UNDERGRADUATE COURSE PROGRAM

Ordinance and Syllabus

FOR

B. Sc. (HONOURS) ENVIRONMENTAL SCIENCE

Three-years (Six 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

2022

1/6/2022

1.6.22

V.B.S. PURVANCHAL UNIVERSITY, JAUNPUR

Ordinance Governing Three Years (Six Semesters) Under graduate Degree B. Sc. (HONS)

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

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Syllabus Developed by:

S. No.	Name	Designation	Department	University
1	Prof. Ram Naraian	Convener, BOS, Environmental Science	Biotechnology	V B S Purvanchal University, Jaunpur-222003
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B.Sc. (Hons.) Environmental Science Course
Department of Environmental Science, Faculty of Science
VBS Purvanchal University Jaunpur-222003 (UP)

The following ordinances have been framed governing the admission, course structure, examination and other allied matters relating to the Three -year (Six semesters) under graduate degree programme B.Sc. (Hons.) in Environmental Science being offered by V.B.S. Purvanchal University.
The admission to B.Sc. (Hons.) Environmental Science programme of VBS Purvanchal University will be conducted as per UG ordinances and Guidelines of VBS Purvanchal University, Jaunpur (UP) from time to time.

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 candidate should have passed 10+2 (class XII) Examination or its equivalent from a recognized Board/ University with any of the three subjects out of Physics, Chemistry and Biology or any other science subject with 50% or equivalent grade (for SC/ ST candidates marks of eligibility will be 45% or equivalent grade).

3. In case of candidates who are studying in University/Board/College/Schools in any of the foreign countries the eligibility/Qualifying marks will be the same as recognized/equivalent to 10+2 by the University or the association of the Indian University with 50% marks of equivalent grade (for SC/ ST candidates, eligibility will be 45% marks or equivalent grade).

4. The candidate who has appeared in the qualifying examination but whose result has so far not been declared can also apply but his/her eligibility for the entrance test will be purely provisional subject to the condition that he/she has to produce a passing certificate scoring at least the minimum percentage of marks as prescribed for the qualifying examination on the day and the specified time of counseling.

5. Admission in B.Sc. (Hons.) Environmental Science course will be based on the entrance test or merit as per the rules of the university

6. The intake of students in this programme shall be fixed by V.B.S. Purvanchal University. The admission to B.Sc. (Hons.) 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.

7. 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.

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8. Admission to B.Sc. (Hons.) 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.

COURSES OF STUDY AND EXAMINATION

9. Undergraduate program B.Sc. (Hons.) will be conducted in CBCS (Choice Based Credit System) and semester system

10. There will be 3(three) theory papers (four credits each) of main subject and 3(three) practical papers (two credits each) in one semester, thus in a semester there will be 18 credits of papers of main subject, 36 (Thirty Six) in 1(one) year.

11. All theory papers of Students own faculty (Science) are compulsory in the first and Second year.

12. It will be mandatory for the student to take minor elective subjects (one minor paper/per year) in the first, second year (undergraduate) and fourth year (postgraduate). The university/college can allot the paper of the minor subject on the basis of the available seats. Minor elective paper will not be compulsory in third, fifth and sixth year.

13. The student can choose the minor elective paper available in even or odd semesters at his convenience.

14. Minor elective paper will be selected from amongst the subjects conducted in the institute. The classes for the selected minor paper will be held along with the classes of the same course conducted in the faculty and his examination will also be held at the same time.

15. In the final (third) year, 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.

16. In the first, second, third and fourth semester of under 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) or more credits.

17. The minor elective paper will have to be taken by the student from any faculty (own faculty and other faculty). It will not require any pre-requisite

18. In order to ensure multidisciplinary, all students have to take minor elective papers from any fourth subject (other than the three main subjects taken by him) at the undergraduate level.

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VOCATIONAL/SKILL DEVELOPMENT COURSE

19. Every graduate student will have to take a skill development course of 3 credits in each semester of the first 2 years (4 semesters) (4 courses of 3x4=12 credits in total).

CO-CURRICULAR COURSES

It will be mandatory for every graduate student to do one co-curricular/course in each semester of 3 years (6 semesters).

21. The student has to pass each co-curricular/course with 40% marks. Grades based on their marks will be marked on the grade seat of the student, but they will not be included in the calculation of CGPA.

22. At the undergraduate level, the student has to do a research project in fifth and sixth semester (Third Year) .

23. This research project can also be in the form of industrial training / internship, survey work etc. Research project

24. At the undergraduate / post graduate / PGDR level, the student has to do a research project in every semester (from fifth to eleventh semester). The student will have to do a minor research project in the third year and a major research project in the fourth and five years. The nature of the research project in PGDR will be decided by the University according to its Pre PhD course work.

25. The student will have to do a research project related to one of the two main subjects of the third year chosen by the student and the main subject of the fourth, fifth, sixth year. This research project may also be interdisciplinary. This research project can also be in the form of industrial training / internship, survey work etc.

26. The research project will be done under the direction of a teacher supervisor; another supervisor can be taken from any industry/company/technical institution/research institute.

27. The student will submit a joint dissertation report for the research project done in both the semesters at the end of the year, which will be assessed jointly out of 100 marks by the supervisor and the external examiner nominated by the University at the end of the year.

28. The grades based on the marks obtained in the research project will be marked on the grade sheet of the graduate level and PGDR student but they will not be included in the calculation of CGPA.

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29. Undergraduate (including research) and postgraduate students will have to undertake a research project of 4 credits in each semester. The grades will be marked on the basis of the marks obtained in the research project and they will also be included in the calculation of CGPA.

CREDIT AND CREDIT ASSESSMENT

30. One credit paper of Theory will consist of one hour/week teaching assignment, i.e. 15 hours of teaching assignments in 15 weeks of a semester.

31. One credit paper of Practical / Internship / Field Work etc. will consist of two hours / per week teaching work i.e. 30 hours of practical / internship / field work etc. will be done in 15 weeks of a semester. In computing the workload of the teacher, the workload of 1 hour of theory / practical / internship / field work etc. will be equal to the workload of 2 hours.

All credit related work will be done through University/State government rule or state level "Academic Bank of Credit".

33. A student can take a one-year certificate on earning a minimum of 46 credits, a two-year diploma after earning a minimum of 92 credits, and a three-year bachelor's degree with a minimum of 132 credits.

34. After using the credits once, the student will not be able to use the credits for those papers again. For example, if a student obtains a certificate after one year using 46 credits, then his credits will be treated as expenses. If he wants to take diploma after some years, he will either surrender his original certificate to the University and re-credit the 46 credits into the account or re-credit the new 46 credits and on the basis of which one can take diploma by earning 92 credits (46 + 46) credits in the second year (actual third year). Similar arrangements will be made for the coming years also. If the student studies continuously and does not take the certificate / diploma, then he can take the degree on the basis of 132 credits.

35. If a qualified student (fast learner) will get the required credits for the degree in a short time, then there will be a gap facility on getting the minimum credits, but the degree will be available only after three years. During the interval he will be free to do any work.

36. In three years, the student will get a degree in the same faculty in which the student will get at least 60 percent of the total credits of the three main subjects.

37. If a qualified student re-credits his/her credit by taking certificate/diploma and fails in the upcoming examination, and then he/she can get the certificate/diploma again by using the recredited credit.

ATTENDANCE AND CREDIT ASSESSMENT

38. It will be necessary to take the exam for credit validation. Credits will be incomplete without exam.

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39. 75 percent attendance will be mandatory as per earlier rules to take the exam.

40. A candidate admitted to the B.Sc. (Hons.) Environmental Science 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.

41. 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.

42. Semester examinations of the B.Sc. (Hons.) Environmental Science 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. 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, subjects quizzes class discussion, etc.

43.The responsibility of evaluating the internal assessment is vested on the teacher(s) who teaches the course.

44. 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 take the qualifying examination in the next time. He won't need to take classes again

3. DECLRATION OF RESULTS

1. If a student wants to leave after passing the first year of graduation by earning a minimum of 46 credits, then he will be awarded a Certificate in Environmental Science

2. If a student wants to leave after passing the Second year of graduation by earning a minimum of 92 credits, then he will be awarded a Diploma in Energy and Environment

3. If a student wants to leave after passing the Third year of graduation by earning a minimum of 132 credits, then he will be awarded a Bachelors Degree (Hons) in Environmental Science

4. The candidates who secure at least 36% of marks in each papers including aggregate of theory and Internal assessment /practical and at least 40% of the aggregate of all papers in semester, shall be declared pass in the semester examination. Therefore on the basis of the above structure the candidates result will be declared on the following manner:-

Pass: Those who secure 36% percent marks in each paper separately and 40% in aggregate.

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Promoted: (Category 1): Those who secure at least 36% in at least 3 papers and 40% in aggregate.
(Category 2): Those who secure at least 36% in all the papers but fail to secure 40% in aggregate.
Failed: Students who do not fall under the pass and promoted categories shall be declared as failed.

5. Students in the failed category in any semester examination shall have to re-appear in the next year in the theory papers, in which he/she has failed. They will be allowed to continue their course as a regular student thereafter.

