

POSTGRADUATE DEGREE PROGRAM

Ordinance and Syllabus

FOR

M. Sc. ENVIRONMENTAL SCIENCE

Two-year (Four semesters)



Faculty of Science

Under Choice Based Credit System (CBCS)

As per the guidelines of NEP-2020

w.e.f. 2022-23 (Session)

V. B. S. Purvanchal University, Jaunpur

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V.B.S. PURVANCHAL UNIVERSITY, JAUNPUR

Ordinance Governing Two-Year (Four Semesters) Postgraduate Degree (M. Sc.)

Environmental Science in the 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. Ram Narayan	Convener, BOS, Environmental Science	Biotechnology	V B S Purvanchal University, Jaunpur-222003
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3	Dr. Vivek Kumar Pandey	Internal Expert, Environmental Science	Environmental Science	V B S Purvanchal University, Jaunpur-222003
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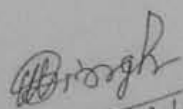
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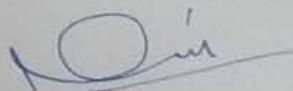
V.B.S. PURVANCHAL UNIVERSITY, JAUNPUR
Ordinance governing two-year (four semesters) postgraduate degree program
M. Sc. in Environmental Science (Faculty of Science)
Under Choice Based Credit System (CBCS)
w.e.f. 2022-23 (Session)

The following ordinances have been framed governing the admission, course structure, examination and other allied matters relating to the two-year (four semesters) postgraduate degree programme (M.Sc.) in Environmental Science being offered by V.B.S. Purvanchal University.

A. ADMISSION AND EXIT

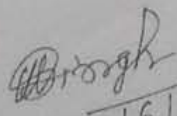
1. All matters relating to admission to this course shall be dealt with by the Admission Committee constituted for the purpose by the University.
2. The M.Sc. Environmental Science course is open to science graduates (with 3 year undergraduate degree) with minimum of 50% of marks, from a recognized University (45% in case of SC/ST). Those who are appearing in final examination of B.Sc. (Biology/Life Sciences/ agriculture/ Mathematics / 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.
3. Admission in M.Sc. Environmental Science course will be based on the entrance test or merit as per the rules of the university.
4. The intake of students in this programme shall be fixed by V.B.S. Purvanchal University. The admission to M.Sc. courses shall be made through a merit based on Written Test conducted by VBS Purvanchal University Combined Admission Test (PUCAT). The reservation norms for admission shall be guided by State Government/ University notification issued from time to time.
5. On selection the candidates shall deposit the fees prescribed for the purpose to get his/her admission confirmed within the time period fixed by the Admission Committee of the Department. If a candidate fails to do so his/her admission shall be automatically cancelled and the seat falling vacant shall be offered to other candidates as per the merit/category. However, matter concerning fees of candidates under SC/ST category would be governed by Govt. Order; as such there is no provision of fee concession/exemption/refund.
6. Admission to M.Sc. course cannot be claimed by any candidate as a matter of right. The Admission Committee shall have power to refuse, reject or cancel any admission if it possesses sufficient reasons to do so.
7. **Student Mentor:** Every student will have a member of faculty of the Department as his/her student advisor. All teachers of the department shall function as Student Mentor (Advisors). The Student Advisor will advise the students in choosing Elective courses and offer all possible student support services


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B. COURSES OF STUDY AND EXAMINATION

