

Veer Bahadur Singh Purvanchal University, Jaunpur
(A State University- Government of Uttar Pradesh; Accredited A⁺ by NAAC)



Ordinance and Syllabus

for

M. Sc. in Environmental Science

[Two-year (Four semesters) postgraduate degree program]

Faculty of Science
Under Choice Based Credit System (CBCS)
As per the guidelines of NEP-2020
w.e.f. 2024-25 (Session)

V.B.S. PURVANCHAL UNIVERSITY, JAUNPUR

Department of Environmental Science,

Faculty of Science

Vision

Department Environmental Science is committed to focusing on education, research, innovation, training and entrepreneurship to create a world class talent pool of competent and curious Environmentalists enabling them to take in national and global challenges.

Mission:

- To provide education to generate quality workforce which fulfill the professional and societal need nationally and globally.
- To create awareness about potentials of Environmental Science with socio-ethical implications.
- To impart quality education to the students and enhance their skills by instilling spirit of innovation and creativity, which make them nationally and globally competitive.
- To provide an environment for the students and faculty for personal and professional growth
- To promote collaboration with research institutions and industries at national and international level to enhance education and research

Syllabus Developed by:

S. No.	Name	Designation	Department	University
1	Prof. Rajesh Sharma	Convener, BOS, Environmental Science	Environmental Science	V.B.S. Purvanchal University, Jaunpur-222003
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Veer Bahadur Singh Purvanchal University, Jaunpur

Ordinance governing 2 Years (4 Semesters) Postgraduate Degree Programme

M.Sc.in Environmental Science

Faculty of Science

Under Choice Based Credit System (CBCS)

w.e.f. 2024-25 (Academic Session)

The following ordinance has been framed governing the admission, course structure, examination and other allied matters relating to the 2 Years (4 Semesters) Postgraduate Degree Programme (M.Sc.) in Environmental Science being offered by Veer Bahadur Singh Purvanchal University.

1. ADMISSION AND EXIT

- 1.1. All matters related to admission to M.Sc.-Environmental Science programme shall be dealt by the Admission Committee constituted by the University.
- 1.2. The M.Sc. Environmental Science course is open to science graduates (with 3 year undergraduate degree) with minimum of 50% of marks, from a recognized University (45% in case of SC/ST). Those who are appearing in final examination of B.Sc. (Biology / Life Sciences / Agriculture/ Mathematics / M.B.B.S / B. Pharm / B. tech and related subjects) degree can also apply for admission and shall be eligible to appear in the Entrance Test for admission but they will have to produce a proof of being a graduate at the time of admission. However, students of VBS Purvanchal University can be given provisional admission by the Admission Committee in case of delayed results.
- 1.3. Admission in M.Sc.- Environmental Science programme will be based on the Entrance Test or merit as per the rules of the university.
- 1.4. The intake of students in this programme shall be fixed by Veer Bahadur Singh Purvanchal University. The admission to M.Sc.- Environmental Science programme shall be made through a merit based on Written Test conducted by Veer Bahadur Singh **Purvanchal University Combined Admission Test(PUCAT)**. The reservation norms for admission in M.Sc.- Environmental Science programme shall be as per the Uttar Pradesh State Government/ University policy notified from time to time.
- 1.5. On selection for admission to the M.Sc.- Environmental Science programme, the candidate shall deposit the prescribed fees to get their admission confirmed within the stipulated time period by the Admission Committee of the Department. If the candidate fails to do so their admission shall be automatically liable to be cancelled and the seat falling vacant shall be offered to another candidate as per the merit/category. There is no provision of Fee concession/exemption under any circumstances except the case related to Social Welfare Department, Uttar Pradesh Government. Fee refund policy shall be applicable as per the university norms.
- 1.6. Admission to M.Sc.- Environmental Science programme cannot be claimed by any candidate as a matter of right. The Admission Committee of M.Sc.- Environmental Science

programme of the University shall have power to refuse, reject or cancel any admission if it possesses sufficient reasons to do so.

- 1.7. All teachers of the department shall function as Student Mentor (Advisors). Every student will be assigned a mentor (advisor) before commencement of the academic session to support the students for their overall development in all possible way related to their academics/cocurricular/extracurricular/sports/personality development/soft skill/ cultural activities and offer all possible student support services.

2. COURSES OF STUDY AND EXAMINATION

- 2.1. M.Sc. - Environmental Science Programme will be based on CBCS (Choice Based Credit System) mode and conducted in semester system.

- 2.2. M.Sc. 1st semester - 4 Theory papers of major/core courses (4 credit each) = 16 credits
1 Practical (4credits) = 4credits
1 Minor elective from other faculty (4 credits) = 4credits

1st semester there will be 24 credits.

- M.Sc. 2nd semester - 3 Theory papers of major/core courses (4 credits each) = 12 credits
1 Theory paper of major elective courses (4 credits) = 4 credits
1 Practical (4credits) = 4credits
1 Major/core Industrial Training/Surveys/Research Project = 8 credits

2nd semester there will be 28 credits.

Thus, 1st year of M.Sc. will be of 52 credits.

- M.Sc. 3rd semester - 3 Theory papers of major/core courses (4 credit each) = 12 credit
1 Theory paper of major elective courses (4 credit) = 4 credit
1 Practical (4credit) = 4credit

3rd semester there will be 20 credits.

- M.Sc. 4th semester - 4 Theory papers of major elective courses (4 credits each) = 16 credits
1 Practical (4credits) = 4credit
1 Major/core Industrial Training/Surveys/Research Project = 8 credits

4th semester there will be 28 credits.

Thus, 2nd year of M.Sc. will be of 48 credits.

Hence, two years (4 semesters) M.Sc.- Environmental Science programme is of 100 credits.

- 2.3. All four theory Major/core courses are compulsory in the first semester.
- 2.4. In the second and third semester, the student can choose one major elective course according to their interest and the resources available in the university /colleges.
- 2.5. All the theory papers in the fourth semester are major elective courses from which the student can choose any four elective courses as per their interest.
- 2.6. In the first year of post graduation, the student will have to take only 1 minor elective course from other faculty of 4(four) credits.
- 2.7. To conduct the M.Sc. - Environmental Science systematically and within a time bound frame, the department shall strictly adhere to academic calendar notified by the university in the beginning of academic session.

- 2.8. A candidate admitted to the M.Sc.- Environmental Science programme shall pursue a regular mode of study in all the four semesters and attend a minimum of 75% of the total classes held to be eligible for appearing in the semester examinations.
- 2.9. If a student fails to attend requisite classes (minimum of 75%) in a semester due to medical ground, there may be given relaxation of 15% attendance (5% at the level of Head of Department and 10% at the level of Vice-Chancellor) on production of medical certificate.
- 2.10. Semester examinations of the M.Sc.- Environmental Science programme shall be conducted by way of theory papers, practical and industrial training/surveys/research project. Each theory of major/core and elective paper will be of 100 marks out of which 75 marks shall be allocated for End Semester Examination (ESE) and 25 marks for Continuous Internal Evaluation (CIE). The pattern of question papers for theory examinations will be as per the University norms.
- 2.11. Continuous Internal Evaluation (CIE) is an integral part of the courses and is compulsory for all students. The academic performance of a student is evaluated by assessing day to day performance, attendance, assignments, periodic tests, seminar presentation, subject's quiz, class discussion, etc. There shall be no mid-term examination of CIE will be held rather a teacher assess the student along with the class teaching.
- The 25 Marks of CIE shall be allocated as given below:**
10 marks for Test/Subject' quiz,
10 marks for presentational along with assignment
05 marks for Class interactions, discussion, performance, attendance.
- 2.12. The responsibility of evaluating the internal assessment is vested on the teacher(s) who teaches the course.
- 2.13. One practical (4 credits of 100 marks) examination shall be conducted which will be assessed jointly by the internal examiner of the department and the external examiner nominated by the university at the end of each semester of 75 marks and 25 marks of internal practical are assessed by concerned teacher of the course and will be averaged before online submission.
- 2.14. The end semester examinations shall be held as per academic calendar notified by the university.
- 2.15. Industrial Training/Surveys /Research Project: In the first and second year, the student will have to do a major research project including internship/technical report/comprehensive review/online or field surveys work/training in industry or institute.
- 2.16. Industrial Training/Surveys/Research Project can also be interdisciplinary or multi-disciplinary.
- 2.17. The research project will be done under the guidance of a teacher (supervisor) of the department. In case of topic of the research project is interdisciplinary/ multidisciplinary, the student may carry out their research work under a Co-supervisor from outside the department viz Industry/Company/Technical Institute/Research Institute.
- 2.18. Bachelor's Degree (with Research) and postgraduate students will be required to undertake a research project of four credits (4 hours per week) in each semester.