6. The promoted student will have to re-appear, in the papers in which they have not qualified, along with the next concerned semester examination

7. The sessional marks of failed and promoted candidates shall, however, be carried forward as such to the next examination in which they re-appear.

8. The result of the Bachelor of Science (Hons) 6th semester shall be declared on the basis of the combined marks secured by a candidate in all the six Semesters of the Bachelor of Science (Hons) in the following categories:

Passed 40% and above but less than 45%
2nd class 45% and above but less than 60%
1st class 60% and above but less than 75%

Distinction 75% and above

9. Those who failed in any paper of the semester Examination shall not be assigned any rank while declaring the final result of the Bachelor of Science (Hons) course.

10. If required, before the declaration of result for each semester a moderation committee shall be formed by the Vice chancellor on recommendations of the Convener. The moderation committee shall have the course convener as its convener and the name of the other shall be proposed by the course convener for the approval of the Vice chancellor.

11. In view of the fast advancement in the field of Science and information technology, the course curriculum shall be revised at regular intervals.

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Syllabus

B. Sc. (Hons.) in Environmental Science

Designed as per Syllabus Development Guidelines of National Education Policy-2020 (NEP-2020)

Year	Semester	Course code	Paper title	Theory/Practical	Credit
First Year	I	BH150101T	Ecology and Ecosystems	Theory	4
		BH150102P	Ecology and Ecosystems	Practical	2
		BH150103T	Physics & Chemistry of Environment	Theory	4
		BH150104P	Physics & Chemistry of Environment	Practical	2
		BH150105T	Earth & Earth Surface Processes	Theory	4
		BH150106P	Earth & Earth Surface Processes	Practical	2
			Minor elective from other faculty		4
			Vocational Skill Development course		3
			Co-Curricular		
				Total credit Semester	**25**
	II	BH150201T	Biodiversity & Conservational Biology	Theory	4
		BH 150202P	Biodiversity & Conservational Biology	Practical	2
		BH150203T	Environmental Biotechnology	Theory	4
		BH150204P	Environmental Biotechnology	Practical	2
		BH150205T	Environmental Health and Toxicology	Theory	4
		BH150206P	Environmental Health and Toxicology	Practical	2
			Vocational Skill Development course		3
			Co-Curricular		
				Total credit Semester	**21**

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		Total credit in year (Semester I + Semester II) = 46			
Second Year	III	BH150301T	Water and Water Resources Management	Theory	4
		BH150302P	Water and Water Resources Management	Practical	2
		BH150303T	Land management and soil conservation	Theory	4
		BH150304P	Land management and soil conservation	Practical	2
		BH150305T	Natural Resources Management & Sustainability	Theory	4
		BH150306P	Natural Resources Management & Sustainability	Practical	2
			Minor elective (other faculty)		4
			Vocational Skill Development course		3
			Co-Curricular		
			Total credit in Semester		25
	IV	BH150401T	Analytical methods, instrumentation and Measurement	Theory	4
		BH150402P	Analytical methods, instrumentation and Measurement	Practical	2
		BH150403T	Green Technologies	Theory	4
		BH150404P	Green Technologies	Practical	2
		BH150405T	Energy & Environment	Theory	4
		BH150406P	Energy & Environment	Practical	2
			Vocational		3
			Co-Curricular course (Qualifying)		
			Total credit in Semester		21
		Total credit in year (Semester III+ Semester IV)=46			

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Third Year	V	BH150501T	Environmental Pollution and Human Health	Theory	4
		BH150502P	Environmental Pollution and Human Health	Practical	2
		BH150503T	Atmosphere & Global Climate	Theory	4
		BH150504P	Atmosphere & Global Climate	Practical	2
		BH150505T	Environmental Legislation & Policy	Theory	4
		BH150506R	Industrial Training/Surveys/Research Project (Qualifying)		
		BH150507T	*Elective paper* Organismal & Evolutionary Biology	Theory	4
		BH150508T	*Elective paper* Urban Ecosystems	Theory	4
			Total credit in Semester		**20**
	VI	BH150601T	Environment Impact & Risk Assessment	Theory	4
		BH150602P	Environment Impact & Risk Assessment	Practical	2
		BH150603T	Remote Sensing, Geographic Information System & Modeling	Theory	4
		BH150604P	Remote Sensing, Geographic Information System & Modeling	Practical	2
		BH150605T	Natural Hazards & Disaster Management	Theory	4
		BH150606R	Industrial Training/Surveys/Research Project (Qualifying)		
		BH150607T	*Elective paper* Wildlife Management	Theory	4
		BH150608T	*Elective paper* Systematic & Biogeography	Theory	4
			Total credit in Semester		**20**
			Total credit in year (Semester V + Semester VI) = 40		

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		Total credit of B.Sc. Environmental Science Hons = 132

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Program Educational Objectives (PEOs)	
The **B. Sc. honors degree Environmental Sciences** program illustrates the scientific understanding to the graduate's students and strengthens the diverse emerging research to manage environmental issues. The course provides the opportunities to build the career 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 SPECIFIC OUTCOMES (PSOs)s	
	CERTIFICATE IN ENVIRONMENTAL SCIENCE
B. Sc. First Year	The aim is to build conceptual and fundamental understanding among students to exposing the basic principles behind various environmental processes (Abiotic and Biotic). 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. 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.
	DIPLOMA IN ENERGY & ENVIRONMENT
B. Sc. Second Year	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. To enrich the knowledge on biodiversity its value and various approach for conservations. Make students aware of biodiversity of India, bio-geographic zones and role of local communities and traditional knowledge in conservation. Environment provisions in constitution, power and functions of government agencies for pollution control.
	DEGREE IN BACHELOR OF ENVIRONMENTAL SCIENCE (HONS)
B. Sc. Third Year	In addition also get the knowledge of sustainable management of wastes. To introduce students to the general environmental awareness, current environmental priorities in India and basic of statistics and instrumentations. To develop the understanding on natural resources and their significance and to know the strategies for sustainable management. Understand the basic principles and application of remote sensing and GIS techniques. Impart knowledge on microbial diversity and recent advancement methods in the analysis of microbial diversity. Provide in-depth knowledge of role of beneficial and pathogenic microorganisms in environment. Understand the application of microbes for production of different eco-friendly products. Impart knowledge in molecular biotechnology and its applications in Environmental management and conservation. Make students aware about EIA, Bioethics, bio-safety and IPR. To Understand the basic laws, act, treaty, public policies and PIL.

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The Award of the Certificate/Diploma/Degree will be as per the below criteria

CERTIFICATE IN ENVIRONMENTAL SCIENCE

-After completion of One year (Semester first+ Semester second)

DIPLOMA IN ENERGY & ENVIRONMENT

-After completion of Two years (Semester first+ Semester second Semester third +Semester four)

(Hons.) DEGREE IN ENVIRONMENTAL SCIENCE

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Programme /Class: Certificate /B. Sc. (Hons) Environmental Science	Year: First (1)	Semester: First (I)
Subject: Environmental Science		
Course Code: BH150101T	Course Title: ECOLOGY AND ECOSYSTEMS	
Course Outcomes (COs)		
CO1 Strengthen the knowledge about 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	Basic concepts and definitions: ecology, landscape, habitat, ecozones, biosphere, ecosystems, ecosystem stability, resistance and resilience; autecology; synecology; major terrestrial biomes.	12
II	Population Ecology : Concept of population; characteristics of population: density, dispersion, natality, mortality, life tables, survivorship curves, age structure; population growth: geometric, exponential, logistic, density dependent; limits to population growth.	12
III	Community: Community structure and organization: physiognomy, sociability, species associations, periodicity, biomass, stability, keystone species, ecotone and edge effect; species interactions: mutualism, symbiotic relationships, commensalism, amensalism, protocooperation, predation, competition, parasitism, mimicry, herbivory; ecological succession: primary and secondary successions, models and types of successions, and meta-population; r- and Kselection, climax community concepts, examples of succession, rudreal, competitive and stress-tolerance strategies	12

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IV	Types of ecosystem: forest, grassland, lentic, lotic, estuarine, marine, desert, wetlands; ecosystem structure and function; abiotic and biotic components of ecosystem; ecosystem boundary; ecosystem. function; ecosystem metabolism; primary production and models of energy flow; secondary production and trophic efficiency; ecosystem connections: food chain, food web; detritus pathway of energy flow and decomposition processes; ecological efficiencies; ecological pyramids: pyramids of number, biomass, and energy.	12
V	Biogeochemical cycles and nutrient cycling: Carbon cycle; nitrogen cycle; phosphorus cycle; sulphur cycle; hydrological cycle; nutrient cycle models; ecosystem input of nutrients; biotic accumulation; ecosystem losses; nutrient supply and uptake.	12

Suggested Reading

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 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: Certificate /B. Sc. (Hons) **Environmental Science**	**Year:** First (1)	**Semester:** First (I)
Subject: Environmental Science		
Course Code: BH150102P	**Course Title: ECOLOGY AND ECOSYSTEMS LAB**	
Credits: 2	**Core Compulsory**	

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Maximum Marks:50	Minimum Passing Marks: As per University norms
Total Number of Lectures-Tutorials-Practical (in hours per week) L-T-P: 0-0-1	