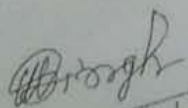
1. Postgraduate program (M. Sc. Environmental Science) will be conducted in CBCS (Choice Based Credit System) and semester system
2. There will be 4(four) theory papers of main subject and 1 (one) practical paper (all four credits) in one semester, thus in a semester there will be 20 credits of papers of main subject. 40(forty) in 1(one) year that would be 80(eighty) credits in 2(two) years
3. All four theory papers are compulsory in the first semester.
4. In the second and third semester, the student can choose one paper based on the optional paper (specialization), according to his interest and on the basis of the resources available in the university /college.
5. All the papers in the fourth semester are optional papers based on specialization from which the student can choose any four theory papers as per his/her interest.
6. In the first year of post-graduation, the student will have to take only 1 minor elective paper from any other faculty (a subject other than the main subject). This paper will be of 4 (four) credits
7. To conduct the M.Sc. (Environmental Science) programme systematically and within a time bound frame, the concerned Department shall draw up an "Academic Calendar" in the beginning of academic session.
8. A candidate admitted to the M.Sc. course shall pursue a regular course of study in all the four semesters of the course and attend a minimum of 75% of the classes held to be eligible to appear in the semester examinations.
9. If a student fails to attend requisite classes in a semester due to illness, he/she may be given relaxation of 15% attendance (10% at the level of Vice-Chancellor and 5% at the level of Head of Department on production of medical certificate.
10. Semester examinations of the M.Sc. course shall be conducted by way of theory papers, practical and industrial training/surveys/research project. Each theory core and elective paper will be of 100 marks out of which 75 marks shall be allocated for semester examination and 25 marks for internal assessment. The pattern of question papers for theory examinations will be as per the University rules
11. Internal assessment is an integral part of the course and is compulsory for all students. Academic performance of students is evaluated by Continuous Internal Assessment (CIA) that includes day to day performance, attendance, home Assignment periodic tests, seminar presentation; subject's quizzes class discussion, etc.
12. The responsibility of evaluating the internal assessment is vested on the teacher(s) who teaches the course.
13. One practical (4 credits) examination shall be conducted which will be assessed jointly by the teachers of the department and the external examiner nominated by the university at the end of each semester out of 100 marks.
14. Ordinarily, the semester examinations shall be held in December and May.
15. Research Project in Post Graduate Program: In the first and second year of post-graduation, the student will have to do a major research project.
16. This research project can also be interdisciplinary / multi-disciplinary. This research project can also be in the form of industrial training / internship / survey work etc.

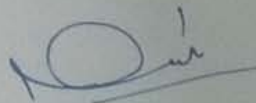

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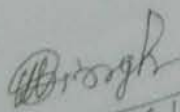
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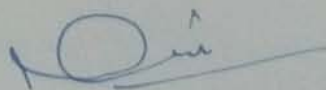
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17. The research project will be done under the guidance of a teacher supervisor; co-supervisor can be taken from any industry/company/technical institute/research institute.
18. Undergraduate (including research) and postgraduate students will be required to undertake a research project of four credits (4 hours per week) in each semester.
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 jointly by the supervisor and the external examiner nominated by the university at the end of the year out of 100* marks. Thus there will be a total of 8 credits of this exam. The students have to submit a project report/dissertation/technical report in bound form duly certified by the supervisor. The evaluation of the project/dissertation/technical will be done through presentation and viva voce examination of the student.
20. If a student publishes any of his research papers in this research project in the UGC-CARE listed Journal and published during the program, then he can be given additional marks up to 25 in the evaluation of the research project (out of 100). The maximum received will be 100.
21. Most of the grades will be marked on the marks obtained in the research project and they will also be included in the calculation of CGPA.
22. It will be necessary to take the exam for credit validation. Credit will be incomplete without the examination.
23. If a student qualifies for the examination on the basis of attendance in the class, but is not able to give the examination due to any reason, then he/she can appear for the qualifying examination in the next time, he will not need to take classes again.
24. Matters pertaining to the syllabi and conduct of examination shall be dealt with by the Board of Studies (BOS) constituted by the Vice-Chancellor.
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 Purvanchal University.
26. Papers for theory examination in sealed covers shall be handed over/sent by registered post to the Registrar/Controller of Examination by the Examiners. Controller of Examinations/Technical Cell will ensure the printing of papers and fair conduct of the examinations.
27. The question papers shall be moderated before examination by a committee consisting of the Head and two senior most teachers of the department and the teacher of concerned paper. The Center Superintendent shall ensure implementation of this provision.
28. 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.
29. Practical examinations of semester I, II, III and IV shall be conducted by one internal and one external examiner. Similarly, in the Second and fourth semester project/dissertation/technical report and presentation carrying 100 marks shall also be evaluated jointly by external as well as internal examiner(s)..


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30. For appearing in semester examinations each student shall have to deposit a prescribed examination fee along with a duly filled examination application form; separate fees will also be charged for back and improvement papers. For SC/ST candidate relaxation in examination fees applicable as per Govt. Order. He/she has been a student of good conduct.

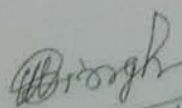
31. The students of M.Sc. course shall be examined in the subjects in accordance with course curriculum given at the end of ordinance.