- 2.19. Students will submit the final report (project report/dissertation) of the research project carried out in both the semesters at the end of the year, which will be assessed out of 100 marks - 8 credits jointly by the respective supervisor and the external examiner nominated by the university or as per the directive of university at the end of the academic year. The student has to submit a project report/dissertation/technical report in hard bound form duly certified by the supervisor. The evaluation of the project/dissertation/technical report/comprehensive review of the student will be done through presentation and viva-voce examination.
- 2.20. If a student publishes any research/review papers from their research project work in the UGC-CARE listed Journals and published during the Programme, then they can be given additional marks up to 25 in the evaluation of the research project (out of 100). The maximum received will be 100.
- 2.21. The marks obtained in the research project will be marked as grades and they will also be included in the calculation of CGPA.
- 2.22. It will be necessary to take the exam for credit validation. Credit will be incomplete without the examination.
- 2.23. If a student qualifies for the examination on the basis of attendance in the class, however, is not able to give the examination due to any reason, then they can appear for the qualifying examination as per university PG ordinance- 2023, however, they will not need to attend the classes again.
- 2.24. Matters pertaining to the syllabi and conduct of examinations shall be dealt with by the Board of Studies (BOS) constituted by the Vice-Chancellor.
- 2.25. The BOS shall recommend the panel of paper setters/examiners to the Vice-Chancellor. After getting approval from the Vice-Chancellor, the appointment letters shall be issued to the concerned paper setters/examiners by the Registrar/Controller of Examination of University.
- 2.26. Question papers for theory examination in sealed envelope shall be handed over/sent by registered post to the Registrar/Controller of Examination by the Examiners. Controller of Examinations will ensure the printing of question papers and fair conduct of the examinations.
- 2.27. The Registrar/Controller of the Examinations, with the approval of the Vice-Chancellor shall associate one or two members of the BoS for the moderation of the papers. The moderated papers shall have to be printed by the Registrar/Controller of the Examinations well before commencement of the Examinations.
- 2.28. After printing the questions papers in sealed covers, shall be handed over to the Examination Superintendent who will ensure the smooth and fair conduct of the examinations.
- 2.29. For appearing in the M.Sc.- Environmental Science semester examination each student shall have to deposit a prescribed examination fee along with a copy of online filled examination form for online verification. Separate fees will also be charged for back and improvement papers as per university norms.

- 2.30. After the examinations, Controller of Examinations/Technical Cell for campus courses shall ensure the evaluation of the answer books and declaration of results of semester examinations within a reasonable time so as to enable the department to adhere to the Academic Calendar.
- 2.31. Practical examinations of semester VII (M.Sc.- I sem.), VIII (M.Sc.- II sem.), IX (M.Sc.-III sem.) and X (M.Sc.-IV sem.) shall be conducted by one internal and one external examiner nominated by the university.
- 2.32. The students of M.Sc.- Environmental Science Programme shall be examined in the subjects in accordance with course curriculum and per the University PG programs ordinance-2023.

3. RESULTS, PROMOTION AND IMPROVEMENT

- 3.1. If a student wants to leave after passing the first year of post-graduation by earning a minimum of 52 credits, then he will be awarded a bachelor's (with research) degree. After earning a minimum of 52+48 credits in the first and second year of post graduation, the student will be awarded a master's degree in that main subject of that faculty.
- 3.2. The results of M. Sc. - Environmental Science semester examination shall be declared pass as per the University PG programs ordinance-2023.
- 3.3. If a student fails in more than 4 papers in an academic year, he/she will not be promoted to the next year. Such student should be re-admitted as Ex. Student with coming batch and their seat will be counted as supernumerary.
- 3.4. Students, who failed in 4 or lower number of papers in the academic year will be awarded back and given two chances to re appear and pass in respective paper(s) in next year and the following year with regular semester examination. There will not be any supplementary/special examination for back/improvement papers. However, all such papers must be cleared within two years ending fourth semester.
- 3.5. In order to pass the 2-year M.Sc. - Environmental Science programme the students must pass both the year separately. The final result shall be declared on the basis of the combined marks secured by a candidate in all the four semesters as per the University PG programs ordinance-2023.
- 3.6. Student securing highest number of marks during the course in the first attempt will be awarded the University Gold Medal for the same.
- 3.7. Conversion of Marks into Grades, Grade points and CGPA calculation shall be applicable as per University PG programs ordinance-2023.

Programme structure:

The M.Sc. Environmental Science programme is a two-year course divided into four-semesters. A student is required to complete hundred (100) credits for the completion of course and the award of degree.

First Year	Semester -I	Semester -I
Second Year	Semester -III	Semester -IV

V.B.S. PURVANCHAL UNIVERSITY, JAUNPUR 222003

Syllabus

Master of Science in Environmental Science (M. Sc. Environmental Science)

Designed as per Syllabus Development Guidelines of

National Education Policy-2020 (NEP-2020)

Fourth Year / M.Sc. – Environmental Science 1 st Year										
Program me	Semester	Course Code	Course Type	Paper Title	Theory Practical /Project	Credit	Maximum Marks			
							CIE	ESE	Total	
Bachelor's Degree (with Research)	VII (M.Sc I)	B150701T	Major/ Core	Ecosystem Dynamics	Theory	4	25	75	100	
		B150702T	Major/ Core	Environmental Chemistry	Theory	4	25	75	100	
		B150703T	Major/ Core	Instrumentation	Theory	4	25	75	100	
		B150704T	Major/ Core	Environmental Microbiology and Biotechnology	Theory	4	25	75	100	
			Minor Elective	Other Faculty	Theory	4	25	75	100	
		B150705P	Major/ Core	Practical-1	Practical	4	25	75	100	
								24		
	VIII (M.Sc II)	B150801T	Major/ Core	Water Pollution	Theory	4	25	75	100	
		B150802T	Major/ Core	Atmospheric (Air & Noise) Pollution	Theory	4	25	75	100	
		B150803T	Major/ Core	Soil Pollution and Management	Theory	4	25	75	100	
		B150804T	Major Elective Course 1*	Natural resources and its harnessing	Theory	4	25	75	100	
		B150805T	Major Elective Course 2*	Solid Waste Management	Theory	4	25	75	100	
		B150806P	Major/ Core	Practical –II	Practical	4	25	75	100	
		B150807R	Major/ Core	Industrial Training / Survey / Research Project	Industrial Training / Survey / Research Project	8	25	75	100	
	*Student opt only one Major Elective Course out of TWO						28			600
	Credit (1 st Year of M.Sc.)						52			1200

CIE-Continuous Internal Evaluation

ESE – End Semester Examination

Fourth Year / M.Sc. – Environmental Science 2 nd Year										
Program me	Semester	Course Code	Course Type	Paper Title	Theory Practic al /Project	Credit	Maximum Marks			
							CIE	ESE	Total	
Master of Science in Environmental Science	IX (M.Sc.III)	B150901T	Major /Core	Eco conservation and Sustainable Development	Theory	4	25	75	100	
		B150902T	Major /Core	Climatology and Meteorology	Theory	4	25	75	100	
		B150903T	Major /Core	Environmental Geosciences	Theory	4	25	75	100	
		B150904T	Major Elective Course 1*	Environmental Toxicology	Theory	4	25	75	100	
		B150905T	Major Elective Course 2*	Wildlife Management	Theory	4	25	75	100	
		B150906P	Major /Core	Practical –III	Practical	4	25	75	100	
	*Student opt only one Major Elective Course out of TWO							20		500
	X (M.Sc. IV)	B151001T	Major Elective Course 1*	Environmental Management, EIA & legislation	Theory	4	25	75	100	
		B151002T	Major Elective Course 2*	Bio statistics, Bioinformatics & IPR	Theory	4	25	75	100	
		B151003T	Major Elective Course 3*	Systematic & Biogeography	Theory	4	25	75	100	
		B151004T	Major Elective Course 4*	Green Technologies	Theory	4	25	75	100	
		B151005T	Major Elective Course 5*	Energy & Environment	Theory	4	25	75	100	
		B151006T	Major Elective Course 6*	Remote Sensing, Geographic Information System & Modeling	Theory	4	25	75	100	
		B151007P	Major /Core	Practical –IV	Practical	4	25	75	100	
		B151008R	Major /Core	Research (Dissertation /Project work)	Industrial Training / Survey / Research Project	8				
	*Student opt only four Major Elective Course out of SIX						28		600	
	Credit (2nd Year of M.Sc.)						48			1100
	Total Credit						100			2300

CIE-Continuous Internal Evaluation

ESE – End Semester Examination

PROGRAMME SPECIFIC OUTCOMES (PSOs)

Bachelor's Degree with Research /M. Sc.-Environmental Science

PSO1:At the time of completion of the programme the student will have developed extensive knowledge in various areas of Environmental Science through the stimulus of scholarly progression and intellectual development.

PSO2:The aim of programme is to form equipped students with excellence in education and skills, thus students become able to choose a career of his/her choice by cultivating talents and promoting all round personality development through multi-dimensional education.

PSO3:Design and conduct experiments, as well as to analyze and interpret scientific data and able to carry out independent as well as collaborative research in specialized areas of Environmental science

PSO4Write and present technical report, projects in the field of Biotechnology and also understand the importance of professional ethics. Students will be able to understand the issue of plagiarism in research and importance of copyrights. Students will also gain knowledge about various ethical issues associated with biotechnology.

PSO5: Develop solution for major Environmental problems by applying appropriate tools., in addition students will be able to implement the scientific skills for development of entrepreneurship.

