 4. Bhatia, S.C. Environmental Chemistry, CBS publications 5. De, A.K. Environmental Chemistry, 6. Bharucha, E. Text Book of Environmental Chemistry, Oxford & IBH 7. Ahuluwalia, V.K. and Sunita Malhotra Environmental Science, Ane Books Pvt. Ltd	
Course Outcomes	**On completion of the course, students should be able to** **CO1:** Understand the toxic effect of various pollutants **CO2:** familiarize the biological effects of various chemical compounds	

SEMESTER - I- PRACTICAL

Course Code & Title	MSEVS01P01 - PRACTICAL IN ENVIRONMENTAL BIOLOGY		
Class	M.Sc. Environmental Science	Semester	I
Course Objectives	The Course aims • To make the student to acquire practical skills in the determination of various ecological and microbiological parameters. • To develop skill in the field of Vegetation analysis.		

SYLLABUS

Modules	Content	No. of Hours
Module 1	**Ecology** 1. Quantitative and Qualitative analysis of Phytoplankton and Zooplanktons 2. Primary Productivity-Light and Dark bottle method. 3. Chlorophyll method 4. Terrestrial-Biomass 5. Screening Test-(Demonstration Only) a. Using fish –LC 50 **b.** b.Macrophytes-Germination	**20**
Module 2	6. Determination of minimum size of the quadrat for vegetation study 7. Study of vegetation density by quadrat method 8. Study of vegetation frequency by quadrat method. 9. Study of Phytoplankton. 10. Estimation of biomass. 11. Study of Zooplankton 12. Determination of water transparency by Secchi disc 13. Determination of pH and temperature of water. **14.** Determination of carbon dioxide in water.	**20**
Module 3	**Environmental Microbiology** 1. General Laboratory equipments and its familiarization 2. **Media:** Preparation for aerobic heterotrophic bacteria, Chemo-autotrophs, photo-autotrophs obligate anaerobes, and Fungi; solid, liquid and semi-solid media; Aerobic culture media; Enrichment media, Enriched media, differential media, selective media, indicator media, transport media, Anaerobic media. 2. **Inoculation and incubation** for aerobic heterotrophic bacteria, Chemo-autotrophs, photo-autotrophs obligate	**30**

	anaerobes, and Fungi and examination of their growth, their enumeration. 3. **Pure culture techniques:** Spread plate, Pour plate, drop inoculation, streaking on plate, Serial dilution method of estimation.	
Module 4	4. **Staining techniques and microscopic observation**: Simple staining, negativestaining, gram staining, spore staining. 5. Cultivation and enumeration of bacteriophages (Coliphages) from raw sewage. 8. Most Probable Number (MPN) method of estimation of Coliforms and E.coli.	**10**
Course Outcomes	**On completion of the course, students should be able to** **CO1:** Outfitted with hands-on knowledge in the qualitative and quantitative analysis of Ecological and microbiological parameters. **CO2:** The students will be trained to conduct vegetation analysis for forest management	

References

1. American Public Health Association (APHA), American Water Works Association, (AWWA) and Water Environment Federation (WEF) (2017). Standard Methods for the Examination of Water and Wastewater, 23rd edition, ISBN: 978-0-87553-287-5; Part 1000: P. 541.
2. UNEP. 2002. Global environment Outlook. Earth Scan Publications ltd. , London
3. Cotgreave P. and Forseth I. 2002. Introductory Ecology. Blackwell Science
4. Freedman B. 1995. Environmental Ecology. Academic Press
5. Odum E.P. 1993. Fundamentals of Ecolgy.
6. Odum, Eugene Pleasants, and Gary W. Barrett. 1971. *Fundamentals of ecology*. Vol. 3. Philadelphia: Saunders.
7. Smith R.L. 1990. Ecology and Field Biology. Harper Collins Publ.
8. Smith R.L. and T.M. smith.1998. Elements of Ecology. Addison Wesley Longman Inc.

SECOND SEMESTER MSc. ENVIRONMENTAL SCIENCE PROGRAMME

CORE COURSE

Course Code & Title	**MSEVS02C04 - ENVIRONMENTAL ENGINEERING**		
Class	M.Sc. Environmental Science	**Semester**	**II**
Course Objectives	The Course aims • To study the standard operating procedure for water and wastewater treatment • To study the design features of water treatment • To know the biological treatment of wastewater • To understand the sludge disposal and treatment • To know about designing features of air pollution control devices		

SYLLABUS

Modules	**Content**	**No. of Hours**
Module I: Introduction to Environmental Engineering	**Water Quality Standards** Water Quality Parameters - Physical, Chemical And Biological Parameters. Water Sampling Type, Selection of Sampling Point, Equipment Used, Sample Preservation and Maintenance. Water Quality Standards - Industrial, Drinking Water.	**15**
Module II: Water Treatment Process	**Water Treatment Process** Water Treatment, Mixing And Flocculation, Coagulation, Jar Test, Softening. Lime Soda And Ion Exchange Process, Filtration, Slow, Rapid And Pressure Filter, Disinfection, Chlorination, Ozonisation and UV Application.	**15**
Module III: Waste Water Treatment	**Waste Water Treatment** Municipal Sewage and Industrial Treatment, Basic Treatment Process And Flow Sheet Water Flow Rates and Their Assessment. Unit Operation Of Pre-Treatment And Primary Treatment, Bar Rocks, Grit Chambers, Communitors, Equalization And Sedimentation, Design Concept, Secondary Treatment, Biological Unit Process, Nature And Kinetics Of Biological Growth, Aerobic Process, Activated Sludge Process And Its Modification, Oxidation Ponds , Attached Growth System, Trickling Filters, Rotating Biological Conductors, High Rate Anaerobic Reactor-CSTR, Up flow Anaerobic Filters – UAFS, UASB, Expanded, Fluidized Bed Reactors, Chemical Unit Processes, Precipitants, Coagulation, Disinfection, Tertiary/Advanced Treatment System, Filtration, Absorption, Nitrogen And Phosphorous Removal, Biological Nutrient Removal (BNR)Systems, Sewage Disposal Methods.	**25**

Module IV: Air Quality Standards, Air Pollution Control, and Solid Waste Management	**Air Quality Standards** Method Of Monitoring And Standards Of Air Pollutants: Air Quality Monitoring, Wind Roses, Air Sampling, Analysis of NOx, SOx, CO and Particulate Matter. Air Quality Standards. **Air Pollution Control** Control of Particulate Matter: Gravitational Setting Chamber, Centrifugal Collector, Electrostatic, Fabric and Wet Collector, Scrubber. Control of Gaseous Contaminants: Adsorption, Absorption, Combustion, Automobile Emission Control. **Solid Waste Management** Municipal, Solid Waste: Types, Sources, Characteristic, Waste Collection and Transport, Techniques/Processing of Solid Waste Recovery, Reclamation, Recycle And Reuse Of Resources, Disposal Methods, Incineration, Pyrolysis, Composting, Vermi-composting, Sanitary Land Fills And Anaerobic Digestion. Industrial and Hazardous Waste Management.	**25**
References	1. Peavy H.S, Rwe, DR, Techobanoglous G, Environmental Engineering, McGraw-Hill Book Company, New York. 2. Metcalf & Eddy Inc, Waste Water Engineering , Disposal and reuse ,2nd Ed.,Tata McGraw-Hill 3. Sawyer & McCarty, Chemistry for Environmental Engineering, McGraw- Hill 4. Wark K, Warner CF, Air Pollution- Its origin and Control, Harper&Row, Newyork, USA 5. Abbasi,S.A. Environmental Pollution and its control, cogent international, Pondicherry. 6. Fair Geyer & Okum, Water supply & Waste Water Engineering 7. Earnest W. Steel, Water supply & Sewage. 8. S.K. Garg ,Water supply Engineering 9. B.K Sharma – Environmental chemistry –Goel publication. 10. Tyagi and Mehra - Environmental Chemistry 11. Trivedi P.R & Raj Gurdeo - Environmental water and soil Analysis Akasdeep Pub. House, New Delhi. 12. V.K.Alhuwalia, Environmental Chemistry Ahe books, India 13. S.P. Misra and S.N. Pandey – Essential Environmental studies – Ane books Pvt. Ltd. 14. P.L. Soni - Physical Chemistry and Analytical Chemistry	
Course Outcomes	**On completion of the course, students should be able to** **CO1:** Understand the design feature of water treatment **CO2:** Know about aerobic and anaerobic water treatment technology **CO3:** Understand various factors affecting the water treatment **CO4:** Know the advantages of anaerobic treatment over aerobic treatment **CO5:** Gain knowledge on design and suitability of air pollution control devices.	