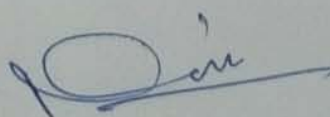
C. RESULTS, PROMOTION AND IMPROVEMENT

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 (including 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.
2. The results of M. Sc. 1st, 2nd and 3rd semester examination shall be declared as pass who scores at least 36% of marks in each paper separately and 40% in aggregate. About 50% of the paper setting would be internal.
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 additional.
4. Students, who failed in 4 or lower number of papers in the academic year will be awarded 'back' and given two chances to reappear 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.
5. In order to pass the 2-year M.Sc. ~~Env. Science~~ course, 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 in the following categories. If a student has secured pass marks in aggregate in a semester but has failed in a maximum of two papers a provision is made to grant him a maximum of 3 grace marks.
6. Student securing highest number of marks during the course in the first attempt will be awarded the University Gold Medal for the same.

Passed	:	40% and above
Second Division	:	45% and above but less than 60%
First Division	:	60% and above

7. Conversion of Marks into Grades: As per University rules
8. Grade Points: Grade points shall be determined as per the Grade point table as per University Examination rule.
9. CGPA Calculation: As per University Examination rule.



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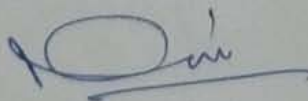


Programme structure:

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

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


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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)

Year	Sem ester	Paper Code	Paper Title	Theory/ Practical	Credits	
Core Paper						
M.Sc. I	I	B150701T	Ecosystem Dynamics	Theory	4	
		B150702T	Environmental Chemistry	Theory	4	
		B150703T	Instrumentation	Theory	4	
		B150704T	Environmental Microbiology and Biotechnology	Theory	4	
	Minor Elective		<i>Any one out of all the available Minor Elective papers offered from other Faculties</i>		Theory*	4
		B150705P	Practical-I	Practical	4	
		B150706R	Industrial Training/Surveys/Research Project	Industrial Training/Surveys/Research Project	4	
				Total Credit	28	
M.Sc. I	II					
Core Paper						
		B150801T	Water Pollution	Theory	4	
		B150802T	Atmospheric (Air & Noise) Pollution	Theory	4	
		B150803T	Soil Pollution and Management	Theory	4	
Elective paper						
<i>(Major Elective theory any one of the two papers)</i>		B150804T	Natural resources and its harnessing	Theory	4	
		B150805T	Solid Waste Management	Theory	4	
Core Paper		B150806P	Practical –II	Practical	4	
		B150807R	Industrial Training / Survey / Research Project	Research	4	
				Total Credit	24	
Total Credit (First + Second semester)= 58						
* Student must opt for any One of the 2 elective courses						

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M.Sc. II	III				
Core Paper		B150901T	Eco conservation and Sustainable Development	Theory	4
		B150902T	Climatology and Meteorology	Theory	4
		B150903T	Environmental Geosciences	Theory	4
Elective paper					
Major elective theory (any one of the two papers)		B150904T	Environmental Toxicology	Theory	4
		B150905T	Wildlife Management	Theory	4
Core Paper		B150906P	Practical –III	Practical	4
		B150907R	Industrial Training /Surveys/Research Project	Research	4
				Total Credit	24
Student must opt for any One of the 2 elective courses					
M.Sc. II	IV				
Elective paper					
Major elective theory (Any four out of six papers)		B151001T	Environmental Management, EIA & legislation	Theory	4
		B151002T	Bio statistics, Bioinformatics & IPR	Theory	4
		B151003T	Systematic & Biogeography	Theory	4
		B151004T	Green Technologies	Theory	4
		B151005T	Energy & Environment	Theory	4
		B151006T	Remote Sensing, Geographic Information System & Modeling	Theory	4
Core Paper		B151007P	Practical –IV	Practical	4
		B151008R	Research (Dissertation /Project work)	Research	4
				Total Credit	24
Total Credit (Third +Fourth semester)= 48					
Student must opt for any four of the 6 elective papers					
Total M.Sc. course Credits (First year (52) + Second year (48)=100					

Note: 1. Up to first three semesters the marks allocated for continuous internal assessment (25 marks) will be evaluated on the basis of class attendance and a seminar. The seminar will be an integral part of the sessional and will be evaluated by all the faculty members of the department.