M. Sc. Environmental Science

Programme Objectives (POs)

The aim of two years programme is to build conceptual and fundamental understanding among students to exposing the basic principles behind various environmental processes (Abiotic and Biotic).

PSO1: To introduce students to the concepts of ecology, Environmental Chemistry, Instrumentation and Environmental Microbiology & Biotechnology for deep analysis of mystery of environment and issue related to environment.

PSO2: They also are able to understand the good laboratory practices and to know the strategies for sustainable management and carrying capacity Educate the students on source, classification, and impact of air, water and soil pollution. The students will also recognize the various control measures of pollution problems. Understand the solid waste pollution, noise pollution, radioactive and thermal pollution and related consequences.

PSO3: Students aware about biodiversity of India, bio-geographic zones and role of local communities and traditional knowledge in conservation and to know the strategies for sustainable management of wastes.

PSO4: To develop the understanding on natural resources and their significance, basic principles and application of remote sensing and GIS techniques. Understand the application of microbes for production of different eco-friendly products.

PSO5: Impart knowledge in molecular biotechnology and its applications in Environmental management and conservation. Make students aware about EIA, Bioethics, bio-safety, IPR, basic laws, act, treaty, public policies and PIL. Environment provisions in constitution, power and functions of government agencies for pollution control.

Program Educational Objectives (PEOs)

The **M. Sc. Environmental Sciences** program describes the deep scientific understanding to the post graduates students and strengthens the diverse emerging research to manage environmental issues.

The course provides the opportunities to avail jobs/ positions in the field of academic / R & D / Industries / consultancy/Government and non government sectors.

PEO1- The students could get employment opportunities in Central Pollution Control Board (CPCB) and State Pollution Control Board (SPCB), Research Institutions, Colleges, Universities and Non-governmental organizations. Students could get opportunities for higher research (Ph. D) and scientific activities across the globe.

PEO2- After successful completion of the course, the students could get job opportunities in urban and rural environmental mitigation and awareness including social forestry programs, bio-fertilizer and bio-pesticide industries, waste management and organic farming divisions funded by National, International and Regional agencies.

PEO3- The students could get employment perspectives in R & D laboratories of waste water treatment plants, metal, chemical and textile effluent treatment plants, municipal solid waste management units and waste management in biomedical industries and hospitals.

PEO4- The students could find employment opportunities in agro industries, forest departments, water harvesting and watershed management sectors, bio-resource utilization and biodiversity conservation organizations, food and feed Industries, environment friendly and integrated livestock management sectors.

PEO5- Students also having the immense opportunities to pursue higher studies in various research fields such as environmental pollution, environmental chemistry, waste management and bioremediation, environmental microbiology, waste water treatment, recycle, reuse and management, sustainable environmental food security, bio-resource utilization and biodiversity conservation, functional and ecosystem ecology, environmental toxicology, agro-waste ecosystem, non-biodegradable synthetic chemicals and polymers in environment, occupational health and industrial safety, environment analytical techniques, environmental impact assessment, remote sensing and geographical information system, environmental biotechnology, carbon sequestration, natural disaster management and mitigation, climate change, marine pollution and resources utilization, restoration of different ecosystems, renewable and green energy and environmental law, policies and auditing.

Programme/Class: Bachelor's Degree with Research / M. Sc. Environmental Science (I)		Year: First (1)	Semester: First (I)
Subject: Environmental Science			
Course Code: B150701T		Course Title: <i>Ecosystem Dynamics</i>	
Course Outcomes (COs)			
<p>CO1 Strengthen the deep knowledge about natural and engineered ecosystem</p> <p>CO2 To build the fundamental concept of Environment</p> <p>CO3 To understand the basic principles of energy subsidies</p> <p>CO4 To understand the model of ecology</p> <p>CO5 To aware fundamental knowledge of ecological productivity.</p>			
Credits: 4		Core Compulsory	
Maximum Marks: 100 (75(ESE)+25(CIE))		Minimum Passing Marks: As per University norms	
Suggested Reading			
Unit	Topics		No. of Lectures
I	Structure, types & function of ecosystem, Homeostasis, Factor of distribution and adaptation; Food chain and Energy flow, Energy Subsidy, Ecological Pyramids		12
II	Concept of productivity, Methods for productivity measurement, Ecological efficiency, Global pattern of productivity.		12
III	Ecological succession, succession models and concept of climax, trends in succession. Structure of the community, analytical and synthetic characters, climax community, Methods of sampling of community.		12
IV	Biological cycling of C, N, S, P and Hydrological cycle. Cycling of non-essential elements, nutrient cycling in tropical forest.		12
V	Ecology of population, Population growth, carrying capacity, biotic potential, interaction models for single and interacting species- Malthus model and Lotka-Volterra model. Inter-specific associations.		12

Suggested Books:		
1. Fundamentals of Ecology	E.P. Odum	
2. Essentials of Ecology	John L. Harper and Michael Begon	
3. Environmental Sciences	Robert M Shaoh	
4. Environmental Science	Andrew RW & Julie M Jackson	
5. Ecology and The Environment	Russell K Manson	
6. Silent Spring	Rachel Carson	
7. Ecosystem	PD Sharma	
8. From the past to future	Richard HW Bradshaw & Martin T Sykes	
Suggested Continuous Internal Evaluation (CIE) methods		
Continuous Internal Evaluation shall be based on Class test, presentation along with assignment and class interactions. Marks shall be as follows		
Total marks: 25		
10 marks for Test		
10 marks for presentation along with assignment		
05 marks for Class interactions		
Programme/Class:		
Bachelor's Degree with Research / M. Sc. Environmental Science (I)	Year: First (1)	Semester: First (I)
Subject: Environmental Science		
Course Code: B150702T	Course Title: <i>Environmental Chemistry</i>	
Course Outcomes (COs)		
On successful completion of this course, student will be able:		
CO1 To aware the fundamentals about chemistry which deals in Environment		
CO2 To aware chemical phenomenon of environment		
CO3 To understand the pollutants behavior in nature		
CO4 To aware the real chemistry require to correct environmental issue		
CO5 To know the limitation of chemistry		
Credits: 4	Core Compulsory	
Maximum Marks: 100 (75(ESE)+25(CIE))	Minimum Passing Marks: As per University norms	
Unit	Topics	No. of Lectures

I	Thermodynamic states of the system, first law of thermodynamics, adiabatic transformation, second law of thermodynamics, Carnot cycle, Entropy, Gibbs free energy.	12						
II	Chemical potential and chemical equilibrium. Acid - base reactions; Solubility and solubility product. Carbonate equilibria (system). Stoichiometry.	12						
III	Structure and physicochemical properties of water, acidity and alkalinity. Solubility's and reaction of gases in water. Chelation. Polyphosphate in water.	12						
IV	Structure and physicochemical properties of atmosphere. Thermo-chemical and photochemical reactions in atmosphere. Chemistry of particulate and gaseous pollutants. Photochemical smog formation. Acid – base reaction in the atmosphere (acid rain). Ozone formation and depletion processes.	12						
V	Principle of Green Chemistry	12						
Suggested Reading								
<table style="width: 100%; border: none;"> <tr> <td style="width: 50%;">1. Environmental Chemistry</td> <td>James E. Gurrard</td> </tr> <tr> <td>2. Environmental Chemistry</td> <td>Stanly.e.manchen</td> </tr> <tr> <td>3. Environmental Chemistry</td> <td>A.K. De</td> </tr> </table>			1. Environmental Chemistry	James E. Gurrard	2. Environmental Chemistry	Stanly.e.manchen	3. Environmental Chemistry	A.K. De
1. Environmental Chemistry	James E. Gurrard							
2. Environmental Chemistry	Stanly.e.manchen							
3. Environmental Chemistry	A.K. De							
Suggested Continuous Internal Evaluation (CIE) methods								
<p>Continuous Internal Evaluation shall be based on Class test, presentation along with assignment and class interactions. Marks shall be as follows</p> <p>Total marks: 25 10 marks for Test 10 marks for presentation along with assignment 05 marks for Class interactions</p>								

Programme/Class: Bachelor's Degree with Research / M. Sc. Environmental Science (I)	Year: First (1)	Semester: First (I)
Subject: Environmental Science		
Course Code: B150703T	Course Title: <i>Instrumentation</i>	
Course Outcomes (COs)		
CO1 To aware the fundamentals about instruments		
CO2 To aware the fundamentals principles of instruments		
CO3 To know the handling of instruments		

CO4 To aware the real instruments require for experiment specifically		
Credits: 4	Core Compulsory	
Maximum Marks: 100 (75(ESE)+25(CIE))	Minimum Passing Marks: As per University norms	
Unit		
Unit	Topics	No. of Lectures
I	Types and application of different microscopes. Design and function scanning and transmission electron microscope.	12
II	Water and air samplers and their applications. Principles, design and application of centrifuges and electrophoresis.	12
III	Beer Lambert Law. Principle, design and application of Spectrophotometer in environmental research.	12
IV	Principle, design and application of Flame photometer and Atomic Absorption Spectrophotometer in elemental analysis of environmental samples.	12
V	Principles of Chromatographic techniques, types of chromatography and their applications. Design and application of Gas Chromatograph and HPLC.	12
Suggested Reading		
Suggested Books:		
<ol style="list-style-type: none"> 1. Standard Methodology of Biochemical Analysis S K Thimmayiah 2. Practical Biochemistry K Willson & John Walker 		
Suggested Continuous Internal Evaluation (CIE) methods		
Continuous Internal Evaluation shall be based on Class test, presentation along with assignment and class interactions. Marks shall be as follows		
Total marks: 25 10 marks for Test 10 marks for presentation along with assignment 05 marks for Class interactions		
Programme/Class:		
Bachelor's Degree with Research / M. Sc. Environmental Science (I)	Year: First (1)	Semester: First (I)
Subject: Environmental Science		