CORE COURSE

Course Code & Title	MSEVS02C05 - ENVIRONMENT OF PHYSICAL SYSTEMS		
Class	I M.Sc. Environmental Science	**Semester**	I
Course Objectives	The Course aims • To understand the concept of nuclear energy and its interactions • To explain at a basic level the most important processes of the Earth system • To understand environmental issues such as global climate change, and natural hazards, and also to make contributions to public debate and decision-making on how to address these issues and hazard • To describe and explain the processes of Earth's physical systems weather and climate, water, ecosystems, geologic and hydrological processes and landform development.		

SYLLABUS

Modules	Content	No. of Hours
Module I : Constituents of the Nucleus & Origin of Earth	Nuclear charge – Mass and binding energy – Radioactivity – Alpha, Beta and gamma emission – successive disintegration – Radioactive series – nuclear reactions – Energy released in fission and fusion. Origin of Earth – Theories pertaining Earth's origin, internal structure of Earth's crust, mantle and core – composition, continental drift, plate tectonics. Minerals – Rock forming and ore forming minerals. Minerals-concept of major, trace and Rare Earth Elements (REE). Classification of trace elements, Trace elements and health. Rock and rock cycle, Structure of rocks - Rocks – Brief classification and characteristic – megascopic features of different types of rocks. **Geomorphology:** Introduction. Soil-Weathering and pedogenesis, Factors of soil formation, soil profile, Classification of types of soil(Reference to India and Kerala),Structure of soil ,Soil quality parameters and assessment Coastal sedimentation and land forms, coastal erosion.	**20**
Module II : Structure and Composition of Atmosphere	**Atmosphere:** Structure, Composition, Stratification, Pressure gradient, Humidity, Thermodynamics of atmosphere, Lapse rate- Dry and wet adiabatic lapse rate, Temperature inversion and air pollution. Velocity, Acceleration. Vertical motion of air parcel in the atmosphere, Vertical stability of atmosphere. Horizontal motion in the atmosphere – Ferrel's Law & Coriolis effect, Winds-formation & classification, local, winds. Clouds-formation & classification, cloud seeding, Aerosols,	**20**

	Artificial rain, Acid rain, Global warming, Green house effect .Ozone layer formation & depletion, Global environmental problems.	
Module III : Weather and Climate & Physical Parameters of Atmosphere	Weather &Climate: Definition & scope, classification. Climate of India, oceanic & continent influence (air-sea interaction), El nino & La nino effects. Climate change-causes, effects. Regional scenario of climate change. Climate of India; Indian monsoon, (Onset of monsoon), Rain bearing systems, Break in change in the ecosystems. Weather& climate monitoring equipments, Meteorological data collection & analysis (Rainfall, Evaporation, Temperature ,Relative humidity, Wind speed, Wind direction, Wind rose) Temperature, Heat, Heat transfer, specific heat, Energy of the atmosphere – solar energy. Absorption by the atmosphere, scattering reflection, refraction, rarefraction. Absorption by earth, Terrestrial radiation – Earth's heat balance. Nature of sound – Physiological and physical properties – speed of sound – interference of sound waves, Resonance, Doppler effect, Acoustics of auditorium, Thunder and lightning, Noise pollution and its measurement and control.	**20**
Module IV : Hydrology	Hydrological Cycle- Inter-relationship of surface and groundwater. Stream flow, ground water relationships. Hydrological processes and the water budget of lakes and rivers-interaction of lake with surface and subsurface water. Influence of geology on groundwater- porosity, specific retention and specific retention and specific yield. Aquifer characteristics, springs and wells. Darcy's law. Ground water quality - physical, biological and chemical properties. Safe yield and artificial recharge. General circulation of oceans- Winds and surface circulation, causes of ocean currents and important current systems, deep sea circulation- characteristics of convergence, upwelling & sinking of ocean water. Mean sea level - sea level changes- Sea coasts and shorelines. Introduction to coastal zone management - coastal processes beach stability, coastal erosion and protection measures.	**20**
References	**Reference Books:** 1. Arther Beiser, Applied physics, Schaum's outline series; Mc Grace Hills Book Co. New York. 2. Albert Miller, Jack C Thompson, Richard E Peterson and Donald R Haragan; Elements of Meteorology; Charles E Merril publishing Co. Columbus. 3. Frederick K Lutgens and Edward J Tarbuck; The atmosphere; prentice	

	Hall publications, New Jersey 4. Floyd F Sabins; Remote sensing – Principles and Interpretation; W.H freeman and Co. San Francisco. 5. Erwin Schande, Springes – Verlag; Remote sensing for environmental sciences; Berling Heidelberg, New York. 6. E.C Barrett and L.F Curtis; Introduction to Environmental Remote Sensing; Chapman and Hall, London. 7. Lutgens and Tarbuck; The Atmosphere, Prentice Hall publication, New jersey. 8. Barry and Charley; Atmosphere, Weather and Climate; The English Language Book Society, 1976. 9. A.A Ramasastry; Weather and Weather forecasting' Publication division, Ministry of Information and Broadcasting, Ministry of India, 1984. 10. Billings; Structural Geology; Tata Mc Grace Hill publication Co. New Delhi. 11. Holmes A; Principles of physical geology, Ronald, New York, 1965. 12. Berry, LG & Brian Mason; Mineralogy; Freeman publication, 1959. 13. A.V Strahles and A.H Strahles; Environmental Geo-Science; Wiley International, 1973. 14. Tyrell G.W; Principles of petrology; Methven publication, 1959. 15. Validia K.S; Environmental Geology; Tata Mc Grace Hill publishing Co. Pvt. Ltd- New Delhi, 1987. 16. R.H.green, Sampling Design and statistical methods for Environmental Biologists, 1979. 17. A.C Wardlove; Practical statistics for Experimental Biologist. 18. D.C Sancheti 7 V.K Kapoor; Statistics; Sulthan Chand & Sons, New Delhi, 1991.
Course Outcomes	**On completion of the course, students should be able to** **CO1:** Develop knowledge and critical understanding of the fundamental characteristics, processes, temporal changes and landscapes especially in relation to biophysical systems, and awareness of integration with social systems **CO2:** Relate specialized understanding of the geography of bio-physical systems to knowledge and practices in environmental and natural sciences **CO3:** Understanding of the principles of scientific investigation as they apply to Earth's physical systems and processes. **CO4:** Describe and explain the processes of Earth's physical systems: weather and climate, water, ecosystems, geologic processes and landform development. **CO5:** Understanding of the modifications humans make to the environment through interactions with Earth's physical systems.

CORE COURSE

Course Code & Title	MSEVS02C06 - ENVIRONMENTAL TOXICOLOGY, OCCUPATIONAL HEALTH AND SAFETY		
Class	M.Sc. Environmental Science	**Semester**	**II**
Course Objectives	The Course aims • To understand the concept of toxicology • To know various types of toxin and toxicants • To understand the toxic action of toxicants on the human system • To assess the risk associated with the exposure to contaminants • To acquire knowledge on natural and manmade contaminants exposure and its outcomes		

SYLLABUS

Modules	Content	No. of Hours
Module I: Basics of Toxicology	Definition of toxicology, Branches of toxicology, scope and importance of toxicology, Environmental toxicology, Principles of toxicology, Toxicants and their classification. Categories of toxic effects. Factors influencing toxicity. Toxic effects due to combination of chemicals. Dose effect and dose response relationships.	**20**
Module II: Toxic Chemicals in the Environment	Toxic chemicals in the environment – Inorganic and organic toxicants- entry in to the environment, cycles and residence time. Translocation of xenobiotics. Toxicity of pesticides, organo chlorine, organo phosphates and carbamides, insecticides, heavy metals, radioactive substance, fluorides, chemicals, fertilizers.	**20**
Module III : Toxicity	Metabolism of toxic substance by plants and animals. Mode of action of toxicants, biotransformation of toxicants, Bioaccumulation of xenobiotics, Bio-concentration and Biomagnification. Toxicity test, In vitro and In vivo toxicity test. Pollution by industries- types and characteristics – dispersion and circulation. Mechanism of pollutants degradable and non degradable toxic substances. Ecosystem influence on the fate and transport of toxicants.	**20**
Module IV: Occupational Health Hazards & Ecological Risk Assessment	Occupational health – physical, chemical, biological and physiological hazards. Control of toxic materials and protection measures. Toxicity of air, water and soil. Health and hygiene epidemiology, epidemiological diseases (air & water) due to pollution problems with special reference to Kerala and India. Ecological risk assessment. Sanitary engineering- sewage systems, sewage treatment and disposal. Sanitary regulation.	**20**
References	**Reference Books:**	