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2. The detailed syllabus is given in the following pages. The numbers given in front of each topic/group of topics represent the number of periods (60 minutes each) allocated for teaching that topic(s).

PROGRAM OUTCOME (POs)

Programme Objectives (POs):

- 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.
- 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.
- 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
- Write 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.
- 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.

PROGRAMME SPECIFIC OUTCOMES (PSOS)

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).

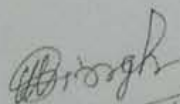
PSO1: To introduce students to the concepts of ecology, Environmental Chemistry, Instrumentation and Environmental Microbiology & Biotechnology for deep analysis of mystery of environment and issue related to environment.

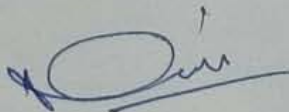
PSO2: They also are able to understand the good laboratory practices and to know the strategies for sustainable management and carrying capacity Educate the students on source, classification, and impact of air, water and soil pollution. The students will also recognize the various control measures of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


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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.

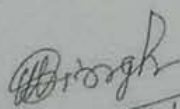
PEO1- The students could get employment opportunities in Central Pollution Control Board (CPCB) and State Pollution Control Board (SPCB), Research Institutions, Colleges, Universities and Non-governmental organizations. Students could get opportunities for higher research (Ph. D) and scientific activities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


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Programme /Class: M.Sc. Environmental Science (I)		Year: First (1)	Semester: First (I)
Subject: Environmental Science			
Couse Code: B150701T		Course Title: <i>Ecosystem Dynamics</i>	
Course Outcomes (COs)			
CO1 Strengthen the deep knowledge about natural and engineered ecosystem			
CO2 To build the fundamental concept of Environment			
CO3 To understand the basic principles of energy subsidies			
CO4 To understand the model of ecology			
CO5 To aware fundamental knowledge of ecological productivity.			
Credits: 4		Core Compulsory	
Maximum Marks: 100 (75(UE)+25(CIE))		Minimum Passing Marks: As per University norms	
Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 4-0-0			
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 Reading			
Suggested Books:			

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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 dynamics	
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: M. Sc. Environmental Science (I)	Year: First (1)
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(UE)+25(CIE))	Minimum Passing Marks: As per University norms
Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 4-0-0	
Unit	Topics
	No. of Lectures

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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

- | | |
|----------------------------|------------------|
| 1. Environmental Chemistry | James E. Gurrard |
| 2. Environmental Chemistry | Stanly.e.manchen |
| 3. Environmental Chemistry | A.K. De |

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: First (I)	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		

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CO4 To aware the real instruments require for experiment specifically		
Credits: 4	Core Compulsory	
Maximum Marks: 100 (75(UE)+25(CIE))	Minimum Passing Marks: As per University norms	
Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 4-0-0		
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		
<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	Year: First (I)	Semester: First (I)
Subject: Environmental Science		

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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(UE)+25(CIE))		Minimum Passing Marks: As per University norms	
Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 4-0-0			
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

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Suggested Reading

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

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: First (I)

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(UE)+25(CIE))

Minimum Passing Marks: As per University norms

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: First (I)

Semester: First (I)

Subject: Environmental Science

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Couse Code: B150705P	Course Title: <i>practical -I</i>
Credits: 4	Core Compulsory
Maximum Marks: 100 (75(UE)+25(CIE))	Minimum Passing Marks: As per University norms
Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 0-0-8	
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

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Programme/Class: M. Sc. Environmental Science		Year: First (I)	Semester: First (I)
Subject: Environmental Science			
Course Code: B150706R		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: 4		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		Year: First (I) Semester: Second (II)	
Subject: Environmental Science			
Course Code: B150801T		Course Title: <i>Water Pollution</i>	
Course Outcomes (COs)			
CO1 To aware fundamental about water pollution and their impact CO2 To know the thrust area of water pollution CO3 To know about relevant tools and techniques of water pollution monitoring CO4 To develop the concept of water characteristic CO5 To aware about marine water pollution			
Credits: 4		Core Compulsory	
Maximum Marks: 100 (75(UE)+25(CIE))		Minimum Passing Marks: As per University norms	
Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 4-0-0			