	Topics	No. of Lectures
	1. Estimation of weed status, with emphasis on compatibility within/among the weeds. 2. Determine the minimum size of quadrate by species area curve method. 3. To study the community by quadrate method by determining Frequency, Density and Abundance of different species present at sampling area. 4. Field study in ecology using both qualitative and quantitative studies (Checklist/Quadrat /Transect) from any one of the following bio-geographical area (coastal/ forest/ Hills) with **report submission.**	15

Programme/Class: Certificate /B. Sc. (Hons)	Year: First (1)	Semester: First (I)
Subject: Environmental Science		
Course Code: BH150103T	Course Title: PHYSICS AND CHEMISTRY OF ENVIRONMENT	

Course Outcomes (COs)

On successful completion of this course, student will be able:

CO1 To Strengthen the knowledge about physical and chemical Environment

CO2 To build the fundamental concept of organic chemistry and Atmospheric chemistry

CO3 To understand the basic principles of chemical reactions

CO4 To understand about Atmospheric photochemical reactions

CO5 To aware fundamental knowledge environmental physics

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	**Fundamentals of environmental physics** **Part A:** Basic concepts of light and matter; spectroscopic concepts: Introduction to the concept of absorption and transmission of light, Beer-Lambert law; scattering of light, Rayleigh and Mia scattering. **Part B:** Basic concepts of pressure, force, work and energy; types of forces and their relation (pressure gradient, viscous, Coriolis, gravitational, centripetal, and centrifugal force); concept of heat transfer, conduction, convection; concept of temperature, lapse rate (dry and moist adiabatic); laws of thermodynamics; concept of heat and work, Carnot engine.	12
II	**Fundamentals of environmental chemistry** **Part A:** Atomic structure, electronic configuration, periodic properties of elements (ionization potential, electron affinity and electronegativity), types of chemical bonds (ionic, covalent, coordinate and hydrogen bonds); mole concept, molarity and normality, quantitative volumetric analysis. **Part B:** Types of chemical reactions; acids, bases and salts, concept of chemical equilibrium, solubility products; solutes and solvents; redox reactions, concepts of pH and pE, electrochemistry, Nernst equation, electrochemical cells **Part C:** Basic concepts of organic chemistry, hydrocarbons, aliphatic and aromatic compounds, organic functional groups, polarity of the functional groups, colloid chemistry. Xenobiotic compounds, chemistry of pesticides and dyes, synthetic polymers.	12
III	**Atmospheric chemistry:**Composition of atmosphere; photochemical reactions in atmosphere; smog formation, types of smog (sulphur smog and photochemical smog), aerosols; chemistry of acid rain, reactions of NOX and SOX; free radicals and ozone layer depletion.	12
IV	Water chemistry : Chemical and physical properties of water; Gases in water, Henry's Law, alkalinity and acidity of water, hardness of water, calculation of total hardness; solubility of metals, complex formation and chelation; heavy metals in water.	12
V	Soil chemistry: Soil composition; relation between organic carbon and organic matter, inorganic and organic components in soil; soil humus; cation and anion exchange reactions in soil; nitrogen, phosphorus and potassium in soil.	12

Suggested Reading

1. Environmental Chemistry — James E. Girrard
2. Environmental Chemistry — Stanly.e.manchen
3. Environmental Chemistry — A.K. De

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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: Certificate /B. Sc. (Hons) **Environmental Science**	**Year:** First (1)	**Semester:** First (I)
Subject: Environmental Science		
Course Code: BH150104P	**Course Title:** PHYSICS AND CHEMISTRY OF ENVIRONMENT LAB	
Credits: 1	**Core Compulsory**	
Maximum Marks: 50	**Minimum Passing Marks:** As per University norms	
Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 0-0-1		

Topics	No. of Lectures
1. Determine the total hardness of given water sample. 2. Determine the alkalinity of given water sample. 3. Determine the free CO_2 content in given water sample. 4. Estimate the chloride content in given water sample. 5. Determine the acidity of water sample. 6. Stress determination on plant, fungi and bacteria. 7. Estimation of chlorophyll content of different plant leaves under stress	15

Programme/Class: Certificate /B. Sc. (Hons) **Environmental Science**	**Year:** First (1)	**Semester:** First (I)
Subject: Environmental Science		
Course Code: BH150105T	**Course Title:** EARTH & EARTH SURFACE PROCESSES	
Course Outcomes (COs)		

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CO1 Strengthen the knowledge about earth **CO2** To build the fundamental concept of earth surface processes **CO3** To understand the principles of evolution of earth's atmosphere and composition **CO4** To understand about Continental collision **CO5** To aware fundamental knowledge of evolution of monsoon in Indian subcontinent

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	History of Earth: Formation of the Earth: formation and composition of core, mantle, crust, atmosphere and hydrosphere; chemical composition of Earth; geological time scale and major changes on the Earth's surface.	12
II	**Earth system processes** Movement of lithosphere plates; mantle convection and plate tectonics, major plates and hotspots, plate boundaries; sea floor spread; earthquakes; volcanic activities; orogeny; isostasy; gravitational and magnetic fields of the earth; origin of the main geomagnetic field; continental drift, Pangaea and presentday continents, paleontological evidences of plate tectonics.	12
III	**Rocks, weathering and minerals:** Minerals and important rock forming minerals; rock cycle: lithification and metamorphism; Three rock laws; rock structure, igneous, sedimentary and metamorphic rocks; weathering: physical, biogeochemical processes; erosion: physical processes of erosion, factors affecting erosion; agents of erosion: rivers and streams, glacial and aeolian transportation and deposition of sediments by running water, wind and glaciers.	12
IV	**Earth atmosphere** Atmosphere: evolution of earth's atmosphere and composition, physical and optical properties, circulation; interfaces: atmosphere-ocean interface, atmosphere-land interface, ocean-land interface.	12
V	**Mountain and river systems of India:** Continental collision and mountain formation; Formation of Peninsular Indian mountain systems - Western and Eastern Ghats, Vindhyas, Aravallis, etc.; Formation of the Himalaya; perennial river systems and evolution of monsoon in Indian subcontinent; formation of Indo-Gangetic Plains, progression of agriculture in the Indian subcontinent in Holocene; withdrawing monsoon and lessons to draw.	12

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Suggested Reading

Suggested Books:

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
7.	The Atmosphere:	
8.	An Introduction to Meteorology	Frederick K Lutgens & Edwrd J Tarbuck

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: Certificate /B. Sc. (Hons) **Environmental Science**	**Year:** First (1)	**Semester:** First (I)
Subject: Environmental Science		
Course Code: BENM150106P	**Course Title:** EARTH & EARTH SURFACE PROCESSES LAB	
Credits: 2	**Core Compulsory**	
Maximum Marks: 50	**Minimum Passing Marks:** As per University norms	
Total Number of Lectures-Tutorials-Practical (in hours per week) L-T-P: 0-0-2		

	Topics	No. of Lectures

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	Identification of rocks & minerals (Hand Specimen) a) Rocks- Granite, Basalt, Dolerite, Shale, Sandstone, Limestone, Slate, Marble, Quartzite, Gneiss b) Minerals- Talc, Bauxite, Mica, Quartz, Hematite, Galena 2. Topological sheet interpretation for geomorphology.	15

Programme/Class: Certificate /B. Sc. (Hons) **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		
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		
Vocational		
Co-Curricular		
Programme/Class: Certificate /B. Sc. (Hons) **Environmental Science**	**Year:** First (1)	**Semester:** Second (II)
Subject: Environmental Science		
Course Code: BH150201T	**Course Title: BIODIVERSITY & CONSERVATIONAL BIOLOGY**	
Course Outcomes (COs)		

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CO1 Strengthen the knowledge about biodiversity CO2 To build the fundamental concept of biodiversity Conservation CO3 To understand the principles of Biodiversity patterns CO4 To understand about Continental collision CO5 To aware fundamental knowledge about Threats of biodiversity

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	**Biodiversity patterns and estimation:** Definition; Types; Spatial patterns: latitudinal and elevational trends in biodiversity; temporal patterns: seasonal fluctuations in biodiversity patterns. Sampling strategies and surveys: floristic, faunal, and aquatic; qualitative and quantitative methods: scoring, habitat assessment, richness, density, frequency, abundance, evenness, diversity, biomass estimation; community diversity estimation: alpha, beta and gamma diversity.	12
II	**Unit 2: Importance of biodiversity:** Economic values - medicinal plants, drugs, fisheries and livelihoods; ecological services - primary productivity, role in hydrological cycle, biogeochemical cycling; ecosystem services - purification of water and air, nutrient cycling, climate control, pest control, pollination, and formation and protection of soil; social, aesthetic, consumptive, and ethical values of biodiversity.	12
III	**Unit 3: Threats to biodiversity:** Natural and anthropogenic disturbances; habitat loss, habitat degradation, and habitat fragmentation; climate change; pollution; hunting; over-exploitation; deforestation; hydropower development; invasive species; land use changes; overgrazing; man wildlife conflicts; consequences of biodiversity loss; Intermediate Disturbance Hypothesis.	12

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IV	**Unit 4: Conservation of biodiversity:** Importance of biodiversity patterns in conservation; In-situ conservation (Biosphere Reserves, National Parks, Wildlife Sanctuaries); Ex-situ conservation (botanical gardens, zoological gardens, gene banks, seed and seedling banks, pollen culture, tissue culture and DNA banks), role of local communities and traditional knowledge in conservation; biodiversity hotspots; IUCN Red List categorization - guidelines, practice and application; Red Data book; ecological restoration; afforestation; social forestry; agro forestry; joint forest management; role of remote sensing in management of natural resources.	12
V	**Unit 5: Biodiversity in India:** India as a mega diversity nation; phytogeographic and zoogeographic zones of the country; National Biodiversity Action Plan.	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
7. Groom.B.&Jenkins.M.2000.GlobalBiodiversityEarth'sLivingResourcesinthe21stCent
   a. Pandit,M.K.&GrumbineR.E.2012.Ongoingandproposedhydropowerdevelopmentinthe Himalaya and its impact on terrestrial biodiversity Conservation Biology 26: 1061- 1071.