	1. A.K. De – Environmental chemistry 2. B.K.Sharma and H. Kans Environmental chemistry 3. P.D.Sharma, Environmental biology and toxicology, 1997-98. 4. P.K.gupta and D.K.Shinlee, Modern toxicology 5. G.C. Butler, Principles of Eco toxicology 6. Duffus, John H, Environmental toxicology 7. Shukla J.P and Pandey, Elements of Toxicology, Radha publishers, New Delhi. 8. Rand G.M and Perocelli S.R, Fundamental of Aquatic Toxicology, Hemisphere publishing Corporation, Washington. 9. Cockerham L.G and Shane B.S, Basic Environmental Toxicology, CRC press, Bocaraton, USA. 10. Jacob, Thankamma, Food Adulteration, MC Millan publishers Pvt. Ltd., 1976. 11. Kalia M & Sood. Food preservation and processing, Kalyani pub. Ludhiana, New Delhi. 12. Hobbs B.C & Roberts D. Food poisoning and Food Hygeine 6th Edition. Edward Arnold pub. London, 1993. 13. Kamleshwar Pandey, Shukla, J.P, Trivedi (ed)2009, fundamentals of toxicology, New central book agency (p) Ltd
Course Outcomes	**On completion of the course, students should be able to** **CO1:** Know the route of entry and its response of toxins and toxicants **CO2:** Know comprehensively about the types of toxicant and contaminants **CO3:** Mobilization and disposition of toxins in human system **CO4:** Gain the knowledge on risk of contaminants when exposed **CO5:** Understand the risk associated with various contaminants

ELECTIVE COURSE

Course Code & Title	MSEVS02E03 – ENVIRONMENT AND CLIMATE CHANGE		
Class	M.Sc. Environmental Science	**Semester**	**II**
Course Objectives	The Course aims • To understand the weather and climate patterns • To study about various organizations involved in the study of climate change • To assess the effect of climate change on various sectors • To know actions taken against the climate change in the world and national level • To learn about carbon trade		

SYLLABUS

Modules	Content	No. of Hours
Module I: Weather and Climate	**Weather and Climate** pattern in India, National weather forecasting -World Meteorological Organization, Indian Meteorological Department. **Natural climate forcing**- climate change with Indian perspective- Intergovernmental panel on climate change, United National Framework Convention on Climate Change (UNFCC), International collective action on climate change.	**20**
Module II: Human induced climate variability	**Human induced climate variability**: Changing patterns of land use, Changes in urban climate, El nino and La mina effects. **Anthropogenic sources** of greenhouse gases, Enhanced greenhouse effect -Aerosols and other pollutants. **Green house gases emission from various sectors**: energy, industries, transport, shipping, aviation, built environment, agriculture, domestics and forestry. Global radioactive forcing.	**20**
Module III: Climate Change Impacts	**Climate Change Impacts** on agriculture, coastal system, food supply and demand, biodiversity. **Land degradation:** desertifation, precipitation, polar ice melting and sea level rise. **Climate change on health**- overview- food- biological and seasonal cycle- economy. Direct effect- health injuries, thermal stress, infectious, malnutrition, mental stress, drugs.	**20**

Module IV: Climate change mitigation policies	**Climate change mitigation policies:** World Summit 1972, Bruntland commission report - sustainable development - Rio conference 1992, Agenda 21, Montreal protocol, Conference of Parties, Kyoto protocol. **Mitigation potentials**-Energy sector -Transport sector - Industrial sector- Agricultural sector. **Bio-energy options**: hybrid fuel system, good cultivation habits, tree cover enhancement and policy regulation. **International emission trading**: carbon credit, carbon budget, green labeling, Coastal regulation zone notification 1991 **National action plan** on climate change and state action plan on climate change	**20**
References	**Reference Books:** 1. Atmosphere, weather and climate 2002, K. Siddhartha, Taylor & Francis, 2010 2. Climate Change, Central pollution control board (2002) 3. Climate Change 2007: The Physical Science Basis, Intergovernmental Panel on Climate Change Report (http://www.ipcc.ch) 4. Stern Review: The Economics of Climate Change (2007) 5. *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* <www.ipcc-nggip.iges.or.jp/public/gl/invs1.htm> 6. (IPCC) *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* <www.ipcc-nggip.iges.or.jp/public/gp/spanish/gpgaum_es.htm> 7. Data base on GHG Emission Factors (web application through<www.ipcc-nggip.iges.or.jp/EFDB/main.php>) 8. GHG Inventory Software for the Workbook <www.ipcc-nggip.iges.or.jp/public/gl/software.htm 9. http://envfor.nic.in/	
Course Outcomes	**On completion of the course, students should be able to** **CO1:** Understand and differentiate the meteorological and climatic features **CO2:** Recognize the human influence on climatic change **CO3:** Differentiate sector wise impact on climate change **CO4:** Realise various mitigation measures and actions taken against the climate change **CO5:** Understand to relate the climate change with the concept of El nino and La nino actions,	

ELECTIVE COURSE

Course Code & Title	MSEVS02E04 - HYDROLOGY AND WATER MANAGEMENT		
Class	M.Sc. Environmental Science	**Semester**	**II**
Course Objectives	The Course aims • To study occurrence movement and distribution of water that is a prime resource for development of a civilization • To know diverse methods of collecting the hydrological information, which is essential, to understand surface and ground water hydrology • To know the basic principles and movement of ground water and surface water and properties of ground water and surface water flow • To promote the awareness of the life-long learning and to introduce them professional ethics and codes of professional practice in water management		

SYLLABUS

Modules	Content	No. of Hours
Module I: Hydrology	Hydrology – Definition, History of hydrology, Branches of hydrology – Chemical hydrology, Eco hydrology, Hydrogeology, hydro informatics, hydrometeorology, isotope hydrology, surface hydrology. Hydrologic cycle – Different process of hydrologic cycle – precipitation, Canopy interception, snow melt, remelt , sub surface flow, infiltration, evaporation, transpiration, sublimation, advection, condensation.	**20**
Module II: Surface and ground water hydrology	Surface water hydrology – rainfall and surface runoff relationship, runoff, runoff characteristics, open channel flow. Statistical analysis in hydrology – Probable maximum precipitation – hydrograph, flow duration curve – Flood frequency analysis and estimation – Water balance. Ground water hydrology – Ground water table, stream – aquifer interactions, base flow recession, porosity and permeability, hydraulic head and fluid potential, Darcy's Law and hydro conductivity, Heterogeneity and anisotropy, storage properties of aquifers, Equations of ground water flow, well hydraulics, solute transport.	**25**
Module III: Hydrologic measurements	Hydrologic measurements a) Quantifying surface water flow – Stage – discharge measurement. b) Quantifying ground water flow - Ground water pressure (Piezometer), ground water depth (aquifer test), conductivity, infiltration (infiltrometer), soil moisture (soil moisture meter, gravimetric method, capacitance probe, Time domain reflectometer, Tensiometer). Geophysical investigation – resistivity and seismic method – application of remote	**20**

	sensing. c) Quantifying hydrologic exchange at the land – atmospheric boundary. Precipitation: a- Precipitation characteristics b- Cloud properties, rain rate estimation, hail and snow detection (radar) c- Rain and snow fall (Rain gauge) d- Humidity (Sling psychrometer, thermo hydrograph) e- Evaporation (Evaporation pan) f- Transpiration	
Module IV: Water management practices	Water management practices 1) Water shed management 2) Wetland conservation 3) Rainfall pits and rain water harvesting 4) Contour bunding 5) Drip irrigation 6) Channel irrigation	**15**
References	**Reference Books:** 1. Chone, V.T. Hand book of Applied Hydrology, Mc Grace Hill publication, New Delhi. 2. Charlu, TGK and Datta, D.K. Grand water development in India, Rural electric corporation, New Delhi, 1982. 3. Jayaram Reddy, A Text Book of hydrology, Lakshmi publishers, New Delhi. 4. Ragunath, H.M, Hydrology, Villey tastem publication, New Delhi, 1985 5. CWRDM Publications, CWRDM, Kamamangalam. 6. Linsev, Kohies Panthus; Appliued Hydrology, Mc Grace Hills Publication, New Delhi. 7. Subramanya.K, Hydrology for Engineers, Tata Mc Grace Hills Publications, New Delhi, 1984. 8. IS L986 91983) Measurement of Rainfall. 9. IS 5973 (1976) Pan evaporimeter. 10. Varshney, R.S; Engineering hydrology, New chand & Bros. Publications Rorkee. 11. Todd.D.K. Green water hydrology; John Wileys & Sons Publications, New York. 12. Validia.K.S, Environmental Geology, Tata Mc Grace Hills Publishing Co. Ltd. New Delhi. 13. Barry and Choslay, Atmosphere, Weather and Climate, The English Language Book Society.	
Course Outcomes	**On completion of the course, students should be able to** **CO1:** Gain knowledge in the theory of hydrological processes and their measurement **CO2:** Apply science and engineering fundamentals to solve current	

	problems and to anticipate, mitigate and prevent future problems in the area of water management **CO3:** Ability to manipulate hydrological data and undertake widely-used data analysis. **CO4:** A systematic understanding of the nature of hydrological stores and fluxes and a critical awareness of the methods used to measure, analyze and forecast their variability; and the appropriate contexts for their application **CO5:** Attaining knowledge on the components of a functioning groundwater, the main aquifer properties – permeability, transmissivity and storage **CO6:** The application of systems concept, advanced optimization techniques to cover the socio-technical aspects in the field of water resources

PRACTICAL

Course Code & Title	MSEVS02P02 - PRACTICAL IN ENVIRONMENTAL CHEMISTRY		
Class	M.Sc. Environmental Science	**Semester**	**II**
Course Objectives	The Course aims • To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis. • To acquaint the students with the determination of molecular weight of a polymer by vacometry.		