Course Code: B150704T		Course Title: <i>Environmental Microbiology & Biotechnology</i>
Course Outcomes (COs)		
Upon completion of this course, the students will be able to:		
CO1 To aware fundamental knowledge of microbiology and Biotechnology		
CO2 Students buildup the application of biotechnological means to save our environment.		
CO3 To know about relevant biotechnological tools & techniques and Understand the role of microbes in bioremediation of environmental pollutants		
CO4 To develop the molecular understanding of genetic material and Proteins		
CO5 To aware about microbiological and Biotechnological tools is benefited than others		
Credits: 4		Core Compulsory
Maximum Marks: 100 (75(ESE)+25(CIE))		Minimum Passing Marks: As per University norms
Suggested Reading		
Unit	Topics	No. of Lectures
I	Introduction to microbes, general characteristics, nutritional types; and microbial diversity. Brief introduction, isolation and characterization of microorganisms. Microbial interactions.	12
II	Effect of environmental factors on growth and activities of microbes in air, water and soil. Microorganisms in extreme environment viz. Thermophiles, Halophiles and Acidophiles.	12
III	Role of microbes in Fermentation technology & Agricultural fertility: biofertilizer, vermiculture technology and biopesticide, Nitrogen fixation.	12
IV	Microbial Toxins and environmental hazards. Translocation of toxicants, biotransformation & bio activation of toxicants. Role of microorganisms in the degradation of man-made compounds; pesticides (chlorinated hydrocarbons), synthetic polymers (plastic).	12
V	Types of bioremediation. Application of bioremediation in removal of metals, oil spills and xenobiotic compounds. Accumulation of heavy metals and radionuclides and their recovery.	12

<ol style="list-style-type: none"> 1. Environmental biotechnology –S.N Jogdand 2. Environmental biotechnology –Pradipta KumarMohapatra 3. Environmental Microbiology –R.G. Buckley 4. Biotechnology- -B.D.Sharma 5. Practical Biochemistry- - K Willson & John Walker 6. Prescott, Harley & Klein’s Microbiology, – Willey, Sherwood and Woolverton. 7. Microbiology – M.J. Pelczar, E.C.S. Chan & N.R. Kreig.. 8. Microbiology – Principles &Exploration , J.G. Black 9. General Microbiology – R.Y. Stanier, J.L Ingraham, M.L. Wheelis, P.R. Painter, 		
Suggested Continuous Internal Evaluation (CIE) methods		
<p>Continuous Internal Evaluation shall be based on Class test, presentation along with assignment and class interactions. Marks shall be as follows.</p> <p>Total marks: 25 10 marks for Test 10 marks for presentation along with assignment 05 marks for Class interactions</p>		
Subject: Environmental Science		
Programme/Class: M. Sc. Environmental Science	Year: First (1)	Semester: First (I)
Subject: Environmental Science		
Course Code: to be provided by other faculty	Course Title: Minor (Other Faculty)	
Minor Other Faculty: 1(one) minor elective paper from any other faculty (a subject other than the main subject)		
Credits: 4	Minor elective (Optional)	
Maximum Marks: 100 (75(ESE)+25(CIE))	Minimum Passing Marks: As per University norms	
Suggested Continuous Internal Evaluation (CIE) methods		
<p>Continuous Internal Evaluation shall be based on Class test, presentation along with assignment and class interactions. Marks shall be as follows</p> <p>Total marks: 25 10 marks for Test 10 marks for presentation along with assignment 05 marks for Class interactions</p>		
Subject: Environmental Science		
Programme/Class: Bachelor’s Degree with Research / M. Sc. Environmental Science (I)	Year: First (1)	Semester: First (I)
Subject: Environmental Science		
Course Code: B150705P	Course Title: <i>practical -1</i>	

Credits: 4	Core Compulsory
Maximum Marks: 100 (75(ESE)+25(CIE))	Minimum Passing Marks: As per University norms
Topics	
	No. of Lectures
<ol style="list-style-type: none"> 1. Field study of ecosystems (grassland). 2. Study the Solid waste degradation by microbes. 3. To study the community by quadrat method by determining Frequency, Density and Abundance of different species present at sampling area. 4. Estimation of weed status, with emphasis on compatibility within/among the weeds. 5. Determine the minimum size of quadrat by species area curve method. 6. Determine the total hardness of given water sample. 7. Determine the alkalinity of given water sample. 8. Determine the free CO₂ content in given water sample. 9. Estimate the chloride content in given water sample. 10. Determine the acidity of water sample. 11. Stress determination on plant, fungi and bacteria. 12. Estimation of chlorophyll content of different plant leaves under stress 13. Separation of chlorophyll pigment by paper chromatography. 14. Separation of protein by paper chromatography. 15. Separation of amino acid by thin-layer chromatography. 16. Protein profiling by SDS-PAGE. 17. Measurement of light intensity. 18. Agarose-Gel electrophoresis <ol style="list-style-type: none"> a. Estimation of protein by <i>Bradford's</i> and <i>Folin Lowry's</i> method 19. Washing and Sterilization of Lab wares. 20. Media preparation for growing (i) Bacteria (ii) Moulds (iii) Yeast. 21. Culturing of Microorganisms – (i) Slant preparation (ii) Suspension culture (iii) Streaking (iv) Plating. 22. Pipetting Techniques, Calculations/Dilutions/ Conversion/ Solutions/. 23. Introduction –Basic principles and handling of: <ol style="list-style-type: none"> a. Balances b. pH meter c. Centrifuges d. Spectrophotometer e. Colorimeter 24. Isolation of Bacteria from soil and water. 25. Staining of bacteria (Gram +ve and Gram -ve). 26. Study the Biochemical test for identification of microbes. 27. Study the Solid waste degradation by microbes. 28. Isolation of nitrogen fixing bacteria through selective media. 	120

Programme/Class: Bachelor's Degree with Research / M. Sc. Environmental Science (I)		Year: First (1) Semester: Second (II)	
Subject: Environmental Science			
Couse Code: B150801T		Course Title: Water Pollution	
Course Outcomes (COs)			
<p>CO1 To aware fundamental about water pollution and their impact</p> <p>CO2 To know the thrust area of water pollution</p> <p>CO3 To know about relevant tools and techniques of water pollution monitoring</p> <p>CO4 To develop the concept of water characteristic</p> <p>CO5 To aware about marine water pollution</p>			
Credits: 4		Core Compulsory	
Maximum Marks: 100 (75(ESE)+25(CIE))		Minimum Passing Marks: As per University norms	
Suggested Reading			
<p>1. Water Pollution V.K. Kudesia & Emminual Pulmen</p>			

2. Aquatic Pollution Edward A –laws 3. Surface water pollution and its control K V Ellis 4. A Text Book of water pollution and water quality indicators a. Kugamoorthy & Belautha morthy (Lambert Academic Publisher)		
Suggested Continuous Internal Evaluation (CIE) methods		
Continuous Internal Evaluation shall be based on Class test, presentation along with assignment and class interactions. Marks shall be as follows Total marks: 25 10 marks for Test 10 marks for presentation along with assignment 05 marks for Class interactions		
Programme/Class: Bachelor's Degree with Research / M. Sc. Environmental Science (I)		
Year: First (1)		Semester: Second (II)
Subject: Environmental Science		
Course Code: B150802T		Course Title: Atmospheric (Air & Noise) Pollution
Course Outcomes (COs)		
CO1 To know the deep and fundamental about atmosphere CO2 Develop the concept and source of pollutants in air CO3 To know about noise and noise pollution CO4 To develop the concept noise propagation CO5 To know the deep and fundamental about hazardous nature of noise		
Credits: 4		Core Compulsory
Maximum Marks: 100 (75(ESE)+25(CIE))		Minimum Passing Marks: As per University norms
Unit		
Unit	Topics	No. of Lectures
I	Structure and physicochemical properties of atmosphere. Thermo-chemical and photochemical reactions in atmosphere. Chemistry of particulate and gaseous pollutants. Photochemical smog formation. Acid – base reaction in the atmosphere (acid rain). Ozone formation and depletion processes.	12
II	Types and sources of air pollutants (primary and secondary pollutants). Methods of collection of air pollutants. Effects of pollution on living and	12