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: Certificate /B. Sc. (Hons) **Environmental Science**	**Year:** First (1)	**Semester:** Second (II)

Subject: Environmental Science

Course Code: BH150202P	**Course Title:** BIODIVERSITY & CONSERVATIONAL BIOLOGY LAB
Credits: 2	**Core Compulsory**

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Maximum Marks: 50	Minimum Passing Marks: As per University norms

Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 0-0-2

	Topics	No. of Lectures
	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.	15

Programme/Class: Certificate /B. Sc. (Hons) Environmental Science	Year: First (1)	Semester: Second (II)

Subject: Environmental Science

Course Code: BENM15203T	Course Title: ENVIRONMENTAL BIOTECHNOLOGY

Course Outcomes (COs)

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 and techniques

CO4 To develop the molecular understanding of genetic material and Proteins

CO5 To aware about microbiological and Biotechnological tools is benefited than

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	Basic Concepts of Microbiology: Classification of microorganisms, different factors for microbial growth, staining techniques The Structure and Function of DNA, RNA and Protein DNA: structural forms and their characteristics (B, A, C, D, T, Z); physical properties: UV absorption spectra, denaturation and renaturation kinetics; biological significance of different forms; Synthesis. RNA: structural forms and their characteristics (rRNA, mRNA, tRNA; SnRNA, Si RNA, miRNA, hnRNA); biological significance of different types of RNA; synthesis.	12
II	Recombinant DNA Technology Recombinant DNA: origin and current status; steps of preparation; toolkit of enzymes for manipulation of DNA: restriction enzymes, polymerases (DNA/RNA polymerases, transferase, reverse transcriptase), other DNA modifying enzymes (nucleases, ligase, phosphatases, polynucleotide kinase); genomic and cDNA libraries: construction, screening and uses; cloning and expression vectors	12
III	Biotechnology of Solid waste management: Wastewater treatment: anaerobic, aerobic process, methanogenesis, bioreactors, cell and protein (enzyme) immobilization techniques; solid waste treatment: sources and management (composting, vermiculture and methane production, landfill. hazardous waste treatment); specific bioremediation technologies for xenobiotic compounds.	12
IV	Ecologically safe products and processes PGPR bacteria: biofertilizers, microbial insecticides and pesticides, bio-control of plant pathogen, Integrated pest management; development of stress tolerant plants, biofuel; mining and metal biotechnology: microbial transformation, accumulation and concentration of metals, metal leaching.	12
V	GMs and GMOs Concept of GM and GMOs, case studies, biosafety protocol.	12

Suggested Reading

1. Environmental Microbiology — P. Gebra
2. A Text Book of microbiology — RC Dubey
3. Environmental Biotechnology — S.N. Jogdand
4. Environmental Biotechnology — Alans Scragg
5. Environmental Science — Andrew R.W & Julie M Jackson
6. Microbiology — Prescott
7. Environmental Microbiology — Pradipta K Mohapatra
8. Microbiology — HG Slegal
9. Microbiology — Jaicklene G Black
10. Microbiology — Pelczar

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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: Certificate /B. Sc. (Hons) **Environmental Science**	**Year:** First (1)	**Semester:** Second (II)
Subject: Environmental Science		
Course Code: BH150204 P	**Course Title: ENVIRONMENTAL BIOTECHNOLOGY**	
Credits: 2	**Core Compulsory**	
Maximum Marks: 50	**Minimum Passing Marks:** As per University norms	
Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 0-0-2		

Topics	No. of Lectures
1. Gram Staining, 2. Total Coliform 3. count (MPN), 4. Preparation of Microbial Growth media 5. ABO Blood grouping. 6. Review paper preparation/ presentation on topics related to Environmental Biotechnology.	15

Programme/Class: Certificate /B. Sc. (Hons) **Environmental Science**	**Year:** First (1)	**Semester:** Second (II)
Subject: Environmental Science		
Course Code: BH150205T	**Course Title:** **ENVIRONMENTAL HEALTH AND TOXICOLOGY**	
Course Outcomes (COs)		

1/6/2022

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

CO1 Aware fundamental knowledge about Basic Concept of Toxicology

CO2 Students aware about diseases which is based on pollution

CO3 Students buildup the Concept of Immunology

CO4 To buildup the concept of communication for health education

CO5 To aware about toxicant and route exposure.

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	**Epidemiology and Health:** Concept of Health and Disease, principles of epidemiology and epidemiological methods, aims of epidemiology, measurement of mortality, measurement of morbidity.	12
II	**Concept of Disease:** Concept of screening the diseases, some communicable diseases like small pox, cholera, acute diarrheal disease, viral hepatitis, water borne pathogens, vector borne diseases, diseases caused by contaminated food and water, soil borne infections, insect borne diseases.	12
III	**Concept of Immunology:** Elementary idea about antigens and antibody, hyper sensitivity, allergic reactions, pollens and their allergens. Immunological techniques.	12
IV	**Community and Health:** Communication for health education, health care of the country.	12
V	**Basic Concept of Toxicology:** 31 Different types of toxicant, toxicity test, toxicity by different factors, exposure effect relationship, different route of exposure, synergistic and antagonistic effect, Bioaccumulation and Biomagnification. Detoxification, toxico-dynamics.	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

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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: Certificate /B. Sc. (Hons) **Environmental Science**	**Year:** First (1)	**Semester:** Second (II)
Subject: Environmental Science		
Course Code: BH150206P	**Course Title: ENVIRONMENTAL HEALTH AND TOXICOLOGY**	
Credits: 2	**Core Compulsory**	
Maximum Marks: 50	**Minimum Passing Marks:** As per University norms	
Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 0-0-2		

	Topics	No. of Lectures
	1. LC 50 calculation by probit analysis with data provided. 2. Determination of stress related heat, pH, temperature 3. Study of abnormalities in the erythrocytes of fish 4. Study of abnormalities in root tip of Allium cepa	15

Programme/Class: Certificate /B. Sc. (Hons) **Environmental Science**	**Year:** Second (II)	**Semester: Third** (III)
Subject: Environmental Science		
Course Code: BH150301T	**Course Title: WATER AND WATER RESOURCES MANAGEMENT**	
Course Outcomes (COs)		

1/6/2022

CO1 To aware fundamental knowledge of water sources and it types **CO2** Students aware about Physical, Chemical, Biological Properties of water **CO3** Students buildup the concept of ground water **CO4** To buildup the concept of Wetlands CO5 To aware about the Water resource in India.

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	**Water resource:** Sources and types of water; hydrological cycle; precipitation, runoff, infiltration, evaporation, evapotranspiration; classification of water resources (oceans, rivers, lakes and wetlands).	12
II	**Properties of water:** Physical: temperature, colour, odour, total dissolved solids and total suspended solids; Chemical: major inorganic and organic constituents, dissolved gases, DO, COD, BOD, electrical conductivity, sodium adsorption ratio; Biological: phytoplankton, phytobenthos, zooplankton, macro-invertebrates and microbes.	12
III	Surface and Groundwater: Introduction to surface and ground water; water table; vertical distribution of water; formation and properties of aquifers; hydraulic potential, Darcy's equation, types of flow, turbulence, techniques for ground water recharge; watershed and drainage basins; importance of watershed and watershed management	12
IV	**Wetlands and their management:** Definition of a wetland; types of wetlands (fresh water and marine); ecological and hydrological functions of wetlands.	12
V	**Water resource in India and Water sharing conflicts:** Demand for water (agriculture, industrial, domestic); overuse and depletion of surface and ground water resources; water quality standards in India; hot spots of surface water; role of state in water resources management. Water resources and sharing problems.	12

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Suggested Reading

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 Kugamoorthy & Belauthamorthy (Lambert Academic Publisher)

Other ccourse 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: Certificate /B. Sc. (Hons) **Environmental Science**	**Year:** Second (II)	**Semester:** Third (III)
Subject: Environmental Science		
Course Code: Course Code: BH150302P	**Course Title: WATER AND WATER RESOURCES MANAGEMENT LAB**	
Credits: 2	**Core Compulsory**	
Maximum Marks: 50	**Minimum Passing Marks:** As per University norms	
Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 0-0-2		