SYLLABUS

Modules	Content	No. of Hours
Module I: Determination of various Physico - chemical properties of Water	**Determination of various Physico - chemical properties of Water** 1. Determination of pH 2. Determination of conductivity 3. Determination of D.O 4. Determination of total solids (Gravimetry) 5. Determination of total dissolved solids (Gravimetry) 6. Determination of total suspended solids (Gravimetry) 7. Determination of chlorides 8. Estimation of Copper. 9. Estimation of iron (Colourimetry) 10. Estimation of Oil & Grease 11. Estimation of residual chlorine 12. Estimation of H2S 13. Estimation of Hardness, Calcium and Magnesium 14. Chemical oxygen demand 15. Biological oxygen demand	**25**
Module II: Determination of various Physico - chemical properties of Water	16. Estimation of fluoride 17. Estimation of phosphate 18. Estimation of Nitrate 19. Estimation of Nitrite 20. Estimation of Total Nitrogen (Kjeldahl method) 21. Estimation of Sodium & Potassium (Flame photometry) 22. Estimation of pesticides using TLC / paper chromatography / Colum chromatography 23. Analysis of heavy metals – As, Hg, Pb, Cd 24. Estimation of sulphate 25. Estimation Acidity and Alkalinity.	**25**
Module III: Determination	**Determination of various Physico - chemical properties of Soil Analysis**	**20**

of various Physico - chemical properties of Soil Analysis	1. Determination of soil pH 2. Determination of soil moisture content 3. Estimation of soil chloride 4. Determination of TOC 5. Determination of Ca^{2+} & Mg^{2+} 6. Analysis of soil sulphate (Gravimetry) 7. Determination Food Adulterant 8. Estimation of Na+ & K+ in soil	
Module IV: Air Quality Analysis	**Air Quality Analysis** (Demonstration only) 1. Particulate matter 2. NOx 3. SOx 4. Pollen grains.	**10**
References	**Reference Books:** 1. Daniel R. Palleros, "Experimental organic chemistry" John Wiley & Sons, Inc., New York 2001. 2. Furniss B.S. Hannaford A.J, Smith P.W.G and Tatchel A.R., "Vogel"s Textbook of practical organic chemistry", LBS Singapore 1994. 3. Jeffery G.H., Bassett J., Mendham J.and Denny vogel"s R.C, "Text book of quantitative analysis chemical analysis", ELBS 5th Edn. Longman, Singapore publishers, Singapore, 1996. 4. Kolthoff I.M., Sandell E.B. et al. "Quantitative chemical analysis", Mcmillan, Madras 1980.	
Course Outcomes	**On completion of the course, students should be able to** **CO1:** Outfitted with hands-on knowledge in the quantitative chemical analysis of water quality related parameters.	

FIELD WORK

Course Code & Title	MSEVS02F01 - FIELD WORK		
Class	M.Sc. Environmental Science	Semester - II	No. of Hours
	1. Students are required to go for field study in research institutions, wildlife sanctuaries, different ecosystems, polluted areas or ecotourism sites situated within and outside Kerala. 2. Field visit to terrestrial/aquatic environments-Study of ecological adaptations 3. Study of vegetation of local area/college campus-Fauna of local area/campus 4. The Students are required to submit a report on field visit.		4

THIRD SEMESTER MSc. ENVIRONMENTAL SCIENCE PROGRAMME

CORE COURSE

Course Code & Title	**MSEVS03C07 - EIA & ENVIRONMENTAL MANAGEMENT**		
Class	M.Sc. Environmental Science	**Semester**	**III**
Course Objectives	The Course aims • to understand the need for EIA • acquire knowledge on various components of environmental impact assessment • explore various environmental assessment methodologies • comprehend the impact of any developmental activities and its mitigation measures • study about disaster management and policy		

SYLLABUS

Modules	**Content**	**No. of Hours**
Module I: EIA Process	i) Introduction: Definition, aim, principles and concept, scope. Origin and development of EIA. Relationship of EIA to sustainable development EIA in project planning and implementation. ii) Method and steps a) Adhoc Method, b) Overlay Method, c) Checklist Method, d) Network Method e) Matrix Method f) Ecosystem Modeling **i) Methods for preparing EIA** a) Socio-economic aspects, b) Making inventories, c) Sampling and data process d) Baseline study **ii) Impact prediction** a) Positive and negative impact, b) Primary and secondary impact, c) Impact on Physical Social and biotic environment **iii) Evaluation of proposed action** a) Risk assessment and risk management, b) Mitigation Measures, c) Comparison of alternatives, EIS and EMP, d) Review and decision making e) Practices and guidelines in India	**25**
Module II: EIA for Different Environmental Programmes	**EIA for Different Environmental Programmes.** i) Industries, ii) Urban development iii) landuse iv) Energy projects a) Hydel, b) Thermal, c) Nuclear, d) Oil gas e) solar f) wind v) Resource management a) Agriculture, b) Irrigation c) Water, d) Biodiversity, e) Costal Zone vi) EIA case studies	**15**

Module III: Environmental Planning and Management	**Environmental Planning and Management** i) Principles of EPM a) Principle, concepts and scope of environmental Planning b) Ecological aspects of EPM c) Steps in Environmental Planning d) Identification and formulation of strategies of EPM ii) Environmental Analysis and EPM a) Physical planning in relation to environment and land use classification iii) EPM for a) Town and urban lands, b) Rural and agriculture land c) Wastelands, d) Lands reclaimed, e) Wetlands f) Mining areas, g) Industrial areas h) Transportation and urban planning	**20**
Module IV: EPM for Environmental Hazards & Environmental Auditing	**EPM for Environmental Hazards** i) Types of Environmental Hazards a) Flood, draught, landslides, earth quakes, cyclones etc ii) Significance and characteristics of hazards in Environmental Planning and development iii) Opportunity and regional planning for hazard management **Environmental Auditing** i) Cost benefit Analysis ii) Scope and types of Environmental audit iii) Audit Process – Pre , post audit process iv) International organization for standardization (ISO) v) ISO standards and certification	**20**
References	**Reference Books:** • World commission on Environment and Development; "Our common future". Oxford University Press publications. • Leela Krishnan, Law and Environment. • Adiseshiah M.S (1987) Economics of Environment. • Victor P.A (1972) The Economics of Pollution, Mathau, London Publication. • Rogene and Buchoiz (1993) Principles of Environmental management, Prentice Hall publications. • Indian Institute of Ecology and Environment, New Delhi. 1. Occasional monographs – 11,22,41,42,51,70,77,87 2. Environment International – 42,51,71,72,75,76,84,85,86. • Roscheraz, Environment law and policy in India. • Lohithakshan (2002), 'Paristhithi Niyamangal", Kerala State Institute of Languages (Malayalam).	
Course Outcomes	**On completion of the course, students should be able to** **CO1:** Realize the role EIA in decision making **CO2:** Identify various impacts of any proposed projects **CO3:** Understand the procedures for environmental clearance **CO4:** Gain knowledge on environmental audit and its outcomes **CO5:** Understand the role of various sectors on disaster management	

CORE COURSE

Course Code & Title	MSEVS03C08 - BIOSTATISTICS, RESEARCH METHODS AND COMPUTER APPLICATION		
Class	M.Sc. Environmental Science	**Semester**	**III**
Course Objectives	The Course aims • discuss and verify the different types of sampling design • classify and explain the various methods of central tendency and dispersion in research • summarize the advantages and disadvantages of use of computer modelling in research • impart knowledge for develop data analytics skills and meaningful interpretation to the data sets so as to solve the research problem. • design and encompass all the relevant research basics such as data acquisition, literature review, and statistical analysis.		