	non-living. Bio-indicators of atmospheric pollution.	
III	Air quality standard & criteria. Management of air pollutants (SO _x , NO _x , O ₃ , Hydrocarbon, PAN, SPM).	12
IV	Sources of noise pollution. Measurement of noise and indices. Effect of meteorological parameters on noise propagation. Noise exposure level & standards.	12
V	Decibel scale of loudness, addition of loudness, percentile level & equivalent sound pressure levels (Leq.). Noise pollution by supersonic transmission, sonic boom. Infra & Ultra sound sources & hazards. Hearing protection devices & Effect of noise on man. Noise control measures.	12
Suggested Reading		
<ol style="list-style-type: none"> 1. The Atmosphere: An Introduction to Meteorology- Frederick K Lutgens & Edward J 2. Green House and Earth Annika Nilsson 3. Environmental sciences Denial d chiras 4. Environmental sciences Ginger smith 5. Ozone in the Free Atmosphere Robert C. Whitten & Sheos Prasad 		
Suggested Continuous Internal Evaluation (CIE) methods		
<p>Continuous Internal Evaluation shall be based on Class test, presentation along with assignment and class interactions. Marks shall be as follows</p> <p>Total marks: 25</p> <p>10 marks for Test</p> <p>10 marks for presentation along with assignment</p> <p>05 marks for Class interactions</p>		
Programme/Class: Bachelor's Degree with Research / M. Sc. Environmental Science (I)		Year: First (1) Semester: Second (II)
Subject: Environmental Science		
Course Code: B150803T		Course Title: <i>Soil Pollution and Management</i>
Course Outcomes (COs)		
<p>Upon completion of this course, the students will be able to:</p> <p>CO1 To build the concept of soil and their genesis</p> <p>CO2 Develop the concept and source of soil pollutants</p> <p>CO3 To know about synthetic fertilizers and their impacts on environment</p>		

CO4 To develop the concept of soil management		
CO5 To know about solid waste regarding soil		
Credits: 4		Core Compulsory
Maximum Marks: 100 (75(ESE)+25(CIE))		Minimum Passing Marks: As per University norms
Suggested Reading		
Unit	Topics	No. of Lectures
I	Soil formation and weathering, Primary and secondary minerals. Soil organic matter, C/N ratio. Anion and cation exchange phenomenon, Buffering capacity.	12
II	Sources of soil pollution: Pesticides in soil, fate of pesticides, industrial effluent and soil pollution. Inorganic contaminant in soil: Metal and radionuclides.	12
III	Different kinds of synthetic fertilizer and their interactions with biotic and abiotic components of soil.	12
IV	Soil management: Reclamation of acid/alkaline/saline/sodic soil. Soil erosion and its control.	12
V	Soil management: Reclamation of acid/alkaline/saline/sodic soil. Soil erosion and its control.	12
Suggested Continuous Internal Evaluation (CIE) methods		
<p>Continuous Internal Evaluation shall be based on Class test, presentation along with assignment and class interactions. Marks shall be as follows.</p> <p>Total marks: 25 10 marks for Test 10 marks for presentation along with assignment 05 marks for Class interactions</p>		
Programme/Class: Bachelor's Degree with Research / M. Sc. Environmental Science (I)	Year: First (1)	Semester: Second (II)

Subject: Environmental Science		
Course Code: B150804T		Course Title: <i>Natural Resources and Their Harnessing</i>
Course Outcomes (COs)		
After completion of the course, a student will be able to		
CO1 To aware about fundamental and deep knowledge of natural resources		
CO2 To buildup the concept of conservation of natural resources		
CO3 Students aware about mineral resources		
CO4 Students buildup the energy conservation, carbon foot print		
CO5 To aware about the Sustainable Management of wildlife		
Credits: 4		Elective
Maximum Marks: 100 (75(ESE)+25(CIE))		Minimum Passing Marks: As per University norms
Unit		
Unit	Topics	No. of Lectures
I	Natural resources - definition, classification, conservation, Management, and Functions of important national & international organizations.	12
II	Energy resources, management and their impact: Source of energy: Solar, fossil fuel, hydroelectric power, tidal, wind, geothermal, nuclear energy, Magneto-hydrodynamics and bio-energy (bio ethanol bioplastics).	12
III	Mineral resources and environmental impact of mineral exploitation. Carbon-sequestration. Carbon credit. Carbon foot print.	12
IV	Water resources: Global water balance, Degeneration of water resources. Conservation of ground and surface water resources. Rain water harvesting.	12
V	Management of wildlife and forest resource.	12
Suggested Reading		
1. Introduction to forestry and Natural Resources	Donald L Grebner, Pete Bettinger	Jacek P. Siry
2. Energy and the Environment	Robert A Ristinen, Jack P. Kraushaar	
3. Introduction to energy,		
4. The environment and sustainability	Paul Gannon	
5. Natural resources and Environmental Justice	Rakuten Kobo	

6. Sustainable Utilization of Natural Resources	AK Dalai	
7. The environmental & natural Resources Economics	Jonathan M Harris and Brian Roach	
Suggested Continuous Internal Evaluation (CIE) methods		
Continuous Internal Evaluation shall be based on Class test, presentation along with assignment and class interactions. Marks shall be as follows. Total marks: 25 10 marks for Test 10 marks for presentation along with assignment 05 marks for Class interactions		
Programme/Class: Bachelor's Degree with Research / M. Sc. Environmental Science (I)	Year: First (1) Semester: Second (II)	
Subject: Environmental Science		
Couse Code: B150805T	Course Title: <i>Solid Waste Management</i>	
Course Outcomes (COs)		
Students should be able to gain the CO1 To aware fundamental about Solid waste CO2 Students buildup the concept of impact of solid waste on environment. CO3 To know about relevant techniques of solid waste collection CO4 To develop the concept of solid waste management CO5 To aware about Integrated waste management		
Credits: 4	Elective	
Maximum Marks: 100 (75(ESE)+25(CIE))	Minimum Passing Marks: As per University norms	
Unit		
Unit	Topics	No. of Lectures
I	Sources, generation and classification of solid waste, solid waste management plan.	12
II	Impact of solid waste on environment, human and plant health; effect of solid waste and industrial effluent discharge on water quality and aquatic life.	12
III	Different techniques used in collection, storage, transportation and disposal of solid waste.	12
IV	5R concept- reduces, reuse, recycle, recover and reform of solid waste	12

	management, green techniques for waste treatment.	
V	Concept of Integrated waste management; waste management hierarchy; methods and importance of Integrated waste management.	12
Suggested Reading		
<ol style="list-style-type: none"> Improving Municipal Solid waste Management in India Zhu, D., Asnani, P.U., Zurbrugg, C., Anapolsky, S. & Mani, S. 2008. a. The World Bank, Washington D.C. Solid waste management. India Infrastructure Report 570 Asnani, P.U. 2006. 		
Suggested Continuous Internal Evaluation (CIE) methods		
Continuous Internal Evaluation shall be based on Class test, presentation along with assignment and class interactions. Marks shall be as follows.		
Total marks: 25		
10 marks for Test		
10 marks for presentation along with assignment		
05 marks for Class interactions		
Programme/Class:		
Bachelor's Degree with Research /		Year: First (1)
M. Sc. Environmental Science (I)		Semester: Second (II)
Subject: Environmental Science		
Course Code: B150806P		Course Title: Practical-2
Credits:4		Core Compulsory
Maximum Marks: 100 (75(ESE)+25(CIE))		Minimum Passing Marks: As per University norms
Topics		
		No. of Lectures
<ol style="list-style-type: none"> Field study of ecosystems (grassland). Study the Solid waste degradation by microbes. To study the community by quadrat method by determining Frequency, Density and Abundance of different species present at sampling area. Estimation of weed status, with emphasis on compatibility within/among the weeds. Determine the minimum size of quadrat by species area curve method. Determine the total hardness of given water sample. Determine the alkalinity of given water sample. Determine the free CO₂ content in given water sample. Estimate the chloride content in given water sample. Determine the acidity of water sample. Stress determination on plant, fungi and bacteria. Estimation of chlorophyll content of different plant leaves under stress 		120

<p>13. Separation of chlorophyll pigment by paper chromatography. 14. Separation of protein by paper chromatography. 15. Separation of amino acid by thin-layer chromatography. 16. Protein profiling by SDS-PAGE. 17. Measurement of light intensity. 18. Agarose-Gel electrophoresis a. Estimation of protein by <i>Bradford's</i> and <i>Folin Lowry's</i> method 19. Washing and Sterilization of Lab wares. 20. Media preparation for growing (i) Bacteria (ii) Moulds (iii) Yeast. 21. Culturing of Microorganisms – (i) Slant preparation (ii) Suspension culture (iii) Streaking (iv) Plating. 22. Pipetting Techniques, Calculations/Dilutions/ Conversion/ Solutions/. 23. Introduction –Basic principles and handling of: a. Balances b. pH meter c. Centrifuges d. Spectrophotometer e. Colorimeter 24. Isolation of Bacteria from soil and water. 25. Staining of bacteria (Gram +ve and Gram -ve). 26. Study the Biochemical test for identification of microbes. 27. Study the Solid waste degradation by microbes. 28. Isolation of nitrogen fixing bacteria through selective media.</p>				
Programme/Class: Bachelor's Degree with Research / M. Sc. Environmental Science (I)	Year: First (1)	Semester: Second (II)		
Subject: Environmental Science				
Couse Code: B150807R	Course Title: Industrial Training/Surveys/Research Project			
This research project can be interdisciplinary / multi-disciplinary. This research project can also be in the form of industrial training / internship / survey work etc.				
Credits: 8	Core Compulsory			
Maximum Marks: 100*	Minimum Passing Marks: As per University norms			
* Students will submit the final report (project report/dissertation) of the research project carried out in both the semesters at the end of the year, which will be assessed jointly by the supervisor and the external examiner nominated by the university at the end of the year out of 100* marks				
Programme/Class: M. Sc. Environmental Science (II)	Year: Second(2)	Semester: Third (III)		