	Topics	No. of Lectures
	1. Determine the alkalinity. pH, Electrical conductivity, Salinity of given water sample. 2. Determine the alkalinity of given soil sample (through Chloride Estimation). 3. Determine the Dissolved oxygen, TSS, TDS, Iron of given soil sample 4. Determine the TSS, TDS, Iron of given soil sample 5. Determine the Iron of given soil sample 6. Determine the TSS, TDS, Iron of given soil sample	15

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Programme/Class: Certificate /B. Sc. (Hons) **Environmental Science**	**Year:** Second (II)	**Semester:** Third (III)
Subject: Environmental Science		
Course Code: BH150303T	**Course Title: Land management and soil conservation**	

Course Outcomes (COs)

After completion of the course the student should be able to:

CO1 To aware fundamental knowledge of Land Resource

CO2 To buildup the concept of soil science

CO3 Students aware about Soil resistance and resilience

CO4 Students buildup the concept of Land use pattern

CO5 To aware about the Land deterioration and management

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 Land Resource:** Land as a resource, types and evaluation, soil health; ecological and economic importance of soil; types and causes of soil degradation; impact of soil loss and soil degradation on agriculture and food security; need for soil conservation and restoration of soil fertility.	12
II	**Fundamentals of soil science** Soil formation; classification of soil; soil architecture; physical properties of soil; soil texture; soil profile; soil water holding capacity; soil temperature; soil colloids; soil acidity and alkalinity; soil salinity and sodicity; soil organic matter; micronutrients of soil; nitrogen, sulphur, potassium and phosphorus economy of soil; soil biodiversity; soil taxonomy maps.	12
III	**Soil degradation and conservation:** Soil resistance and resilience; nature and types of soil erosion; non-erosive and erosive soil degradation; losses of soil moisture and its regulation; nutrient depletion; soil pollution due to mining and mineral extraction, industrial and urban development, toxic organic chemicals, and organic contaminants in soils; fertilizers and fertilizer management; recycling of soil nutrients.	12

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IV	**Land use changes** Land use pattern, drivers of land use and land cover change in major geographic zones and biodiverse regions with particular reference to the Himalaya and the Western Ghats.	12
V	**Land degradation and management:** Land degradation: biological and physical phenomena; visual indicators of land degradation; drivers of land degradation - deforestation, desertification; habitat loss, loss of biodiversity; range land degradation; land salinization; human population pressure, poverty, socio-economic and institutional factors, Economic valuation of land degradation; onsite and offsite costs of land degradation; loss of ecosystem services; effects on farming communities; effects on food security; effects on nutrient cycles; future effects of soil degradation; emerging threats of land degradation to developing countries. Sustainable land use planning; role of databases and data analysis in landuse planning control and management; land tenure and land policy; legal, institutional and sociological factors; participatory land degradation assessment; integrating land degradation assessment into conservation.	12

Suggested Reading

1. **Suggested Books:**
2. Soil Sciences — N .C Breede
3. Hand Book of Soil Science — Malcolm E Sumner
4. Agriculture and soil pollution — James B Livingston
5. Soil and Water Contamination — Marcel Van Derperk
6. Soil Pollution — Armeando Duarte, Anabela Cachada

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: Certificate /B. Sc. (Hons) **Environmental Science**	**Year:** Second (II)	**Semester:** Third (III)
Subject: Environmental Science		
Course Code: BH150304P	**Course Title: LAND MANAGEMENT AND SOIL CONSERVATION LAB**	
Credits: 2	**Core Compulsory**	

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Maximum Marks: 50	Minimum Passing Marks: As per University norms
Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 0-0-2	

	Topics	No. of Lectures
	1. Estimation of Soil Organic Carbon, 2. Estimation of Water Holding Capacity, 3. Estimation of buffering capacity of soil 4. Estimation of pH of soil 5. Estimation of Determination of Soil carbonate and Bicarbonate 6. Estimation of Available NPK of Soil 7. Bulk density particle density water holding capacity	15

Programme/Class: Certificate /B. Sc. (Hons) Environmental Science	Year: Second (II)	Semester: Third (III)
Subject: Environmental Science		
Course Code: BH150305T	Course Title: NATURAL RESOURCES MANAGEMENT AND SUSTAINABILITY	

Course Outcomes (COs)

CO1 To aware fundamental 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

CO5 To aware about the Sustainable energy strategy

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	**Introduction** Resource and reserves; classification of natural resources; renewable and non-renewable resources; resource degradation; resource conservation; resource availability and factors influencing its availability; land resources; water resources; fisheries and other marine resources; energy resources; mineral resources; human impact on natural resources; ecological, social and economic dimension of resource management.	12
II	**Natural resources and conservation** Forest resources: economic and ecological importance of forests, forest management strategies, sustainable forestry; water resources: supply, renewal, and use of water resources, freshwater shortages, strategies of water conservation; soil resources conservation.	12
III	**Mineral resources:** Mineral resources and the rock cycle; identified resources; undiscovered resources; reserves; types of mining: surface, subsurface, open-pit, dredging, strip; reserve-to-production ratio; global consumption patterns of mineral resources techniques to increase mineral resource supplies; ocean mining for mineral resources; environmental effects of extracting and using mineral resources.	12
IV	**Energy resources** Resource and conservation-Oil and natural gas formation, exploration, extraction and processing. Energy efficiency; life cycle cost; cogeneration; solar energy: technology, advantages, passive and active solar heating system, solar thermal systems, solar cells. Resource and conservation-wind energy, hydropower energy, nuclear energy ,ocean thermal energy conversion (OTEC); geothermal energy, bio energy and tidal energy.	12
V	Sustainable energy strategy: Sustainable energy strategy; principles of energy conservation; Indian renewable energy programme.	12

Suggested Reading

1. Introduction to forestry and Natural Resources — Donald L Grebner, Pete Bettinger i. Jacek P. Siry
2. Energy and the Environment — Robert A Ristinen, Jack P. i. 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 &
8. Natural Resources Economics — Jonathan M Harris and Brian

1. Roach

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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: Certificate /B. Sc. (Hons) **Environmental Science**	**Year:** Second (II)	**Semester:** Third (III)
Subject: Environmental Science		
Course Code: BH150306P	**Course Title: NATURAL RESOURCES MANAGEMENT AND SUSTAINABILITY LAB**	
Credits: 2	**Core Compulsory**	
Maximum Marks: 50	**Minimum Passing Marks:** As per University norms	
Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 0-0-2		

Topics	No. of Lectures
1. Survey of natural agricultural resource for Energ 2. Use and over-utilisation of surface and ground water, floods, drought, conflicts over water, dams – benefits and problems 3. Use of Alternate energy sources, Case studies 4. Non-renewable resources in India 5. Renewable resources in India 6. Natural resources Harnessing Methods and classification	15
Minor elective from other faculty	
Vocational	
Co-Curricular	

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Programme/Class: Certificate /B. Sc. (Hons) Environmental Science	Year: Second (2)	Semester: Fourth (IV)
Subject: Environmental Science		
Course Code: BH150401T	Course Title: ANALYTICAL METHODS, INSTRUMENTATION AND MEASUREMENT	

Course Outcomes (COs)

CO1 To aware fundamental knowledge Sampling

CO2 To buildup the concept of Spectrophotometry

CO3 Students aware about Electrophoresis

CO4 Students buildup the concept of Microscopy

CO5 To aware about the data analysis

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	**Sampling** Sampling, preservation, storage techniques; Principles and applications of titrimetry (Acidimetry, Alkalimetry, Complexometry, Argentometry, Iodometry) gravimetry, potentiometry, conductimetry.	12
II	**Principles and application of Spectrophotometry** Principles and application of UV-VIS Spectrophotometry, Atomic absorbtion spectrophometry flame photometry	12
III	**Electrophoresis**Electrophoresis gel electrophoresis, SDS-PAGE , Chromatography, X-Ray fluorescence	12
IV	**Microscopy**- Microscopy Properties, Types and applications.	12
V	**Date Information-** Knowledge Wisdom Loop, data analysis, errors in data representation.	12

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Suggested Reading

1. Standard Methodology of Biochemical Analysis SK Thimmayiah
2. Practical Biochemistry K Willson & John Walker
3. Labraor manual P.M.Swami

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: Certificate /B. Sc. (Hons) **Environmental Science**	**Year:** Second (2)	**Semester:** Fourth (IV)
Subject: Environmental Science		
Course Code: BENM150402P	**Course Title:** ANALYTICAL METHODS, INSTRUMENTATION AND MEASUREMENT LAB	
Credits: 2	**Core Compulsory**	
Maximum Marks: 50	**Minimum Passing Marks:** As per University norms	

Total Number of Lectures-Tutorials-Practical (in hours per week) L-T-P: 0-0-2

	Topics	No. of Lectures
	1. Separation of chlorophyll pigment by paper chromatography. 2. Separation of protein by paper chromatography. 3. Separation of amino acid by thin-layer chromatography. 4. Protein profiling by SDS-PAGE. 5. Measurement of light intensity. 6. Agarose-Gel electrophoresis. Obtained data from field by Sampling, preservation, tabulation and analysis	15