SYLLABUS

Modules	Content	No. of Hours
Module I	Fundamentals of Statistics (Basic concept) – Collection of Data – Classification and Tabulation – Diagrammatic Representation – Measures of Central Tendencies and Dispersion – Probability and Monte Carlo Analysis – Moments, Skewness and Kurtosis – Normal, Poission and Binomial Distributions.	**20**
Module II	Tests of Significance – Mass and alternative hypothesis – error level of significance – Equal and Unequal Sampling - t, z, x2 test, Analysis of variance – One way ANOVA – Two way ANOVA – Regression and correlation - simple and multiple.	**20**
Module III	Modeling – Computer Modeling – Lotka – Volterra Model, Leslie's Matrix Model – Point Source Stream Pollution Model – Air Quality Model. Thermal Plume and Dispersion models.	**15**
Module IV	Applications of Computer in Environmental Science and Management – Data Analysis using packages (SPSS): Editing, Data Tabulation, Descriptive statistics – Correlation – Regression – Factor analysis – Cluster analysis – PCA, Graph Plotting. Scientific documentation: Methods of literature collection, design, planning and execution of investigation, Statistical methods in biological research, Preparation of scientific documents, general articles, research papers, review articles, editing of research papers, methods of citation, collection of literatures, including web based methods, bibliography and thesis writing. Presentation techniques, effective communication skill, Discussion and critic.	**25**
References	**Reference Books:** 1. Business Mathematics and Statistics, Vittal, R.R. (1986) Murgham	

	Publications. 2. Programming with C, Byron S Gottfried (1996) Hill Publishing Co, New Delhi. 3. Statistical Methods, Gupta, S.P. (1996) Sultan Chand & Sons Publications, New Delhi. 4. Environmental Science Methods, Haynes, R (1982) Chapman & Hall, London. 5. Fundamentals of Bio-Statistics, Khan, I.A and Kanum, A., (1994) Ukaaz Publication, Hyderabad. 6. Quantitative Techniques, Kothari, C.R (1996) Vikas Publishing Housing Pvt Ltd, Hyderabad. 7. Statistics for Advanced Level, Miller, J., (1989) Cambridge University Press. Statistical Methods, Snedcor, G.W. and Cochran, W.G. (1982) Academic Press. 8. Statistics in Biology. Bliss, G.I. (1970). Mc Graw Hill Book Company, Vol. I and II. New Delhi. 9. Practical Statistics for Experimental Biologists. Wardlaw, A.C. (1985), Wiley Chichester. 10. Research Methods in Social Sciences. Sharma, B.A.V., Ravindra Prasad, D. and Satyanarayana, P (1989), Sterling Publishers Pvt. Ltd. 11. Research Methodology – Methods and Techniques. Kothari, C.R., (1989), Wiley Eastern, New Delhi. 12. Introduction to Research Methodology in Agricultural and Biological Sciences, V. 13. Venkatasubramanian (1999), New Century Book House (P) Ltd., Chennai.
Course Outcomes	**On completion of the course, students should be able to** **CO1:** Independently perform univariate data analysis **CO2:** Knowledge on measurement & scaling techniques as well as the quantitative data analysis **CO3:** Basic awareness of data analysis-and hypothesis testing procedures develop the ability to apply the methods while working on a research project work **CO4:** Choose the appropriate research design and develop appropriate research hypothesis for a research project

CORE COURSE

Course Code & Title	MSEVS03C09 - DISASTER MANAGEMENT		
Class	II M.Sc. Environmental Science	**Semester**	**III**
Course Objectives	The Course aims • To provide basic conceptual understanding of disasters. • To understand approaches of Disaster Management • To build skills to respond to disaster • To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity		

SYLLABUS

Modules	Content	No. of Hours
Module I Natural & Artificial hazards	**Natural hazards** a) Flood – causes, nature and frequency of flood. Flood hazard, Urbanization and flooding, Flood mitigation methods. b) Land Slides and Avalanches – Causes, prevention and correction. c) Coastal hazards – Tsunamis, coastal erosion, sea level changes and impact on coastal areas. d) Earth quakes – Causes, intensity and magnitude of earth quakes, geographical distribution of earth zones and seismic waves, nature of destruction, protection from earthquake hazards. e) Volcanism – Nature, extend and causes of volcanism, volcanic materials and pollution, geographical distribution of volcanoes. f) Lightning – Adverse affects and mitigation measures. g) Cyclone and Tornadoes – Causes effects and control measures. h) Drought - Causes, prevention and correction i) Fire - Causes effects and control measures. **Artificial hazards** Fire – Accidents – Types of accidents – Collapse of buildings – Gas and Chemical leakage	**20**
Module II Disaster Management	**Disaster Management** Concept and scope of disaster management / emergency management. Professional activities – Mitigation, preparedness, response, recovery, programme planning and management.	**20**
Module III	**Tools of Disaster management**	**25**

Tools of Disaster management	Forecasting and warning systems of disasters – Measurement of responses of disasters – Community reaction to disaster – Disaster management - Emergency Management Information Systems (EIMS) - Phases of disaster management – Pre disaster phase – Actual disaster phase – Post disaster phase – Disaster Assistance – Technological assistance – Relief camps – Camp layout – Food requirement – Water needs – Sanitation – Security	
Module IV Organizations related to disaster management.	**Organizations related to disaster management.** a) International organizations – International Association of Emergency Managers, Red cross/Red crescent, United Nations, World Bank. b) National Organizations – National Disaster Management of India, Emergency management and research institute (EMRI), National remote sensing institute (NIRS).	**20**
References	**Reference Books:** 1) Anil Tyagi, Environmental Science, Danika publishing company, New Delhi, 2007. 2) Barrington EJW, Environmental Biology. Resource and Environmental Science series, Edward Arnold (pub) Ltd. London. 3) Purohit, S.S, Shammi, Q. Land Agarwal, A.K; A text book of Environmental science, student edition publishers, Jodhpur, 2004. 4) R.K Khitoliya and K. Venkatachalam)(1997), Urban settlements and Natural hazards. Proceedings of seminar on Natural hazards in the Urban habitat. November, NewDelhi. 5) Arya,A.S (1997) key note Address, Seminar on "Built Environment & Natural hazards". Indian buildings congress. February, New Delhi.	
Course Outcomes	**On completion of the course, students should be able to** **CO1:** Differentiate the types of disasters, causes and their impact on environment and society **CO2:** Assess vulnerability and various methods of risk reduction measures as well as mitigation. **CO3:** Draw the hazard and vulnerability profile of India, Scenarious in the Indian context, **CO4:** Disaster damage assessment and management	

ELECTIVE COURSE

Course Code & Title	MSEVS03E05 - NATURAL RESOURCE AND THEIR CONSERVATION		
Class	I M.Sc. Environmental Science	**Semester**	I
Course Objectives	The Course aims • To understand the importance of natural resources • To know the role of water, soil conservation and management • To learn moral and ethical values of biodiversity • To create awareness on sustainable utilization of resources • To gain knowledge on various hurdles of resource management		

SYLLABUS

Modules	Content	No. of Hours
Module I : Natural resource conservation	**Natural resource** – Definition – Concept, classification of natural resources (Renewable and non renewable resources) **Renewable resources** – **Land / Soil resources** – Land as a resource, land degradation, conservation measures. Soils of India, Soil or land degradation, Causes of soil and land degradation, waste lands, desertification. **Water resources** – sources of water, hydrological cycle, Use and exploitation of surface and ground water, conflict over water, water conservation strategies, **Forest resources** – Importance of Forest - Ecological and Economic significance - Classification of Forest resources - Use and over exploitation, deforestation, Timber extraction, aforestation, basic causes of deforestation, management of forest resources. **Plants and animal resources** – over exploitation, species extinction, control measures.	**25**
Module II : Nonrenewable and renewable Energy resources	**Non renewable energy resources** – Fossil fuels (Coal, Petroleum and natural gas), nuclear fuel. **Renewable energy resources** (Biomass, Bio fuel, Hydropower, Tidal energy, wave energy, wind energy, geothermal energy, solar energy, magneto hydrodynamic power, Hydrogen energy). Energy crisis, management of energy resources.	**20**
Module III : Mineral resources	**Classification of Minerals**, Minerals of India. Uses of economic importance of minerals. Management of Mineral resource, Mineral wealth of our planet, non renewable nature of mineral deposits, the inexhaustible nature of mineral elements, use and exploitation of mineral resources, environmental effects of extracting and using mineral resources. Remedial measures.	**20**
Module IV : Food resources, Role of an Individual in	**Food resources** – World food problems, changes caused by agriculture and over grazing, effects of modern agriculture, merits of conventional agricultural system. World food supply, food security, Sustainable agriculture.	**15**

conservation of natural resources	Definition and meaning of conservation, equitable use of resources for sustainable development.	
References	1. Anil Tyagi, Environmental Sceince, Danika publishing company, New Delhi, 2007. 2. Barrington EJW, Environmental Biology. Resource and Environmental Science series, Edward Arnold (pub) Ltd. London. 3. Purohit, S.S, Shammi, Q. Land Agarwal, A.K; A text book of Environmental science, student edition publishers, Jodhpur, 2004. 4. R.K khitoliya and K. Venkatachalam)(1997), Urban settlements and Natural hazards. Proceedings of seminar on Natural hazards in the Urban habitat. November, New Delhi. 5. Arya,A.S (1997) key note Address, Seminar on "Built Environment & Natural hazards". Indian buildings congress. February, New Delhi	
Course Outcomes	**On completion of the course, students should be able to** **CO1:** Understand the value of natural resources **CO2:** Investigate pros and cons of non-renewable energy utilization **CO3:** Understand environmental implications of resource extraction **CO4:** Awareness on natural resources conservation practices **CO5:** Need for the conservation of the genetic resources	