Subject: Environmental Science		
Course Code: B150901T		Course Title: <i>Eco conservation and Sustainable Development</i>
Course Outcomes (COs)		
<p>This course introduces the basic principles of Eco conservation and Sustainable Development and after completion of this course, students will be able to-</p> <p>CO1 To develop the basis and fundamental concept of biodiversity conservation</p> <p>CO2 To know about the Criteria of choice of species for conservation</p> <p>CO3 To know about the sustainable biodiversity</p> <p>CO4 To aware about Current environmental issues in INDIA.</p> <p>CO5 To know the gist of Environmental education and environmental ethics</p>		
Credits: 4		Core Compulsory
Maximum Marks: 100 (75(ESE)+25(CIE))		Minimum Passing Marks: As per University norms
Suggested Reading		
<p>1. The Biodiversity of India Erach Bharucha</p>		

Unit	Topics	No. of Lectures
I	Concept and importance of biodiversity, biodiversity indices. Principles of biodiversity conservation. Ex-situ and in-situ conservation, Extinction and vulnerability of species threatened and endangered species. Protected areas, botanical garden, national parks and sanctuaries, gene pool, hot spots, sacred grooves, key stone species.	12
II	Criteria of choice of species for conservation, role of public and NGOs in biodiversity conservation.	12
III	Evaluation of sustainable development, temporal and spatial dimensions of sustainable development, sustainable agriculture and Jhum cultivation, Concept of minimum viable population, inbreeding depression. Role of homozygosity and heterozygosity in conservation of species.	12
IV	Eco-restoration and eco-development. Current environmental issues in INDIA.	12
V	Environmental education, environmental ethics, public awareness.	12

2. An advance text book of biodiversity, 3. Principles and Practices 4. Hand book of sustainable development 5. Environmental sciences 6. Green House and Earth	K. V. Krishnamurthy Giles Atkinson, Eric Neumayer Ginger smith Annika Nilsson	
Other course books published in Hindi must be prescribed by the University/College		
Suggested Continuous Internal Evaluation (CIE) methods		
Total marks: 25 10 marks for Test 10 marks for presentation along with assignment 05 marks for Class interactions		
Subject: Environmental Science		
Programme/Class: M. Sc. Environmental Science (II)	Year: Second (II) Semester: Third (III)	
Course Code: B150902T	Course Title: <i>Climatology and Meteorology</i>	
Course Outcomes (COs)		
After completion of the course the student should be able to: CO1 To develop the basis and fundamental concept of climatology CO2 To know about the General atmospheric circulation of air CO3 To know about the Pollution mediated climatology CO4 To aware about the concept of Atmospheric stability. CO5 To know the about laws involve in behavior of pollutants in the atmosphere		
Credits: 4	Core Compulsory	
Maximum Marks: 100 (75(ESE)+25(CIE))	Minimum Passing Marks: As per University norms	
Unit	Topics	No. of Lectures
I	Introduction to climatology, atmospheric air, temperature, pressure, winds, moisture & precipitation, wind rose. Cloud formation.	12
II	Weather forecasting. General atmospheric circulation pattern of atmosphere and blocking action.	12

III	Pollution climatology: green house gases, global warming, sea level rise & climatic change.	12
IV	Atmospheric stability, environmental lapse rate, inversion, plume rise and plume behaviour models, Transportation and diffusion of pollutant.	12
V	Gas laws governing the behaviour of pollutants in the atmosphere, heat islands.	12
Suggested Reading		
<p>1. The Atmosphere: An Introduction to Meteorology Frederick K Lutgens & Edward J Tarbuck</p> <p>2. Green House and Earth Annika Nilsson</p> <p>3. Ozone in the Free Atmosphere Robert C. Whitten & Sheos Prasad</p> <p>4. Environmental sciences Denial D Chiras</p> <p>1. Environmental sciences Ginger smith</p>		
Suggested Continuous Internal Evaluation (CIE) methods		
<p>Continuous Internal Evaluation shall be based on Class test, presentation along with assignment and class interactions. Marks shall be as follows.</p> <p>Total marks: 25 10 marks for Test 10 marks for presentation along with assignment 05 marks for Class interactions</p>		
Programme/Class: M. Sc. Environmental Science (II)		
Year: Second (II)		Semester: Third (III)
Subject: Environmental Science		
Course Code: B150903T		Course Title: <i>Environmental Geosciences</i>
Course Outcomes (COs)		
<p>CO1 To develop the basis and fundamental concept of Earth Process</p> <p>CO2 To know about the inside function of earth</p> <p>CO3 To know about the costal hazards</p> <p>CO4 To aware about the concept of earth activity in terms of hazards</p> <p>CO5 To know the about GIS and remote sensing</p>		
Credits: 4		Core Compulsory
Maximum Marks: 100 (75(ESE)+25(CIE))		Minimum Passing Marks: As per University norms

Unit	Topics	No. of Lectures
I	Earth process and geological hazards. Energy budget of earth. Earth processes.	12
II	Introduction to plate-tectonics, Sea floor spreading, mountain building and evolution of continents.	12
III	Coastal hazards: Cyclones and Tsunamis, El-nino, La-nino, river flooding causes, nature and extent of flood hazard. Urbanization and flood, effect of flood, flood mitigation method.	12
IV	Earthquake: causes, intensity & magnitude; geographical distribution of earthquake zone: effects and mitigations. Volcanism: causes, effect and mitigation method.	12
V	Principles of remote sensing and its application in environmental science. Application of GIS in environmental management.	12
Suggested Reading		
1.	Environmental Science	Andrew RW & Julie M Jackson
2.	Environmental Sciences	Robert M Shaoh
3.	Earth and intimate history	Richard Fortey
4.	Environmental Geosciences	Savindra Singh
5.	Green House and Earth	Annika Nilsson
6.	Ozone in the Free Atmosphere	Robert C. Whitten & Sheos Prasad
Suggested Continuous Internal Evaluation (CIE) methods		
<p>Continuous Internal Evaluation shall be based on Class test, presentation along with assignment and class interactions. Marks shall be as follows.</p> <p>Total marks: 25 10 marks for Test 10 marks for presentation along with assignment 05 marks for Class interactions</p>		
Programme/Class: M. Sc. Environmental Science (II)		Year: Second (II) Semester: Third (III)
Subject: Environmental Science		
Course Code: B150904T		Course Title: Environmental Toxicology
Course Outcomes (COs)		
CO1 To develop the basis and fundamental concept toxicology		

CO2 To know about the Translocation of toxicants		
CO3 To know about the Potency vs toxicity		
CO4 To aware about the concept of environmental stresses		
CO5 To know the about impact of environmental stresses		
Credits: 4		Elective
Maximum Marks: 100 (75(ESE)+25(CIE))		Minimum Passing Marks: As per University norms
Unit		
Unit	Topics	No. of Lectures
I	Principles of toxicology. Dose-response relationship, lethal dose & lethal concentration. Exposure of toxicants, route & sites of exposure.	12
II	Translocation of toxicants, biotransformation & bioactivation of toxicants. Mechanisms of action of organ specific toxicity, teratogenicity, carcinogenicity, immunotoxicity	12
III	Potency vs toxicity. Margin of safety. Toxicity tests. Target & non-target organ toxicity: Occupational factor & health hazards. Metal toxicity.	12
IV	Concept of environmental stresses. Oxygen-an agent of oxidative stress. Chemistry of free radicals & their effect on living system.	12
V	High temperature and low temperature stress and their effects on living system, UV light and photoreactivation, drought and salinity stress.	12
Suggested Reading		
<ol style="list-style-type: none"> 1. Fundamentals of Toxicology Casserette & Doulls 2. Fundamentals of Toxicology Shukla, Pandey & Trivedi 3. Environmental Toxicology Crutis Dklaassel 4. Environmental Biology & Toxicology P D Sharma 		
Suggested Continuous Internal Evaluation (CIE) methods		
Continuous Internal Evaluation shall be based on Class test, presentation along with assignment and class interactions. Marks shall be as follows.		
Total marks: 25		
10 marks for Test		
10 marks for presentation along with assignment		
05 marks for Class interactions		