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Programme/Class: Certificate /B. Sc. (Hons) **Environmental Science**	**Year:** Second (2)	**Semester:** Fourth (IV)
Subject: Environmental Science		
Course Code: BH150403T	**Course Title:** GREEN TECHNOLOGIES	
Course Outcomes (COs)		
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	**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	**Green infrastructure, planning and economy** Concept of green technology, Chronological development of green technology, green belts.	12
II	**Applications of green technologies** 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	**Green chemistry** Introduction to green chemistry; principles and recognition of green criteria in chemistry; bio- degradable and bio-accumulative products in environment; green nanotechnology; reagents, reactions and technologies that should be and realistically could be replaced by green alternatives; photodegradable plastic bags.	12

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IV	**Green future** Agenda of green development; reduction of ecological footprint; role of green technologies towards a sustainable future; major challenges and their resolution for implementation of green technologies; green practices to conserve natural resources (organic agriculture, agro forestry, reducing paper usage and consumption, etc.); emphasis on waste reduction instead of recycling.	12
V	**Innovation of Green technology** Emphasis on innovation for green future; role of advancement in science in developing environmental friendly technologies.	12

Suggested Reading

1. Conservation of Natural Resources. Prentice Hall Publication Klee. G.A. 1991.
2. Anastas,
3. Green Chemistry: Theary & Practice. Oxford University Press P.T. & Warner,J.C. 1998.
4. Boeker,E.&Grondelle,R.2011.EnvironmentalPhysics:SustainableEnergyandClimateC hange.Wile
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: Certificate /B. Sc. (Hons) **Environmental Science**	**Year:** Second (2)	**Semester:** Fourth (IV)
Subject: Environmental Science		
Course Code: BH150404P	**Course Title:** **GREEN TECHNOLOGIES LAB**	
Credits: 2	**Core Compulsory**	
Maximum Marks: 50	**Minimum Passing Marks:** As per University norms	
Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 0-0-2		

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	Topics	No. of Lectures
	1. Analysis of stability of vermi-compost by compost respiration method. 2. Analysis of rainwater harvesting potential in urban/rural catchments 3. Developed green practices to conserve natural resources (organic agriculture, agro forestry, reducing paper usage and consumption) 4. Developed green practices for photodegradable plastic bags	15

Programme/Class: Certificate /B. Sc. (Hons) **Environmental Science**	**Year:** Second (2)	**Semester:** Fourth (IV)
Subject: Environmental Science		
Course Code: BENM150405T	**Course Title: ENERGY AND ENVIRONMENT**	

Course Outcomes (COs)

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	**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	**Energy resources** 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

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II	**Energy demand** Global energy demand: historical and current perspective; energy demand and use in domestic, industrial, agriculture and transportation sector; generation and utilization in rural and urban environments; changes in demand in major world economies; energy subsidies; environmental costs.	12
III	**Energy, environment and society** 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; energy production	12
IV	**Our energy future** Current and future energy use patterns in the world and in India; evolution of energy use over time; alternative sources as green energy (biofuels, wind energy, solar energy, geothermal energy; tidal energy, ocean energy; nuclear energy); need for energy efficiency; energy conservation and sustainability; action strategies for sustainable energy management from a future perspective	12
V	**Energy impact and issues** Energy transformation and utilization associated environmental impacts (Chernobyl and Fukushima nuclear accidents, construction of dams, environmental pollution); energy over-consumption and its impact on the environment, economy, and global change; social inequalities related to energy production, distribution, and use; energy conservation.	12

Suggested Reading

1. Anastas, P.T. & Warner,J.C. 1998. Green Chemistry: Theary & Practice. Oxford University Press
2. Boeker.E.&Grondelle.R.2011.EnvironmentalPhysics:SustainableEnergyandClimateC hange.Wile
3. Boyle G., 2004. Renewable Energy: Power for Sustainable Future. Oxford University Press.
4. 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: Certificate /B. Sc. (Hons) **Environmental Science**	**Year:** Second (2)	**Semester:** Fourth (IV)

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Subject: Environmental Science	
Course Code: BH150406P	**Course Title:** ENERGY AND ENVIRONMENT
Credits: 2	**Core Compulsory**
Maximum Marks: 50	**Minimum Passing Marks:** As per University norms
Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 0-0-2	

	Topics	No. of Lectures
	1. Calculation of energy efficiency from given data. 2. Preparation of energy audit of a domestic unit and report submission. 3. Submit a report on Green energy development (biofuels, wind energy, solar energy, geothermal energy, tidal energy, ocean energy, nuclear energy) in Indian contest	15

Vocational

Co-Curricular

Programme/Class: Certificate /B. Sc. (Hons) **Environmental Science**	**Year:** Third (III)	**Semester:** Fifth (V)

Subject: Environmental Science	
Course Code: BH150501T	**Environmental Pollution and Human Health**

Course Outcomes (COs)

CO1 To aware fundamental knowledge of Pollutants

CO2 To buildup the concept of Ambient air quality and noise

CO3 To buildup the concept of water pollution

CO4 Students buildup the concept of soil pollution

CO5 To aware about the pollution management

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	**Introduction** Definition of pollution; pollutants; classification of pollutants.	12
II	**Air & Noise pollution** Ambient air quality: monitoring and standards (National Ambient Air Quality Standards ofIndia); air quality index; sources and types of pollutants (primary and secondary); indoor air pollution: sources and effects on human health. Noise pollution-sources; frequency, intensity and permissible ambient noise levels; effect on communication, impacts on life forms and humans - working efficiency, physical and mental health; control measures.	12
III	**Water pollution** Sources of surface and ground water pollution; water quality parameters and standards; organic waste and water pollution; eutrophication; COD, BOD, DO; effect of water contaminants on human health (nitrate, fluoride, arsenic, chlorine, cadmium, mercury, pesticides); water borne diseases; concept and working of effluent treatment plants (ETPs). Marine resources and their importance; sources of marine pollution; oil spill and its effects; coral reefs and their demise; coastal area management; existing challenges and management techniques (planning, construction, environmental monitoring of coastal zones).	12
IV	**Soil pollution** Causes of soil pollution and degradation; affect of soil pollution on environment, vegetation and other life forms; control strategies. Radioactive material and sources of radioactive pollution; effect of radiation on human health (somatic and genetic effects); thermal pollution and its effects.	12
V	**Pollution** Pollution control mechanism of air, water, soil and noise. Activated Sludge Process (ASP) - Trickling Filters - oxidation ponds, fluidized bed reactors,membrane bioreactor neutralization, ETP sludge management; digesters, up flow anaerobic sludge blanket reactor, fixed film reactors, sequencing batch reactors, hybrid reactors, bioscrubbers, biotrickling filters; regulatory framework for pollution monitoring and control; case study: Ganga Action Plan; Yamuna Action Plan; implementation of CNG in NCT of Delhi.	12

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Suggested Reading

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
6. Water Pollution — V.K. Kudesia & Emminual Pulmen
7. Aquatic Pollution — Edward A –laws
8. Surface water pollution and its control — K V Ellis
9. A Text Book of water pollution and water quality indicators Kugamoorthy & Belauthamorthy (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: Certificate /B. Sc. (Hons) **Environmental Science**	**Year:** Third (III)	**Semester:** Fifth (V)
Subject: Environmental Science		
Course Code: BH150502P	**Course Title: ENVIRONMENTAL POLLUTION AND HUMAN HEALTH LAB**	
Credits: 2	**Core Compulsory**	
Maximum Marks: 50	**Minimum Passing Marks:** As per University norms	
Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 0-0-2		

	Topics	No. of Lectures
	1. Estimation of BOD, COD of Gomati river water 2. Estimation of Noise level (dB (A) in Jaunpur city 3. Estimation of SPM, RSPM of air 4. Estimation of Dust fall rate of road side vegetation 5. Soil pollution	15

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Programme/Class: Certificate /B. Sc. (Hons) **Environmental Science**	**Year:** Third (III)	**Semester:** Fifth (V)
Subject: Environmental Science		
Course Code: BH150503T	**Course Title: ATMOSPHERE AND GLOBAL CLIMATE CHANGE**	

Course Outcomes (COs)

CO1 To aware fundamental knowledge Earth's energy balance

CO2 To buildup the concept of Atmospheric circulation

CO3 To buildup the concept of Meteorological parameters

CO4 Students buildup the concept and trends of global warming and climate change

CO5 To aware about the ozone layer depletion

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	**Global energy balance** Earth's energy balance; energy transfers in atmosphere; Earth's radiation budget; green house gases (GHGs); greenhouse effect; global conveyor belt.	12
II	**Atmospheric circulation** Movement of air masses; atmosphere and climate; air and sea interaction; southern oscillation; western disturbances; El Nina and La Nina; tropical cyclone; Indian monsoon and its development, effect of urbanization on micro climate; Asian brown clouds.	12
III	**Meteorology and atmospheric stability** Meteorological parameters (temperature, relative humidity, wind speed and direction, precipitation); atmospheric stability and mixing heights; temperature inversion; plume behavior; Gaussian plume model.	12