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Unit	Topics	No. of Lectures
I	Source of water pollution. Effect of water pollution on aquatic and terrestrial ecosystem; Eutrophication and Biomagnification. Water quality standards. Structure and physicochemical properties of water, acidity and alkalinity. Solubility's and reaction of gases in water. Chelation. Polyphosphate in water.	12
II	Effects of thermal, industrial and municipal water pollution in the environment. Water borne human diseases and causative agents. Acid mine drainage.	12
III	Biological monitoring of water. Physicochemical composition and microorganisms in sewage, DO BOD COD and coliform test.	12
IV	Types of waste water and their characteristics: Primary, Secondary and Tertiary treatment of waste water. Oxidation pond. Treatment of potable water.	12
V	Marine pollution: Source, Control and disposal of pollutants in marine system.	12
Suggested Reading		
<ol style="list-style-type: none"> 1. Water Pollution V.K. Kudesia & Emminual Pulmen 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 <ol style="list-style-type: none"> 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: M. Sc. Environmental Science		
Year: First (I)		Semester: Second (II)
Subject: Environmental Science		
Couse Code: B150802T		Course Title: Atmospheric (Air & Noise) Pollution
Course Outcomes (COs)		
CO1 To know the deep and fundamental about atmosphere		

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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(UE)+25(CIE))		Minimum Passing Marks: As per University norms
Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 4-0-0		
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 non-living. Bio-indicators of atmospheric pollution.	12
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 & Edwrd 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		

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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: First (I)	Semester: Second (II)
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Subject: Environmental Science

Course Code: B150803T	Course Title: <i>Soil Pollution and Management</i>
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Course Outcomes (COs)

Upon completion of this course, the students will be able to:

CO1 To build the concept of soil and their genesis

CO2 Develop the concept and source of soil pollutants

CO3 To know about synthetic fertilizers and their impacts on environment

CO4 To develop the concept of soil management

CO5 To know about solid waste regarding soil

Credits: 4	Core Compulsory
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Maximum Marks: 100 (75(UE)+25(CIE))	Minimum Passing Marks: As per University norms
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Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 4-0-0

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

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V	Soil management: Reclamation of acid/alkaline/saline/sodic soil. Soil erosion and its control.	12
Suggested Reading		
1.	Soil Sciences	N .C Breede
2.	Hand Book of Soil Science	Malcolm E Sumner
3.	Agriculture and soil pollution	James B Livingston
4.	Soil and Water Contamination	Marcel Van Derperk
5.	Soil Pollution	Armeando Duarte, Anabela Cachada
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:	Year: First (I)	Semester: Second (II)
M. Sc. Environmental Science		
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(UE)+25(CIE))	Minimum Passing Marks: As per University norms	
Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 4-0-0		

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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.

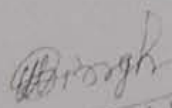
Total marks: 25

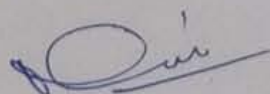
10 marks for Test

10 marks for presentation along with assignment

05 marks for Class interactions

Programme/Class:	Year: First (I)	Semester: Second (II)
M. Sc. Environmental Science		
Subject: Environmental Science		
Couse Code: B150805T	Course Title: Solid Waste Management	


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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(UE)+25(CIE))		Minimum Passing Marks: As per University norms
Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 4-0-0		
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 management, green techniques for waste treatment.	12
V	Concept of Integrated waste management; waste management hierarchy; methods and importance of Integrated waste management.	12
Suggested Reading		
1. 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. 2. 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		

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Programme/Class: M. Sc. Environmental Science	Year: First (I)	Semester: Second (II)
Subject: Environmental Science		
Course Code: B150806P	Course Title: <i>Practical-2</i>	
Credits:4	Core Compulsory	
Maximum Marks: 100 (75(UE)+25(CIE))	Minimum Passing Marks: As per University norms	
Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 0-0-8		
	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 	120

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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.		
Programme/Class: M. Sc. Environmental Science		
Year: First (1)		Semester: Second (II)
Subject: Environmental Science		
Course 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: 4		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		
Year: Second(2)		Semester: Third (III)
Subject: Environmental Science		
Course Code: B150901T		Course Title: <i>Eco conservation and Sustainable Development</i>
Course Outcomes (COs)		
This course introduces the basic principles of Immunology and after completion of this course. students will be able to-		
CO1 To develop the basis and fundamental concept of biodiversity conservation		
CO2 To know about the Criteria of choice of species for conservation		
CO3 To know about the sustainable biodiversity		
CO4 To aware about Current environmental issues in INDIA.		
CO5 To know the gist of Environmental education and environmental ethics		