Programme/Class: M. Sc. Environmental Science		Year: Second (II)	Semester: Third (III)
Subject: Environmental Science			
Course Code: B150905T		Course Title: <i>WILDLIFE MANAGEMENT</i>	
Course Outcomes (COs)			
<p>CO1 To learn basic knowledge of wildlife</p> <p>CO2 To buildup the strategy of wildlife Conservation</p> <p>CO3 To aware about concept and practices of wildlife management</p> <p>CO4 Develop skill of Analysis of wild life management</p> <p>CO5 To Develop skill through Fundamentals technique of wild life management</p>			
Credits: 4		Elective	
Maximum Marks: 100 (75(ESE)+25(CIE))		Minimum Passing Marks: As per University norms	
Suggested readings			
Environmental Communication lab to land 2021 Mishra and Updhyay Shree publication new delhi			
Unit	Topics	No. of Lectures	
I	Understanding of wildlife, Role of stakeholders in managing wildlife. Journey of mankind from predator to conservator.	12	
II	Wildlife management, conservation and policies regarding protected areas in 21st century; positive values provided by wildlife conservation (monetary, recreational, scientific and ecological benefits).	12	
III	Analysis of wild life management problems. Species conservation projects in India (Tiger, Rhino, Lion)	12	
IV	Analysis of threatened species as per guide line of IUCN and develop possible conservation strategy	12	
V	Development of conservation site (National Park and sanctuaries, biosphere reserve scientifically and legislatively	12	

Suggested Continuous Internal Evaluation (CIE) methods		
<p>Continuous Internal Evaluation shall be based on Class test, presentation along with assignment and class interactions. Marks shall be as follows</p> <p><u>Total marks: 25</u> 10 marks for Test 10 marks for presentation along with assignment 05 marks for Class interactions</p>		
Further Suggestions: None		
Programme/Class: M. Sc. Environmental Science (II)	Year: Second (II)	Semester: Third (III)
Subject: Environmental Science		
Couse Code: B150906P	Course Title: <i>Practical-3</i>	
Credits: 4	Elective	
Maximum Marks: 100 (75(ESE)+25(CIE))	Minimum Passing Marks: As per University norms	
Topics		
		No. of Lectures
<ol style="list-style-type: none"> 1. Estimation of vegetation through analysis of Frequency of species. 2. Estimation of vegetation through analysis of density of species. 3. Estimation of vegetation through analysis of abundance, relative density of species. 4. Analysis of indices (Shannon wiener diversity index, Simpson's index, Simpson's index of diversity, evenness index) in studied area. 5. Field study of biodiversity 6. Enlist the aquatic Vegetation local area. 7. Enlist popular medicinal plants in local area 8. Estimation of relative humidity of air. 9. Tabulate the temp., humidity, and wind speed & wind direction of Two Months from the environment. 10. Identification of clouds. 11. Draw wind rose diagram from given data. 12. Field study of mountains for identification of rocks. 		120

	<p>13. Develop the model of earthquake.</p> <p>14. Develop the model of cyclone and anti cyclones.</p> <p>15. Estimation of chlorophyll content of different plant leaves under stress.</p> <p>16. Separation of chlorophyll pigment by paper chromatography.</p> <p>17. Separation of protein by paper chromatography.</p> <p>18. Stress determination on plant, fungi and bacteria.</p> <p>19. Estimation of lethal Potency (LC) & (LD)</p> <p>20. Analysis of threatened species as per guide line of IUCN</p> <p>21. wildlife conservation (monetary, recreational, Analysis of scientific and ecological benefits of wild life management</p>	
Programme/Class: M. Sc. Environmental Science (II)		Year: Second (II) Semester: Fourth (IV)
Subject: Environmental Science		
Course Code: B1501001T		Course Title: <i>Environmental Management, EIA and Legislation</i>
Course Outcomes (COs)		
<p>On completion of this course, students should be able to:</p> <p>CO1 To develop the basis and fundamental concept EM and EIA</p> <p>CO2 To know about the EM and EIA rule</p> <p>CO3 To know about the mode of environmental impact analysis</p> <p>CO4 To aware about the concept of methodology of environmental impact analysis</p> <p>CO5 To know the concept of Legislation mediated Environmental Management and EIA</p>		
Credits: 4		Elective
Maximum Marks: 100 (75(ESE)+25(CIE))		Minimum Passing Marks: As per University norms
Unit		
Unit	Topics	No. of Lectures
I	Environmental management, waste minimizing technology and Clean development mechanism (CDM).	12
II	Hazardous waste management rule 1989. Disaster management & risk	12

	analysis. Resource management. Environmental cost benefit analysis.	
III	Introduction of environmental impact analysis. National environmental policy and statutory requirements of EIA; objectives of EIA. Methodology of EIA; scoping, categorization and evaluation criteria; prediction and assessment of impact, interactions between environmental components and impacts. Alternate strategies and mitigation measures, environmental monitoring and audit. Environmental impact statement & environmental management plan. EIA guide line 2006.	12
IV	Impact assessment methodologies. Guidelines for environmental audit. Environmental planning.	12
V	Provision of constitution of India regarding environment (48A & 51A). Wildlife protection act 1972. Forest conservation act 1980. Air act 1981. Motor vehicle act 1988. Water (prevention & control of pollution) act 1974. The Environment (protection) act 1986.ISO 9000 and ISO 14000. Public liability insurance act 1991 & rules 1991. IUCN, red data book.	12
Suggested Reading		
<ol style="list-style-type: none"> 1. Management Planning for Nature Conservation Axeander Mike 2. Inside ISO 1400 The competitive advantage 3. of Environmental Management Don Sayre 4. Introduction to Environmental Management Mary K Theodore 5. International Environmental Law Philippe Sands 6. Law relating to Intellectual Properties Dr BL Wadehra 7. Hand Book of Environmental Laws, 8. Acts, Guidelines, Compliances and standards Dr RK Trivedy 		
Suggested Continuous Internal Evaluation (CIE) methods		
<p>Total marks: 25 10 marks for Test 10 marks for presentation along with assignment 05 marks for Class interactions</p>		
Programme/Class: M. Sc. Environmental Science		
Year:Second (II)		Semester: Fourth(IV)
Subject: Environmental Science		
Couse Code: B1501002T		Course Title: <i>Biostatistics, Bioinformatics and IPR</i>

Course Outcomes (COs)		
<p>CO1 To develop fundamental concept statistics</p> <p>CO2 To know about the advance statistics, data analysis</p> <p>CO3 To know about the role of <i>In silico</i> study</p> <p>CO4 To aware about the concept of bioinformatic</p> <p>CO5 To develop the concept of IPR</p>		
Credits: 4		Elective
Maximum Marks: 100 (75(ESE)+25(CIE))		Minimum Passing Marks: As per University norms
Unit	Topics	No. of Lectures
I	Scope of statistics in environmental data analysis. Tabulation and diagrammatic presentation of data. Measures of central tendency (mean, mode, median). Dispersion (mean deviation and standard deviation).	12
II	Simple measure of Skewness and Kurtosis. Test of significance. Z- test, t- test, chi-square test. Correlation and regression and analysis of variance (ANOVA).	12
III	Introduction, classification and generation of computer, components of a computer system. Input and output devices.	12
IV	Introduction and scope of bioinformatics. Biological database: Basic concept of primary, secondary and composite database.	12
V	Intellectual Property Right (IPR), Bio-safety, International trade and environment; Trade Related Intellectual Properties (TRIPs), Intellectual Property Rights (IPRs), Corporate environmental ethics. Role of environmental agencies (NGT), Scheme of labelling environment friendly products (Ecomark).	12
Suggested Reading		
<ol style="list-style-type: none"> 1. Fundamentals of applied statistics SC Gupta & DK Kapoor 2. Biostatistics PN Arora & DK Malhan 3. Basic of Biostatistics for Public health B. Burt Gerstman 4. Statistics David Freed man Rabert Pisani 5. Fundamental of Bioinformatics Harisha S 		

Suggested Continuous Internal Evaluation (CIE) methods		
<p>Continuous Internal Evaluation shall be based on Class test, presentation along with assignment and class interactions. Marks shall be as follows</p> <p>Total marks: 25 10 marks for Test 10 marks for presentation along with assignment 05 marks for Class interactions</p>		
Programme/Class: M. Sc. Environmental Science (II)	Year: Second (II)	Semester: Fourth (IV)
Subject: Environmental Science		
Course Code: B1501003T	Course Title: <i>Systematic Biogeography</i>	
Course Outcomes (COs)		
<p>CO1 To develop fundamental concept of taxonomy</p> <p>CO2 To know about the Principles and rules of taxonomy</p> <p>CO3 To know about the rules of Biogeography</p> <p>CO4 To aware about the terminology of Biogeographically concept</p> <p>CO5 To aware about the advances in Bio geographical study</p>		
Credits: 4	Elective	
Maximum Marks: 100 (75(ESE)+25(CIE))	Minimum Passing Marks: As per University norms	
Unit	Topics	No. of Lectures
I	Definition of taxonomy, taxonomic identification keys/tools for systematic biogeography. Concept of species and taxonomic hierarchy.	12
II	Principles and rules (International Code of Botanical and Zoological Nomenclature); ranks and names.	12
III	Biogeographical rules-Gloger's rule, Bergmann's rule, Allen's rule, Geist rule; biogeographical realms and their fauna; endemic, rare, exotic, and cosmopolitan species.	12
IV	Species, habitats; environment and niche concepts; biotic and abiotic	12

	determinants of communities; species-area relationships.	
V	Allopatric, parapatric, sympatric; ecological diversification; adaptive radiation, convergent and parallel evolution; dispersal and immigration; means of dispersal and barriers to dispersal; extinction.	12
Suggested Reading		
1. Systematics and Biogeography. Springer. 158. Williams, D.M., Ebach, M.C. 2008. Foundations of		
Suggested Continuous Internal Evaluation (CIE) methods		
Continuous Internal Evaluation shall be based on Class test, presentation along with assignment and class interactions. Marks shall be as follows Total marks: 25 10 marks for Test 10 marks for presentation along with assignment 05 marks for Class interactions		
Programme/Class: M. Sc. Environmental Science (II)		
Year: Second (II)		Semester: Fourth (IV)
Subject: Environmental Science		
Course Code: B1501004T		Course Title: GREEN TECHNOLOGIES
Course Outcomes (COs)		
On completion of this course, students should be able to: CO1 To aware fundamental knowledge and Concept of green technology CO2 To buildup the concept of application green technology CO3 To buildup the concept of application green chemistry CO4 Students buildup the concept of sustainable green chemistry CO5 To aware about the Innovation of Green technology		
Credits: 4		Elective
Maximum Marks: 100 (75(ESE)+25(CIE))		Minimum Passing Marks: As per University norms
Unit	Topics	No. of Lectures