ELECTIVE COURSE

Course Code & Title	MSEVS03E06 - APPLICATION OF REMOTE SENSING AND GIS		
Class	M.Sc. Environmental Science	**Semester**	**III**
Course Objectives	The Course aims • study the basic principles of Remote sensing and GIS • differentiate various types and characters of sensors • understand the concept of active, passive and microwave remote sensing • know the importance of digital image processing • know about various applications of GIS and Remote sensing		

SYLLABUS

Modules	Content	No. of Hours
Module I: Basics and Components of Remote sensing technique	**Basics of Remote sensing** Definition History, principle, concept and scope of remote sensing Indian Remote Sensing Programmes **Components of Remote sensing technique** Electromagnetic energy - Electromagnetic spectrum Interaction between light and matter Platforms for Remote sensing techniques - Sensors - Types of sensors & resolution - Imaging byscanning techniques- across ttrack and along track scanning - Image characteristics – Image processing – Photo interpretation and photogrammetry.	**25**
Module II: Source and application of remote sensing information	**Source and application of remote sensing information** Aerial photography – characteristics of aerial photographs, Aerial photographs and their interpretation. Satellite imagery - landsat imagery, Application of remote sensing into ground water exploration, mining of mineral resources, Landslides, subsidence and earthquake mitigation, waste land mappings, wet land conservation.	**20**
Module III: Geographic information system (GIS)	History and Development - Terminology and scope of GIS - Principles of GIS - Introduction to mapping and GIS - Components and Organisation of GIS. Fundamentals of computing GIS - Theory of GIS - Data concepts - Processing and visualization - Information analysis and digital data processing - Introduction to GIS Packages.	**20**
Module IV: Application of GIS in Environmental studies	Disaster Management, Forestry, Agriculture, Water resource management, Watershed management, Coastal zone management.	**15**

References	**Reference Books:** 1. Arther Beiser, Applied physics, Schaum's outline series; Mc Grace Hills Book Co. New York. 2. Albert Miller, Jack C Thompson, Richard E Peterson and Donald R Haragan; Elements of Meteorology; Charles E Merril publishing Co. Columbus. 3. Frederick K Lutgens and Edward J Tarbuck; The atmosphere; prentice Hall publications, New Jersey 4. Floyd F Sabins; Remote sensing – Principles and Interpretation; W.H freeman and Co. San Francisco. 5. Erwin Schande, Springes – Verlag; Remote sensing for environmental sciences; Berling Heidelberg, New York. 6. E.C Barrett and L.F Curtis; Introduction to Environmental Remote Sensing; Chapman and Hall, London. 7. Lutgens and Tarbuck; The Atmosphere, Prentice Hall publication, New jersey. 8. Barry and Charley; Atmosphere, Weather and Climate; The English Language Book Society, 1976. 9. A.A Ramasastry; Weather and Weather forecasting' Publication division, Ministry of Information and Broadcasting, Ministry of India, 1984. 10. Billings; Structural Geology; Tata Mc Grace Hill publication Co. New Delhi. 11. Holmes A; Principles of physical geology, Ronald, New York, 1965. 12. Berry, LG & Brian Mason; Mineralogy; Freeman publication, 1959. 13. A.V Strahles and A.H Strahles; Environmental Geo-Science; Wiley International, 1973. 14. Tyrell G.W; Principles of petrology; Methven publication, 1959
Course Outcomes	**On completion of the course, students should be able to** **CO1:** Understand the characteristics of GIS and Remote sensing **CO2:** Gain knowledge on Toposheet and digital maps usage **CO3:** Acquire knowledge on scanner and sensor in application **CO4:** Know about the importance of image processing and enhancement of GIS and Remote sensing **CO5:** Attempt GIS and RS applications on various domains of environmental studies

ELECTIVE COURSE

Course Code & Title	MSEVS03E07 - NANO TECHNOLOGY AND ENVIRONMENTAL APPLICATIONS		
Class	M.Sc. Environmental Science	**Semester**	**III**
Course Objectives	This course on Nanotechnology and Environmental applications covers the basic principles of nanotechnology which includes different type of nanomaterials, its fabrication and synthesis, size dependent properties, characterization, and environmental applications of these nano materials.		

SYLLABUS

Modules	Content	No. of Hours
Module I:	**Introduction to Nano** Historical introduction, Bulk Vs Nano size, Concept of Nano and it evolution, Scientific Revolution - Feynman's Vision and its explanation, Size-dependence of properties - Surface area to volume ratio and Quantum size effects, Classifications - zero Dimensional, one Dimensional, two Dimensional and three Dimensional Nanomaterials, Metal nanoparticles, semiconductor quantum dots, Nanoporous materials – mesoporous and micro porous materials, Magnetic nanoparticles, Nanomagnetism, carbon nanostructures: fullerenes, carbon nanotubes and graphene nanostructures.	**25**
Module II:	**Nanomaterials and Properties** Metal Nanoparicles- Surface plasmon resonance, Semiconductor nanoparticles optical and electronic properties, Nanoporous materials – mesoporosity and micro porosity, Magic numbers, Mesoporous materials - silica and titania and their applications, Self-assembled nanostructures. Nanomaterials Synthesis - General: Top down process – Lithrography and High-energy balling, Bottom up approach -Wet chemical routes, solution phase and vapour phase synthesis, sol-gel synthesis, Synthetic methods for metal and semiconductor nanoparticles, Template-based synthesis of mesoporous metal oxides, Synthesis of carbon nanotubes, fullerenes and graphene.	**20**

Module III:	Nanomaterials Characterization Tools for Characterisation of Nanomaterials - UV-Visible spectroscopy, X-Ray Diffraction (XRD) Techniques, Electron microscopy – Scanning Electron and Transmission Electron Microscopy (SEM and TEM), Atomic Force Microscopy (AFM) techniques, BET surface area measurements.	**15**
Module IV:	Environmental Applications of Nanomaterials Environmental applications of Nanomaterials, Nanomaterials for water treatment- Photocatalysis, Degradation of textile industry wastes such as dyes, Removal of waste from water using semiconductor nanomaterials, air purifications, Nanomaterials for antimicrobial coatings- medical implants and paints, superhydrophilicity, Self-cleaning applications, Dye sensitized solar cells and electrochromic device applications.	**20**
References	1. C. P. Poole Jr. & F. J. Ownes. *Introduction to Nanotechnology*. Wiley India (2007), New Delhi. 2. T. Pradeep. *Nano*: *The Essentials*. Tata McGra Hill (2007), New Delhi. 3. K. J. Klabunde (Ed.) *Nanoscale Materials in Chemistry*, John Wiley & Sons (2001). 4. Hari Singh Nalwa (Ed.), *Nanostructured materials and nanotechnology*, Academic Press, New York (2002). 5. D. Vollath. *Nanomaterials*, Wiley-VCH (2008). 6. K.K. Cathopadhyay & A.N. Banerjee, *Introduction to Nanoscience and Technology*, PHl Learning Pvt. Ltd. (2009). 7. G. A. Ozin, A. C. Arsenault, L. Cademartiri, *Nanochemistry: A Chemical Approach to Nanomaterials*, Royal Society of Chemistry (2009) London. 8. P. Atkins & J. De Paula, *Atkins's Physical Chemistry*, 8th Edition, W.H. Freeman & Co., 2006. 9. Skoog and West, *Principles of Instrumental Analysis.*	
Course Outcomes	**General Outcome** 1. To encourage students to familiarize to advanced topic of nanotechnology and promote research oriented mentality to solve environmental issues and problems such as water and air pollution using nanomaterials. 2. The course contents will be give idea about the latest development in the area of Nanotechnology. 3. This course prepares the student to acquire knowledge, skills and expertise on nanotechnology along with the integrated knowledge of	

	all relevant disciplines. **Specific outcome** Learning objectives for this course will focus on developing a fundamental understanding of the following topics as they relate to nanotechnology. 1. Motivation/Vision: Feynman's vision, why use/explore new nanomaterials? 2. General classification - 0D, 1D, 2D and 3 Dimensional and self assembled nanostructures. Metals, metal oxides, semiconductors, carbon, porous and biological nanomaterials. 3. Size Dependent Chemical and Physical Properties: Optical, catalytic and magnetic properties. 4. Synthesis and Fabrication : Top down *Vs* bottom up techniques, nucleation theory, surface energy and stabilization 5. Characterization techniques : Structure, porosity, crystallinity and Morphology **Applications:** Environment and energy applications such as water purification, self-cleaning surface, antibacterial, solar cells and electrochromic cells.