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Credits: 4	Core Compulsory	
Maximum Marks: 100 (75(UE)+25(CIE))	Minimum Passing Marks: As per University norms	
Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 4-0-0		
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
Suggested Reading		
1. The Biodiversity of India	Erach Bharucha	
2. An advance text book of biodiversity.		
3. Principles and Practices	K.V. Krishnamurthy	
4. Hand book of sustainable development	Giles Atkinson, Eric Neumayer	
5. Environmental sciences	Ginger smith	
6. Green House and Earth	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		
Programme/Class: M. Sc. Environmental Science	Year: Second (II)	Semester: Third (III)

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Subject: Environmental Science		
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(UE)+25(CIE))		Minimum Passing Marks: As per University norms
Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 4-0-0		
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		
1. The Atmosphere: An Introduction to Meteorology Frederick K Lutgens & Edwrd J Tarbuck		
2. Green House and Earth Annika Nilsson		
3. Ozone in the Free Atmosphere Robert C. Whitten & Sheos Prasad		
4. Environmental sciences Denial D Chiras		
1. Environmental sciences Ginger smith		

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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: B150903T

Course Title: *Environmental Geosciences*

Course Outcomes (COs)

CO1 To develop the basis and fundamental concept of Earth Process

CO2 To know about the inside function of earth

CO3 To know about the costal hazards

CO4 To aware about the concept of earth activity in terms of hazards

CO5 To know the about GIS and remote sensing

Credits: 4

Core Compulsory

**Maximum Marks: 100
(75(UE)+25(CIE))**

Minimum Passing Marks: As per University norms

Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 4-0-0

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

B. Singh
1/6/2022

Q. D. Singh

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		
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: B150904T		Course Title: <i>Environmental Toxicology</i>
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(UE)+25(CIE))		Minimum Passing Marks: As per University norms
Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 4-0-0		
Unit	Topics	No. of Lectures

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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

- | | |
|---------------------------------------|--------------------------|
| 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)
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Subject: Environmental Science

Course Code: B150905T	Course Title: WILDLIFE MANAGEMENT
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Course Outcomes (COs)

CO1 To learn basic knowledge of wildlife

CO2 To buildup the strategy of wildlife Conservation

CO3 To aware about concept and practices of wildlife management

CO4 Develop skill of Analysis of wild life management

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CO5 To Develop skill through Fundamentals technique of wild life management		
Credits: 4	Elective	
Maximum Marks: 100 (75(UE)+25(CIE))	Minimum Passing Marks: As per University norms	
Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 4-0-0		
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 readings		
Environmental Communication lab to land 2021 Mishra and Updhyay Shree publication new delhi		
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		
Further Suggestions: None		
Programme/Class: M. Sc. Environmental Science	Year: Second (II)	Semester: Third (III)
Subject: Environmental Science		
Couse Code: B150906P	Course Title: Practical-3	

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Credits: 4	Elective	
Maximum Marks: 100 (75(UE)+25(CIE))	Minimum Passing Marks: As per University norms	
Total Number of Lectures-Tutorials-Practical (in hours per week) L-T-P: 0-0-8		
	<p style="text-align: center;">Topics</p> <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. 13. Develop the model of earthquake. 14. Develop the model of cyclone and anti cyclones. 15. Estimation of chlorophyll content of different plant leaves under stress. 16. Separation of chlorophyll pigment by paper chromatography. 17. Separation of protein by paper chromatography. 18. Stress determination on plant, fungi and bacteria. 19. Estimation of lethal Potency (LC) & (LD) 20. Analysis of threatened species as per guide line of IUCN 21. wildlife conservation (monetary, recreational. Analysis of scientific and ecological benefits of wild life management 	<p style="text-align: center;">No. of Lectures</p> <p style="text-align: center;">120</p>
Programme/Class: M. Sc. Environmental Science	Year: Second (II)	Semester: Third (III)