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IV	**Global warming and climate change** Earth's climate through ages; trends of global warming and climate change; drivers of global warming and the potential of different green house gases (GHGs) causing the climate change; atmospheric windows; impact of climate change on atmosphere, weather patterns, sea level rise, agricultural productivity and biological responses - range shift of species, CO2 fertilization and agriculture; impact on economy and spread of human diseases. Environmental policy debate; International agreements; Kyoto protocol 1997; Convention on Climate Change; carbon credit and carbon trading; clean development mechanism.	12
V	**Ozone layer depletion** Ozone layer or ozone shield; importance of ozone layer; ozone layer depletion and causes; Chapman cycle; process of spring time ozone depletion over Antarctica; ozone depleting substances (ODS); effects of ozone depletion; mitigation measures and international protocols - Montreal protocol 1987.	12

Suggested readings

1. The Atmosphere: An Introduction to Meteorology
2. Frederick K Lutgens & Edwrd J Tarbuck
3. Green House and Earth — Annika Nilsson
4. Ozone in the Free Atmosphere — Robert C. Whitten & Sheos Prasad
5. Environmental sciences — Denial D Chiras
6. Environmental sciences — Ginger smith

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: Certificate /B. Sc. (Hons) **Environmental Science**	**Year:** Third (III)	**Semester:** Fifth (V)

Subject: Environmental Science

Course Code: BENM150504P	**Course Title: ATMOSPHERE AND GLOBAL CLIMATE CHANGE *LAB***
Credits: 2	**Core Compulsory**
Maximum Marks: 50	**Minimum Passing Marks:** As per University norms

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Total Number of Lectures-Tutorials-Practical (in hours per week) L-T-P: 0-0-2		
	Topics	**No. of Lectures**
	1. Estimation of atmospheric pressure, 2. Estimation of relative humidity, 3. Estimation of rainfall, 4. Estimation of insolation, 5. Calculate the wind speed, 6. Estimation of light intensity (Lux meter) 7. Prepare a summary report of weather with the help of one month data	15

Programme/Class: Certificate /B. Sc. (Hons) Environmental Science	**Year:** Third (III)	**Semester:** Fifth (V)
Subject: Environmental Science		
Course Code: BH150505T	**Course Title: ENVIRONMENTAL LEGISLATION AND POLICY**	

Course Outcomes (COs)

CO1 To aware fundamental knowledge of Constitution of India related to environment

CO2 To determine the concept of policy

CO3 To buildup the concept of Environmental legislation

CO4 to develop concept and trends of National Environmental policy and act

CO5 To aware about the International laws and policy of Environment

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	**Introduction** Constitution of India; fundamental rights; fundamental duties; Union of India; union list, state list, concurrent list; legislature; state assemblies; judiciary; panchayats and municipal bodies.	12
II	**History of environmental legislation and policy** Provision of Environmental Conservation - British India: Indian Penal Code 1860, Forest Act 1865, Fisheries Act 1897; Independent India: Van Mahotsava 1950, National Forest Policy 1952, National Forest Policy 1988.	12
III	**Environmental legislation** Legal definitions (environmental pollution, natural resource, biodiversity, forest, sustainable development); Article 48A (The protection and improvement of environment and safeguarding of forests and wildlife); Article 51 A (Fundamental duties). The Indian Forest Act 1927; The Wildlife (Protection) Act 1972; The Water (Prevention and Control of Pollution) Act 1974; The Water (Prevention and Control of Pollution) Cess Act 1977; The Forests (Conservation) Act 1980; The Air (Prevention and Control of Pollution) Act 1981; The Environment (Protection) Act 1986; Motor Vehicle Act 1988; The Public Liability Insurance Act 1991; Noise Pollution (Regulation and Control) Rules 2000; The Biological Diversity Act 2002; The Schedule Tribes and other Traditional Dwellers (Recognition of Forests Rights) Act 2006; The National Green Tribunal Act 2010; scheme and labeling of environment friendly products, Ecomarks.	12
IV	**Role of Government institutions and National Policies** Role of Ministry of Environment, Forests & Climate Change in environmental law and policy making; role of central and state pollution control boards in environmental law and policy making; National Green Tribunal; National Environment Policy, 2006.	12
V	**International laws and policy** Stockholm Conference 1972; United Nations Conference on Environment and Development 1992; Rio de Janeiro (Rio Declaration, Agenda 21); Montreal Protocol 1987; Kyoto Protocol 1997; Copenhagen and Paris summits; Ramsar convention.	12

Suggested Reading

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

1.

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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		
Programme/Class: Certificate /B. Sc. (Hons) **Environmental Science**	**Year:** Third (III)	**Semester:** Fifth (V)
Subject: Environmental Science		
Course Code: BH150506R		**Course Title:** Industrial Training/Surveys/Research Project
Credits: As per University norms		**Core Compulsory**
Maximum Marks: 50		**Minimum Passing Marks:** As per University norms

Programme/Class: Certificate /B. Sc. (Hons) **Environmental Science**	**Year:** Third (III)	**Semester:** Fifth (V)
Subject: Environmental Science		
Course Code: BH150507T	**Course Title:** ORGANISMAL AND EVOLUTIONARY BIOLOGY	
Course Outcomes (COs)		
CO1 To aware fundamental knowledge of life on Earth **CO2** To buildup the concept of Evolution of unicellular life **CO3** To buildup the concept of Geography of evolution **CO4** Students buildup the concept of Molecular evolution **CO5** To aware about the Fundamentals of population genetics		
Credits: 4	**Elective**	
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	**History of life on Earth** **Part-A : Paleontology and evolutionary History;** Evolutionary time scale; eras, periods and epoch; major events in the evolutionary time scale; stages in primate evolution including Homo. **Part B: Lamarck's concept of evolution;** Darwin's Evolutionary Theory: variation, adaptation, struggle, fitness and natural selection; Mendelism; spontaneity of mutations; The Evolutionary Synthesis.	12
II	**Evolution of unicellular life** Origin of cells and unicellular evolution and basic biological molecules; abiotic synthesis of organic monomers and polymers; Oparin-Haldane hypothesis; study of Miller; the first cell.	12
III	**Geography of evolution** Biogeographic evidence of evolution; patterns of distribution.	12
IV	**Molecular evolution** Introduction to biomolecules: Protein, Lipids, Carbohydrates (General characteristics and classification) Neutral evolution; molecular divergence and molecular clocks; molecular tools in phylogeny, classification and identification; protein and nucleotide sequence analysis.	12
V	**Fundamentals of population genetics** Concepts of populations, gene pool, gene frequency; concepts and rate of change in gene frequency through natural selection, migration and genetic drift; adaptive radiation; isolating mechanisms; speciation (allopatric, sympatric, peripatric and parapatric); convergent evolution; sexual selection; coevolution; Hardy-Weinberg Law.	12

Suggested Reading

1. Nei, M. 1987. Molecular Evolutionary Genetics. Columbia University press.
2. Bawa K.S., Primack R.B, Oommen M.A. 2004. Conservation Biology: A Primer for South Asia. University Press.

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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: Certificate /B. Sc. (Hons) **Environmental Science**	**Year:** Third (III)	**Semester:** Fifth (V)
Subject: Environmental Science		
Course Code: BH150508T	**Course Title:** URBAN ECOSYSTEMS	
Course Outcomes (COs)		
To aware fundamental knowledge of urban ecosystem **CO2** To buildup the concept of urban habitat growth **CO3** To buildup the concept of City ecosystem **CO4** Students buildup the concept of city planning and environmental management **CO5** To aware about the Fundamentals of urban environmental 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	**Environment in an urban setting** Man as the driver of urban ecosystem; co modification of nature; economic and ecological perspectives of urban development.	12
II	Urban Sprawl; Housing scenario across a range of large-medium-small cities; poverty and slums in an urban context; Town planning Acts and their environmental aspects; energy consumption and waste disposal as well as accumulation; environmental costs of urban infrastructure.	12

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III	**Urban interface with the environment** Definition and concepts: green technology, green energy, green infrastructure, green economy, and, green chemistry; sustainable consumption of resources; individual and community level participation such as small-scale composting pits for biodegradable waste, energy conservation.	12
IV	**Natural spaces in a city** Concept of 'controlled nature'; scope, importance and threats to nature in the city; organization and planning of green spaces such as parks, gardens and public spaces; concept of green belts; urban natural forest ecosystem as green lungs.	12
V	**Planning and environmental management** Green buildings; history of green buildings, need and relevance of green buildings over conventional buildings.	12

Suggested Reading

1. Freeman, A.M. 2003. Millennium Ecosystem Assessment: Conceptual Framework. Island Press.
2. Loreau, M. &Inchausti, P. 2002. Biodiversity and Ecosystem functioning: Synthesis and Perspectives. Oxford University Press, Oxford. UK.
3. Fundamentals of Ecology — E.P. Odum
4. Essentials of Ecology — John L. Harper and Michael Begon
5. Ecology and The Environment — Russell K Manson
6. Silent Spring — Rachel Carson
7. Ecosystem dynamics From the past to future-Richard HW Bradshaw & Martin T Sykesf

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: Certificate /B. Sc. (Hons) **Environmental Science**	**Year:** Third (III)	**Semester:** Sixth (VI)
Subject: Environmental Science		
Course Code: BH150601T	**Course Title:** ENVIRONMENTAL IMPACT AND RISK ASSESSMENT	
Course Outcomes (COs)		