ELECTIVE COURSE

Course Code & Title	MSEVS03E08 - ENVIRONMENTAL MICROBIOLOGY AND BIOTECHNOLOGY		
Class	M.Sc. Environmental Science	**Semester**	**II**
Course Objectives	The Course aims • To understand the history and basics of microbiology • To learn about microbial diversity in environmental matrix • To study the importance of microbes in the field of environmental microbiology • To understand the biodegradation and its importance • To know about recent advances in bioremediation technique		

SYLLABUS

Modules	Content	No. of Hours
Module I: Scope and history of Environmental Microbiology	Scope and history of Environmental Microbiology – characteristics, classification, identification and morphology of microorganism. Microbial world – Bacteria, Archaea, Fungai, Algae, Virus, Protozoa. Identification of microorganisms – Direct microscopic examination, cultural characteristics, biochemical and physiological and physiological properties, Antibiotic sensitivity testing, serological methods, Phage typing, protein analysis, comparison of nucleotide sequences.	**20**
Module II: Genetic engineering	**Genetic engineering and tissue culture**- Principles and scope of Genetic engineering. Application of genetic engineering, benefits and hazards- the ethical and social implications of genetic engineering, Tissue culture Techniques and its applications	**15**
Module III: Environmental Microbiology	**Microbiology and segments of Environment.** Microbial diversity in soil, biogeochemical role of soil microorganisms. Biodegradation of herbicides and pesticides. The aquatic micro organisms. The role and importance of microbial ecosystems, biogeochemical transformation.	**20**
Module IV: Environmental Biotechnology & Emerging trends in Environment Biotechnology	**Environment Biotechnology** – Principles and scope, Role of biotechnology in Environmental Protection, biotechnology in industrial pollution control – Paper industries, Textile Industries, Petrochemical Industries, Leather Industries and Mining Industries **Emerging trends in Environment Biotechnology**- Bioremediation and Biosensors. Principles of Bioremediation, Techniques used in Bioremediation, Advantages and disadvantages of Bioremediation. Principles and applications of Biosensors. Concept of Bioremediation in waste water management. Waste water treatment Practices, solid waste management.	**25**
References	1. Microbiology. Prescott, Harley and Klein (Ed) 7th edition. 2. Manual of Microbiology - Tools and Techniques. Second edition. Kanika	

	Sharma, House, 2010 3. Microbiology- Michael J Pelzar, JR.E.C.S Chan and Noel.R.Krieg. 8th edition. 4. Microbiology. Prescott Harley and Klein (Ed) 7thedition. 5. Microbiology- Michael J Pelzar, JR.E.C.S Chan and Noel.R.Krieg. 8th edition. 6. Biological Science. R.Soper. Cambridge University. 3rdEditon. 7. Modern soil Microbiology, Elsar, Jansson and Tervors. 2nd Edition. 8. Microbiology - Michael J Pelzar, JR.E.C.S Chan and Noel.R.Krieg. 8thedition. 9. Microbiology. Prescott Harley and Klein (Ed) 7thedition. 10. Handbook of Environment Biotechnology vol 1. S.C Bhatia. Atlantic publication 11. Advances Environment Biotechnologyby S.K Agarwal 12. Environment Biotechnology, theory and application. Gareth.M.Evans and Indith C.Fuslong 13. Essentials of Biotechnology. R.C Sobti and Suparna S Pachauri. 14. Handbook of Environment Biotechnology. Vol 1 .S.C Bhatia, Atlantic publisher and distributions 15. Biotechnology in Environment management. Vol 2 Essentials of Biotechnology by Sobti. 16. Methods in Biotechnology by Hanspeter.
Course Outcomes	**On completion of the course, students should be able to** **CO1:** Gain knowledge on microbial diversity **CO2:** Know about microbiological standards for water **CO3:** Compare microbial diversity among the environmental compartments **CO4:** Acquire knowledge on microbes aid in containments degradation **CO5:** Explore various updated methods of bioremediation technique

PRACTICALS

Course Code & Title	MSEVS03P03 - PRACTICAL IN ENVIRONMENTAL GEOLOGY		
Class	M.Sc. Environmental Science	Semester	III
Course Objectives	The Course aims • To develop analytical skill in the respective areas • To study the basic principles of Remote sensing and GIS and to apply for practical studies • Understand the Geological features by practical methods • To conduct digital image processing • Apply GIS and Remote sensing techniques for Environmental analysis		

SYLLABUS

Modules	Content	No. of Hours
Module 1	• **Determination of mechanical properties of soil** – Soil texture, Moisture, bulk density, porosity, permeability, infiltration, liquid limit, plastic limit and plasticity index • **Texture analysis of soil** – Sieve method and settling analysis • **Rock identification** (Hand specimen only) – Texture and structure – Granite, Gneiss, Schist, Slate, Marble, Sand Stone, Grit, Conglomerate, lime stone, Kankar Lime stone, Shale, Orthoquartzite and laterite.	
Module 2	• **Study of water bearing characteristics of the above rocks**. • **Sedimentology** - Exercise - Size classification of sediments, sediment and rock fragments. • **Study of minerals** - Hand Specimens • **Structural geology** - Interpretations of topographical and geological maps.	
Module 3	• **Introduction to GIS software**-Familiarization of GIS software (ArcGIS/ QGIS) Geo-referencing, Shape file creation, Digitization techniques, Spatial Analysis, DEM, Slope, Aspects, Geo-processing, raster interpolation. Delineation of Watershed - Generation of drainage density and drainage frequency maps. Topology checker- layout preparation, Introduction to Google earth Interface.	
Module 4	• **Climogram Analysis** – Measurement of Rainfall and Graphical representation of rain fall data – Estimation of relative humidity using dry and wet bulb thermometer - Estimation of Sunshine duration and intensity – Atmospheric Temperature - Wind Velocity	

	and Direction • **Hydro-geological Analysis** – Measurement of Evaporation – Infiltration – Velocity of Water Current • **Wind Rose Analysis** – Interpretation of results	
References:	1. DebashisChakraborty,Rabi N. Sahoo (2007). Fundamentals of Geographic Information System-Viva Books, New Delhi. 2. MiroslavRadojevic, Vladimir Bashkin (1999). Practical Environmental Analysis, The Royal society of chemistry, Cambridge, UK. 3. Nesse, W. D. (2012). Introduction to mineralogy (No. 549 NES). 4. Perkins, Dexter. "Mineralogy." In the Beginning 17.17 (1998): 38.Prentice Hall, p484. 5. Remote Sensing and Image Interpretation. Thomas M. Lillesand and Ralph W. Kiefer, 3rd edn., Wiley, New York, 1994,750 pp., ISBN O-471-57783-9. 6. Thomas, M. L., Ralph, W. K., & Jonathan, W. C. (2000). Remote sensing and image interpretation. Jhon Wiley and sons, Newyork. **7.** William Lowrie , Andreas Fichtner (2020). Fundamentals of Geophysics, 3rd Edition, Cambridge university Press, uk.	
Course Outcome	The Course aims • The students will develop analytical skill in the respective areas • The students will study the basic principles of Remote sensing and GIS and to apply for practical studies • The students can understand the Geological features by practical methods • Able to conduct digital image processing • Develop skill to Apply GIS and Remote sensing techniques for Environmental analysis	

FOURTH SEMESTER MSc. ENVIRONMENTAL SCIENCE PROGRAMME

CORE COURSE

Course Code & Title	**MSEVS04P04 – PROJECT WORK**		
Class	M.Sc. Environmental Science	**Semester**	**IV**
Course Objectives	The Course aims To develop Research aptitude in the field of Environmental Sciences To develop skill to prepare research reports		

SYLLABUS

Modules	Activity	No. of Hours
Module	The students have to complete a research project during IV Semester in collaboration with any of the authorized research institutions located within or outside the state.	80

ELECTIVE COURSE

Course Code & Title	**MSEVS04E09 - INDUSTRIAL PROCESS AND WASTE MANAGEMENT**		
Class	M.Sc. Environmental Science	**Semester**	**IV**
Course Objectives	The Course aims • To know about the various industrial processes • To acquire knowledge on industrial specific pollutants • To gain knowledge on industrial waste management • To know about various control measures followed in industries • To understand the nature and characteristics of industrial emissions. • To impart knowledge on sources and characteristics of various industrial wastes and strategies for its prevention and control		

SYLLABUS

Modules	Content	No. of Hours
Module I	**Sugar, Distillery and Diary**: Manufacturing Process, Sources and characteristics of waste, effects of waste on receiving water system and waste water treatment techniques.	20
Module II:	**Pulp and paper mills, Textiles, Synthetic fibre and Dyes**: Manufacturing process, Sources, Characteristics and effects of pollutants and methods of waste water treatment.	20
Module III:	**Tanneries, Plastics, Rubber and Detergent:** Manufacturing process, sources, characteristics and effects of waste – water control methods.	15
Module IV:	**Fertilizers, oil refineries and Mineral acids**: Manufacturing, Sources, Characteristics, effects and control methods for waste water. **Cement, Pharmaceutical, food processing industry and Electroplating**: Process, Sources of waste, effects of waste and control measures.	25
References	**Reference Books:** 1. Industrial Pollution Control Handbook - HerbetF.Lund 2. Industrial chemistry - B.K.Sharma, Krishna Prakashan Media, 1991 3. Pollution Managements in Industries - R.K.Trivedy, Environmental Publications, 1989 4. Pollution Control in Process Industries - S.P.Mahajan, Tata McGraw-Hill Education, 1985 5. Industrial Pollution-N. Manivasakam.	
Course Outcomes	**On completion of the course, students should be able to** **CO1:** Gain knowledge on various industrial process **CO2:** Characterize and differentiate industrial emissions **CO3:** Evaluate specific pollutants of various industries **CO4:** Update the knowledge on control measures **CO5:** An insight into the pollution from major industries including the sources and characteristics of pollutants	