I	Concept of green technology, Chronological development of green technology	12
II	Introduction to green chemistry; principles and recognition of green criteria in chemistry; bio- degradable and bio-accumulative products in environment, photodegradable plastic bags.	12
III	Techniques and researches to reduction of Green House Gas (GHG), Emissions carbon capture and storage (CCS) technologies, green chemistry for bioremediation, green technology for energy generation	12
IV	Agenda of green development; reduction of ecological footprint; role of green technologies towards a sustainable future;	12
V	Major challenges and their resolution for implementation of green technologies; green practices to conserve natural resources (organic agriculture, agroforestry, reducing paper usage and consumption, etc.).	12

Suggested Reading

1. Conservation of Natural Resources. Prentice Hall Publication Klee, G.A. 1991.
2. Anastas,
3. Green Chemistry: Theory & Practice. Oxford University Press P.T. & Warner, J.C. 1998.
4. Boeker, E. & Grondelle, R. 2011. Environmental Physics: Sustainable Energy and Climate Change. Wiley
5. Renewable Energy: Power for Sustainable Future. Oxford University Press. Boyle G., 2004.

Suggested Continuous Internal Evaluation (CIE) methods

Continuous Internal Evaluation shall be based on Class test, presentation along with assignment and class interactions. Marks shall be as follows

Total marks: 25

10 marks for Test

10 marks for presentation along with assignment

05 marks for Class interactions

Programme/Class: M. Sc. Environmental Science (II)	Year: Second (II)	Semester: Fourth (IV)
Subject: Environmental Science		
Course Code: B1501005T	Course Title: ENERGY AND ENVIRONMENT	
Course Outcomes (COs)		

Course Outcomes (CO)		
CO1 To aware fundamental knowledge of Global energy resources		
CO2 To buildup the concept of energy demand		
CO3 To buildup the concept of Energy for environment and society		
CO4 Students buildup the concept of sustainable energy resources		
CO5 To aware about the Energy impact and issues		
Credits: 4		Elective
Maximum Marks: 100 (75(ESE)+25(CIE))		Minimum Passing Marks: As per University norms
Unit		
Unit	Topics	No. of Lectures
I	Defining energy; forms and importance; Global energy resources; renewable and non-renewable resources: distribution and availability; sources and sinks of energy; past, present, and future technologies for capturing and integrating these resources into our energy infrastructure.	12
II	Global energy demand current perspective; energy demand and use in domestic, industrial, agriculture and transportation sector.	12
III	Energy production as driver of environmental change; nature, scope and analysis of local and global impacts of energy use on the environment; fossil fuel burning and related issues of air pollution, nuclear energy and related issues such as radioactive waste, spent fuel.	12
IV	Energy over-consumption and its impact on the environment, economy, and global change.	12
V	Action strategies for sustainable energy management from a future perspective	12
1. Suggested Reading		
2. Green Chemistry: Theory & Practice. Oxford University Press Anastas, P.T. & Warner, J.C. 1998.		
3. Environmental Physics: Sustainable Energy and Climate Change. Wile Boeker, E. & Grondelle, R. 2011.		
4. Renewable Energy: Power for Sustainable Future. Boyle G., 2004. Oxford University Press.		
Suggested Continuous Internal Evaluation (CIE) methods		

Total marks: 25 10 marks for Test 10 marks for presentation along with assignment 05 marks for Class interactions		
Suggested Continuous Internal Evaluation (CIE) methods		
Continuous Internal Evaluation shall be based on Class test, presentation along with assignment and class interactions. Marks shall be as follows Total marks: 25 10 marks for Test 10 marks for presentation along with assignment 05 marks for Class interactions		
Course Outcomes (COs)		
CO1 To aware fundamental knowledge of Remote Sensing CO2 To buildup the concept of GIS CO3 To buildup the concept of environmental management system CO4 strengthen the knowledge of GPS survey and software CO5 To aware about the Fundamentals of GIS application		
Credits: 4		Elective
Maximum Marks: 100 (75(ESE)+25(CIE))		Minimum Passing Marks: As per University norms
Subject: Environmental Science		
Programme/Class: M. Sc. Environmental Science (II)		Year: Second(II) Semester: Fourth (IV)
Couse Code: B1501006T		Course Title: Remote Sensing, Geographic Information System & Modelling
Unit	Topics	No. of Lectures
I	Definitions and principles; Electromagnetic (EME) spectrum; interaction of EMR with Earth's surface; spectral signature; satellites and sensors; aerial photography and image interpretation.	12

II	Definitions and components; spatial and non-spatial data; raster and vector data; database generation;	12
III	Database management system; land use! land cover mapping; overview of GIS	12
IV	Software packages; GPS survey, data import, processing, and mapping.	12
V	Applications and case studies of remote sensing and GIS in geosciences for water resource management, lands use planning, forest resources, agriculture, marine and atmospheric studies.	12
Suggested Reading		
<ol style="list-style-type: none"> 1. Guha, P.K. 2013. Remote Sensing for the Beginner (3rd ed.), Affiliated East West Press. 2. Jenson J.R. 2003. Remote Sensing of the Environment: An Earth Resource Perspective. Pearson. 1. Lillesand T.M. and Kiefer R.W., 2011. Remote Sensing and Image Interpretation (6th ed.). Wiley. 		
Suggested Continuous Internal Evaluation (CIE) methods		
Total marks: 25 10 marks for Test 10 marks for presentation along with assignment 05 marks for Class interactions		
Programme/Class:		
M. Sc. Environmental Science (II)		Year: Second(2)
		Semester: Forth (IV)
Subject: Environmental Science		
Course Code: B151007P		Course Title: <i>Practical</i>
Credits: 4		Elective
Maximum Marks: 100 (75(ESE)+25(CIE))		Minimum Passing Marks: As per University norms
Topics		No. of Lectures
<ol style="list-style-type: none"> 1. An introduction to Computers, MS-Word, MS Excel, MS Power Point. 2. Similarity searches using tools like BLAST and interpretation of results. 3. Exercise to data entry, edit, copy, move etc. using MS EXCEL spreadsheet 4. Computations analysis of biological data by Mean, Median, Mode, S.D., Correlation, regression Analysis, Chi square test, Student test, ANOVA 		120

<ol style="list-style-type: none"> 5. Designing of bar diagram, pi chart, histogram, scatter plots, in EXCEL for presentation of data. 6. Measure of skewness and kurtosis 7. Probability 8. Biogeographical rules-Gloger's rule, Bergmann's rule, Allen's rule, <ol style="list-style-type: none"> i. Geist rule; biogeographical realms 9. Biotic and abiotic determinants of communities 10. Analysis of carbon emission from industries and road side 11. Green technology for energy generation 12. Reduction Methods of Green House Gas (GHG) 13. Emissions carbon capture and storage (CCS) technologies 14. Preparation of energy audit of a domestic unit and report submission. 15. Submit a report on Green energy development (biofuels, wind energy, solar energy, geothermal energy, tidal energy, ocean energy, nuclear energy) in Indian contest 16. Arc GIS online study for Mapping 17. Q GIS online study for Mapping 18. Analysis of Mapper and imaging 19. Preparation of disaster management plan for any of the following disaster flood, earthquake, cyclone, fire outbreak and report submission. 		
<p>Programme/Class: M. Sc. Environmental Science (II)</p>		<p>Year: Second(2); Semester: Forth (IV)</p>
<p>Couse Code: B1501008R</p>		<p>Course Title: Industrial Training/Surveys/Research Project</p>
<p>This research project can be interdisciplinary / multi-disciplinary. This research project can also be in the form of industrial training / internship / survey work etc.</p>		
<p>Credits: 8</p>		<p>Core Compulsory</p>
<p>Maximum Marks: 100*</p>		<p>Minimum Passing Marks: As per University norms</p>
<p>* Students will submit the final report (project report/dissertation) of the research project carried out in both the semesters at the end of the year, which will be assessed jointly by the supervisor and the external examiner nominated by the university at the end of the year out of 100* marks</p>		
<p></p>		