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Subject: Environmental Science		
Course Code: B150907R		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: 4	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	Year: Second (II)	Semester: Fourth (IV)
Subject: Environmental Science		
Course Code: B1501001T		Course Title: Environmental Management, EIA and Legislation
Course Outcomes (COs)		
On completion of this course, students should be able to:		
CO1 To develop the basis and fundamental concept EM and EIA		
CO2 To know about the EM and EIA rule		
CO3 To know about the mode of environmental impact analysis		
CO4 To aware about the concept of methodology of environmental impact analysis		
CO5 To know the concept of Legislation mediated Environmental Management and EIA		
Credits: 4	Elective	
Maximum Marks: 100 (75(UE)+25(CIE))	Minimum Passing Marks: As per University norms	
Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 4-0-0		
Unit	Topics	No. of Lectures
I	Environmental management, waste minimizing technology and Clean development mechanism (CDM).	12

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II	Hazardous waste management rule 1989. Disaster management & risk analysis. Resource management. Environmental cost benefit analysis.	12
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 2. Inside ISO 1400 The competitive advantage 3. of Environmental Management 4. Introduction to Environmental Management 5. International Environmental Law 6. Law relating to Intellectual Properties 7. Hand Book of Environmental Laws, 8. Acts, Guidelines, Compliances and standards 	<p>Axeander Mike</p> <p>Don Sayre</p> <p>Mary K Theodore</p> <p>Philippe Sands</p> <p>Dr BL Wadehra</p> <p>Dr RK Trivedy</p>	
Suggested Continuous Internal Evaluation (CIE) methods		
<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: M. Sc. Environmental Science	Year: Second (II)	Semester: Fourth(IV)
Subject: Environmental Science		

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Course Code: B1501002T		Course Title: <i>Biostatistics, Bioinformatics and IPR</i>
Course Outcomes (COs)		
CO1 To develop fundamental concept statistics in environmental data generation		
CO2 To know about the advance statistics, data analysis		
CO3 To know about the role of <i>In silico</i> study		
CO4 To aware about the concept of bioinformatic		
CO5 To develop the concept of IPR		
Credits: 4		Elective
Maximum Marks: 100 (75(UE)+25(CIE))		Minimum Passing Marks: As per University norms
Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 4-0-0		
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		
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	

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4. Statistics	David Freed man Rabert Pisani
5. Fundamental of Bioinformatics	Harisha S

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: Fourth (IV)
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Subject: Environmental Science

Course Code: B1501003T	Course Title: <i>Systematic Biogeography</i>
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Course Outcomes (COs)

CO1 To develop fundamental concept of taxonomy

CO2 To know about the Principles and rules of taxonomy

CO3 To know about the rules of Biogeography

CO4 To aware about the terminology of Biogeographically concept

CO5 To aware about the advances in Bio geographical study

Credits: 4	Elective
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Maximum Marks: 100 (75(UE)+25(CIE))	Minimum Passing Marks: As per University norms
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Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 4-0-0

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

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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 determinants of communities; species-area relationships.	12
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

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

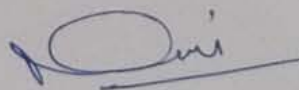
Credits: 4

Elective

Maximum Marks: 100
(75(UE)+25(CIE))

Minimum Passing Marks: As per University norms

Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 4-0-0		
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		
<ol style="list-style-type: none"> 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		
<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: M. Sc.		
Environmental Science	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(UE)+25(CIE))		Minimum Passing Marks: As per University norms
Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 4-0-0		
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.		

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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

Programme/Class: M. Sc. Environmental Science	Year: Second (II)	Semester: Fourth (IV)
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Subject: Environmental Science

Course Code: B1501006T	Course Title: Remote Sensing, Geographic Information System & Modelling
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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
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Maximum Marks: 100 (75(UE)+25(CIE))	Minimum Passing Marks: As per University norms
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Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 4-0-0

Unit	Topics	No. of Lectures
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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

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	Year: Second(2)	Semester: Forth (IV)
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Subject: Environmental Science

Course Code: B 151007P	Course Title: Practical
Credits: 4	Elective
Maximum Marks: 100 (75(UE)+25(CIE))	Minimum Passing Marks: As per University norms

Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 0-0-8

Topics	No. of Lectures
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	120

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4. Computations analysis of biological data by Mean, Median, Mode, S.D., Correlation, regression Analysis, Chi square test, Student test, ANOVA
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.
 - 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 context
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.

Subject: Environmental Science

Couse Code: B1501008R

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: 4

Core Compulsory

Maximum Marks: 100*

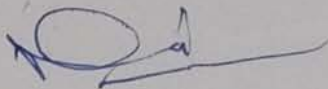
Minimum Passing Marks: As per University norms

*** 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**

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