ELECTIVE COURSE

Course Code & Title	MSEVS04E10 - SUSTAINABLE DEVELOPMENT		
Class	II M.Sc. Environmental Science	**Semester**	IV
Course Objectives	The Course aims • To understand the status of environment • To assess the concept of sustainability on various sectors • To know actions taken against the climate change in the world and national level • To impart knowledge on the principles for balancing social, economic and environmental dimensions of development and the associated international and national frameworks • To learn about environmental management		

SYLLABUS

Modules	Content	No. of Hours
Module I: Challenges of sustainable development and global Environmental issues	Status of Global and Indian environment - Environmental, Social and Economical issues- Need for sustainability- Nine ways to achieve sustainability- population, resources, development and environment. Concept of sustainability - Factors governing sustainable development - Linkages among sustainable development - Environment and poverty - Determinants of sustainable development - Case studies on sustainable development - Population, income and urbanization - Health care - Food, fisheries and agriculture - Materials and energy flows.	**25**
Module II: Sustainable Development Indicators	Need for indicators – Statistical procedures – Aggregating indicators – Use of principal component analysis – Three environmental quality indices.	**15**
Module III: Environmental Assessment	National environmental policy act of 1969 – Environmental Impact Assessment – Project categories based on environmental impacts – Impact identification methods – Environmental impact assessment process.	**20**
Module IV: Environmental Management and Social Dimensions	Revisiting complex issues – Sector policies concerning the environment – Institutional framework for environmental management-Achievements in environmental management – People's perception of the environment – Participatory development – NGOs – Gender and development – Indigenous peoples –	**20**

	Social exclusion and analysis.	
Module V: Sustainable Development through Environmental Law	i) History of environmental law, environmental legislation in India, Central and state boards for the prevention and control of environmental pollution, powers and functions of pollution control boards, penalties and procedure, duties and responsibilities of citizens for environment protection ii) Wildlife Act 1972, Air and Water act, Water cess Act, Forest Act, Environmental protection Act 1986, Hazardous waste (Management and Handling) rules 1989, Bio medical waste (Management and Handling) rules 1998. Ministry of Environment and forests – notification relating to hazardous microorganisms and genetically modified organism 1999. Public liability insurance Act 1995. Noise pollution 2000. National environment tribunal Act 1995. iii) International cooperative movements. Global Environment monitoring systems (GEMS). Antarctica convention, Stockholm summit, UNCED and its four conventions- climate change biodiversity, desertification, tropical forest, Ramsar convention.	
References	**Reference Books:** 1 Sayer, J. and Campbell, B., "The Science of Sustainable Development: Local Livelihoods and the Global Environment" (Biological Conservation, Restoration &Sustainability), Cambridge University Press, London, 2003. 2. Kirkby, J., O"Keefe P. and Timberlake, "Sustainable Development", Earth scan Publication, London, 1993. 3. Peter P. Rogers, Kazi F. Jalal, John A. Boyd, "An introduction to sustainable development", Glen Educational Foundation, 2008. 4. Jennifer A. Elliott, "An introduction to sustainable development". London: Routledge: Taylor and Francis group, 2001. 5. Low, N. Global ethics and environment. London: Routledge. 1999. 6. Douglas Muschett, Principles of Sustainable Development, St. Lucie Press, 19	

Course Outcomes	On completion of the course, students should be able to
	CO1: Attaining the national and global environmental, economic and social issues and the principles of different sustainable development frameworks **CO2:** Applying the sustainable development principles during the planning of developmental activities

ELECTIVE COURSE

Course Code & Title	**MSEVS04E11– GENERAL VIVA**		
Class	M.Sc. Environmental Science	**Semester**	**IV**
Course Objectives	The Course aims • To test the understanding capability of students about the various courses.		

SYLLABUS

Modules	Content	No. of Hours
Modules 1	To conduct Viva voce by covering the Theory courses of all Semesters of the Programme.	**40**
Course Outcome	The students will follow Regular and repeated study to remember what they learned. Will help to develop understanding capability of students about the various courses.	

ELECTIVE COURSE

Course Code & Title	MSEVS04E12 – INDUSTRY VISIT		
Class	M.Sc. Environmental Science	**Semester**	**IV**
Course Objectives	The Course aims • To find out the observation skill and understanding capability of students about the various industrial operations and associated pollution emissions. • To equip the students to suggest proper mitigation measures for industrial pollutions.		

SYLLABUS

Modules	Content	No. of Hours
Modules 1	The students have to visit industries located within or outside the Kerala State and to prepare a report on industrial operations, pollution and mitigation measures.	**40**
Course Outcome	The students will get an idea about industrial operations. Will help to develop understanding capability of students about pollution associated with industries and to suggest mitigation measures	

SEMESTER IV – OPEN ELECTIVE

Course Code & Title	MSEVS04O01 - FUNDAMENTALS OF ENVIRONMENTAL SCIENCE		
Class	Open to other P.G courses	Semester	IV
Course Objectives	• To understand the basics of environment and its role • To assess the concept of ecology • To know the interaction of matter, energy and material cycling • To impart knowledge on the principles for balancing social, economic and environmental dimensions of human development • To learn about environmental management		

SYLLABUS

Modules	Content	No. of Hours
Module I:	Basics of environmental science - Definition, scope and importance. Natural Resources : Renewable and non-renewable resources : Natural resources and associated problems. a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. e) Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies. f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. • Role of an individual in conservation of natural resources. • Equitable use of resources for sustainable lifestyles.	**25**
Module II:	Ecosystems: Concept of an ecosystem. Structure and function of an ecosystem. • Producers, consumers and decomposers.	**15**

	• Energy flow in the ecosystem. • Ecological succession. • Food chains, food webs and ecological pyramids. • Introduction, types, characteristic features, structure and function of the following ecosystem :- a. Forest ecosystem b. Grassland ecosystem c. Desert ecosystem d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)	
Module III:	Environmental Pollution Definition • Cause, effects and control measures of :- a. Air pollution b. Water pollution c. Soil pollution d. Marine pollution e. Noise pollution f. Thermal pollution g. Nuclear hazards • Solid waste Management : Causes, effects and control measures of urban and industrial wastes. • Role of an individual in prevention of pollution. • Pollution case studies. Disaster management : floods, earthquake, cyclone and landslides	**20**
Module IV:	Social Issues and the Environment • From Unsustainable to Sustainable development • Urban problems related to energy • Water conservation, rain water harvesting, watershed management • Resettlement and rahabilitation of people; its problems and concerns. Case Studies • Environmental ethics: Issues and possible solutions. • Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies. • Wasteland reclamation. • Consumerism and waste products. • Environment Protection Act. • Air (Prevention and Control of Pollution) Act. • Water (Prevention and control of Pollution) Act • Wildlife Protection Act • Forest Conservation Act • Issues involved in enforcement of environmental	**20**

	legislation. • Public awareness.	
References	a) Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner. b) Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India, Email:mapin@icenet.net (R) c) Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p d) Clark R.S., Marine Pollution, Clanderson Press Oxford (TB) e) Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumabai, 1196p f) De A.K., Environmental Chemistry, Wiley Eastern Ltd. g) Down to Earth, Centre for Science and Environment (R) h) Gleick, H.P. 1993. Water in crisis, Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute Oxford Univ. Press. 473p i) Hawkins R.E., Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay (R) j) Heywood, V.H & Waston, R.T. 1995. Global Biodiversity Assessment. Cambridge Univ. Press 1140p. k) Jadhav, H & Bhosale, V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi 284 p. l) Mckinney, M.L. & School, R.M. 1996. Environmental Science systems & Solutions, Web enhanced edition. 639p. m) Mhaskar A.K., Matter Hazardous, Techno-Science Publication (TB) n) Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB) o) Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA, 574p	
Course Outcomes	**On completion of the course, students should be able to** **CO1:** Understand Importance of Environment, various ecosystem's structure, function and characteristics **CO2:** Acquired knowledge on species inter and intra species interaction **CO3:** Know Characterization of community and its dominance as well as co-existing with other community **CO4**: Realize the importance of protection and conservation of biodiversity **CO5:** To act on various Environmental Issues and try to restore precious Environment.	

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Head of the Department