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On completion of this course, students should be able to:

CO1 To aware fundamental knowledge of Environmental impact assessment

CO2 To buildup the concept of EIA module

CO3 To buildup the concept of EIA regulation

CO4 Students buildup the concept of EIA risk assessment

CO5 To aware about the Fundamentals of ISO

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	**Environmental impact assessment (EIA):** Definitions, introduction and concepts; rationale and historical development of EIA; scope and methodologies of EIA; role of project proponents, project developers and consultants; Terms of Reference; impact identification and prediction; baseline data collection; Environmental Impact Statement (EIS), Environmental Management Plan (EMP)	12
II	**Environmental impact assessment module** Rapid EIA; Strategic Environmental Assessment; Social Impact Assessment; Cost-Benefit analysis; Life cycle assessment; environmental appraisal; environmental management - principles, problems and strategies; environmental planning; environmental audit;	12
III	**Environmental impact assessment regulation** EIA regulations in India; status of EIA in India; current issues in EIA; case study of hydropower projects thermal projects.	12
IV	**Risk assessment**: Introduction and scope; project planning; exposure assessment; toxicity assessment; hazard identification and assessment; risk characterization; risk communication; environmental monitoring; community involvement; legal and regulatory framework; human and ecological risk assessment.	12
V	**ISO Certification** Introduction to ISO 9000 and ISO 14000, certification; sustainable development.	12

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Suggested Reading

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, Acts, Guidelines, Compliances and standards-Dr RK Trivedy

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: Certificate /B. Sc. (Hons) **Environmental Science**	**Year:** Third (III)	**Semester:** Sixth (VI)
Subject: Environmental Science		
Course Code: BH150602P	**Course Title:** ENVIRONMENTAL IMPACT AND RISK ASSESSMENT	
Credits: 2	**Core compulsory**	
Maximum Marks: 50	**Minimum Passing Marks:** As per University norms	
Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 0-0-2		

	Topics	No. of Lectures
	1. Industrial Case study 2. Preparation and submission of report	30

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: Certificate /B. Sc. (Hons) **Environmental Science**	**Year:** Third (III)	**Semester:** Sixth (VI)
Subject: Environmental Science		
Course Code: BH150603T	**Course Title:** *REMOTE SENSING, GEOGRAPHIC INFORMATION SYSTEM & MODELLING*	
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	**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	**Remote Sensing:** 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	**Geographical Information Systems:** Definitions and components; spatial and non-spatial data; raster and vector data; database generation;	12
III	**Management** 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;** Water resource management, lands use planning, forest resources, agriculture, marine and atmospheric studies.	12

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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.). Wiely.

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: Certificate /B. Sc. (Hons) **Environmental Science**	**Year:** Third (III)	**Semester:** Sixth (VI)
Subject: Environmental Science		
Course Code: BH150604P	**Course Title:** *REMOTE SENSING, GEOGRAPHIC INFORMATION SYSTEM & MODELLING* **Lab**	
Credits: 2	**Core compulsory**	
Maximum Marks: 50	**Minimum Passing Marks:** As per University norms	
Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 0-0-2		

	Topics	**No. of Lectures**
	1. ArC GIS online study for Mapping 2. Q GIS online study for Mapping 3. Analysis of Mapper and imaging	15

Programme/Class: Certificate /B. Sc. (Hons) **Environmental Science**	**Year:** Third (III)	**Semester:** Sixth (VI)
Subject: Environmental Science		
Course Code: BENH15605T	**Course Title: NATURAL HAZARDS AND DISASTER MANAGEMENT**	
Course Outcomes (COs)		

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CO1 Strengthen the knowledge about 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	**Introduction** Definition of hazard; natural, technological, and context hazards; concept of risk and vulnerability; reasons of vulnerability - rapid population growth, urban expansion, environmental pollution, epidemics, industrial accidents, inadequate government policies.	12
II	**Natural hazards:** Natural hazards: hydrological, atmospheric & geological hazards; earthquake: seismic waves, epicenter; volcanoes: causes of volcanism, geographic distribution; floods: types and nature, frequency of flooding; landslides: causes and types of landslides, landslide analysis; drought: types of droughtmeteorological, agricultural, hydrological, and famine; Glacial Lake Outburst Floods (GLOF); tornadoes, cyclone & hurricanes; tsunamis: causes and location of tsunamis; coastal erosion, sea level changes and its impact on coastal areas and coastal zone management.	12
III	**Anthropogenic hazards** Impacts of anthropogenic activities such as rapid urbanization, injudicious ground water extraction, sand mining from river bank, deforestation, mangroves destruction; role of construction along river banks in elevating flood hazard; disturbing flood plains. Deforestation and landslide hazards associated with it; large scale developmental projects, like dams and nuclear reactors in hazard prone zones; nature and impact of accidents, wildfires and biophysical hazards. Case studies of Bhopal, Minamata and Chernobyl disaster. role of space technology in disaster management. role of government bodies such as NDMC and IMD; role of armed forces	12
IV	**Risk and vulnerability assessment** Two components of risk: likelihood and consequences, qualitative likelihood measurement index; categories of consequences (direct losses, indirect losses, tangible losses, and intangible losses); application of geoinformatics in hazard, risk & vulnerability assessment.	12

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V	**Mitigation and preparedness** Concept of mitigation; types of mitigation: structural and non-structural mitigation, use of technologies in mitigations such as barrier, deflection and retention systems; concept of preparedness; importance of planning, exercise, and training in preparedness; role of public, education and media in hazard preparedness.	12

Suggested Reading

Suggested Readings:

1. Coppola D.P. 2007. Introduction to International Disaster Management. Butterworth Heinemann.
2. Craig, J.R., Vaughan, D.J. &Skinner. B.l. 1996. Resources of the Earth: Origin, Use, and Environmental Impacts(2 nd edition). Prentice Hall, New Jersey.
3. Critchfield, H.J. 2012. General Climatology (4th & Indian edition), PHI.
4. Cutter, S.L. 2012.Hazards Vulnerability and Environmental Justice. Earth Scan, Routledge Press.

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: Certificate /B. Sc. (Hons) **Environmental Science**	**Year:** Third (III)	**Semester:** Sixth (VI)
Subject: Environmental Science		
Course Code: BENH15606R	**Course Title:** Industrial Training/Surveys/Research Project Credits	
Credits: As per University norms	Core Compulsory	

Programme/Class: Certificate /B. Sc. (Hons) **Environmental Science**	**Year:** Third (III)	**Semester:** Sixth (VI)
Subject: Environmental Science		
Course Code: BH150607T	**Course Title:** WILDLIFE MANAGEMENT	

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Course Outcomes (COs)	
On successful completion of this course, student will be able: **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 **CO5** To Develop skill through Fundamentals technique of wild life management	
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	**Need of** wildlife **management** Role of stakeholders in managing wildlife. Journey of mankind from predator to conservator; prehistoric association between wildlife and humans: records from Bhimbetka wall paintings	12
II	**Conservation of** wildlife In the reign of king Ashoka: excerpts from rock edicts; understanding 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	**Practices of** wildlife **management** Principles and practices of wildlife management, Course and fine filter approaches for wildlife Management.	12
IV	**Analysis and management** Analysis of wild life management problems. Species conservation projects in India (Tiger, Rhino, Lion)	12
V	Capture and handling techniques, Identification and marking techniques, Measuring animal abundance, radio telemetry	12

Suggested Reading

1. Wildlife Ecology, Conservation, and Management, (3rd Edition), John M. Fryxell, Anthony R. E. Sinclair, Graeme Caughley 2014 Wiley Blackwell

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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: Certificate /B. Sc. (Hons) **Environmental Science**	**Year:** Third (III)	**Semester:** Sixth (VI)
Subject: Environmental Science		
Course Code: BH150608T	**Course Title:** SYSTEMATICS AND BIOGEOGRAPHY	

Course Outcomes (COs)

CO1 To learn basic concept of biogeography

CO2 To buildup the concept of Nomenclature

CO3 To aware about concept and practices of Bio-geographical rules

CO4 Enhance the knowledge of Biogeography and its types

CO5 learn about Speciation and extinction

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 systematic approaches** Definition of taxonomy, taxonomic identification keys/tools for systematic biogeography. Concept of species and taxonomic hierarchy	12
II	**Nomenclature and systems of classification** Principles and rules (International Code of Botanical and Zoological Nomenclature); ranks and names.	12

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III	**Biogeography** 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	**Types of Biogeography** **Part-A: Historical Biogeography** Earth's history; paleo-records of diversity and diversification; continental drift and plate tectonics and their role in biogeographic patterns **Part-B: Ecological Biogeography** Species, habitats; environment and niche concepts; biotic and abiotic determinants of communities **Part-C: Conservation Biogeography** Application of biogeographical rules in design of protected area and biosphere reserves; use of remote sensing in conservational planning.	12
V	**Speciation and extinction Types and processes of speciation** - 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

Suggested Readings:

1. Williams, D.M., Ebach, M.C. 2008.FaundatiansafSystematics and Biogeography. Springer. 158.
2. Ecology and Biogeography in India. Dr. WJunk Publishers., TheHague Mani, M.S. 1974.

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