

BUNDELKHAND UNIVERSITY, JHANSI
BOARD OF STUDIES
IN ACCORDANCE WITH NEP, 2020

Date of BoS:
14.06.2022

Faculty: Science

Subject: Environmental
Science

Name of course:
M.Sc. Environmental Science

S.No	BoS Member	Designation	Feedback of Student	Revision of Syllabus (mentioned in percentage)	Credit course	Non Credit Course	Multidisciplinary Courses	Vocational/Skilled Orientation Courses	Number of Value added course with Title (Semester Wise)
1.	Dr. Vinit Kumar	Convener		80%	List Attached	NA	Student has to choose from Minor elective Courses ordinance for PG Courses	Sem. I: Educational Tour	NA
								Sem. II: Industrial Training	
	Dr. A.K. Giri	Member						Sem. III: Case Assignment and Field Training	
	Dr. Smriti Tripathi	Member							

Dr.	Member	Sem. IV: Project Work
Dr. Abhimanyu Singh	Member	
Dr. Amit Pal	Member	
Dr. Sandeep Arya	Member	
Prof. R.P. Singh	External Expert	
Mr. Sanjay Singh	External Expert	
Prof. N.C. Gautam	External Expert	
Prof. Kusum Arunachalam	Special Invited Member	

Nirbh
 (Dr. VINIT KUMAR)
Tripathi
 (Dr. Sarathi Tripathi)

Internal Members

A.K.
 A.K. GIRI

me
 (Dr. Abhimanyu Singh)
Dr. Anil Kumar
 (Dr. Anil Kumar)

External members

**Institute of Environment and Development Studies
Bundelkhand University, Jhansi**

Syllabus M.Sc. Environmental Sciences

Semester	Subject Code	Subject Title	Credits	Marks		
				Int.	Ext.	Total
1 st Semester	DES - 101	Principles of Environment & Ecology	4	25	75	100
	DES - 102	Environmental Chemistry	4	25	75	100
	DES - 103	Abiotic Environment	4	25	75	100
	DES - 104	National and Global Environmental Issues	4	25	75	100
	DES - 105	Minor Elective	4	25	75	100
	DES - 106	Practical I	4	50	150	200
	DES - 107	Educational Tour	4		100	100
			28			800
2 nd Semester	DES - 201	Biological Process and System	4	25	75	100
	DES - 202	Biodiversity Forestry and Wildlife	4	25	75	100
	DES - 203	Water Soil pollution management	4	25	75	100
	DES - 204	Air pollution and its management	4	25	75	100
	DES - 205	Practical II	4	50	150	200
	DES - 206	Industrial Training, report submission and presentation	4		100	100
				24		
Total Credits (1 st Semester + 2 nd Semester)			52			1500
3 rd Semester	DES - 301	EIA, Environmental Audit and Disaster Management	4	25	75	100
	DES - 302	Environmental Management and Laws	4	25	75	100
	DES - 303	Elective - 1 1. Ecotoxicology and Human Health 2. Occupational Health and Safety management	4	25	75	100
	DES - 304	Resource Conservation & Management	4	25	75	100
	DES - 305	Practical III	4	50	150	200
	DES - 306	Case Assignment and field trip			100	100
				24		

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4 th semester	DES - 401	Ecotourism	4	25	75	100
	DES - 402	Current Research Methodology in Environment	4	25	75	100
	DES - 403	Sustainable management and sustainable development	4	25	75	100
	DES - 404	Elective - 1 1. Environmental Microbiology 2. Environmental biotechnology	4	25	75	100
	DES - 405	Practical IV	4	50	150	200
	DES - 404	Project work	4		100	100
			24			700
Total Credits (3 rd Semester + 4 th Semester)			48			1400
TOTAL			100			2900

Dr. Partha
Vind

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**Institute of Environment & Development Studies
Bundelkhand University, Jhansi**

Department code : 121

***Ordinances and Scheme of Examination for PG programme-
M. Sc. in Environmental Sciences (2022 onwards)***

This academic course will run in the Department of Environmental Sciences under the Institute of Environment & Development Studies. It will be two years course based on semester (IV – Semester) system of Examination.

Degree – Master of Science in Environmental Sciences

1. INTRODUCTION

1.1 Preamble

This ordinance governs all the rules and regulations as per the NEP 2020 for the traditional post graduate program, M.Sc., which are not covered by any regulatory bodies (AICTE, BAR Council, PCI, NCTE etc) running in the University campus or its affiliated colleges in Bundelkhand University, Jhansi. This ordinance supersedes all the previous relevant ordinances, rules and regulations.

1.2 Duration

Bundelkhand University has adopted the semester system in various Postgraduate courses as per directives of Higher Education Department, Uttar Pradesh Government vide letter No 401/seventy-3-2022 dated 09-02-2022 to accelerate the teaching-learning process and enable vertical and horizontal mobility in learning from the academic session 2022- 23 onwards.

The duration of PG courses shall be two years comprising of four semesters. In case a student(s) exits from this programme after completion of the first year (2 semesters),he/she may take exit from the programme and shall be awarded the Degree of Bachelor in Research. After the successful completion of two years (4 semesters) a student shall be awarded the Master's degree in the concerned subject. The maximum duration to complete the course shall be four years.

Eligibility for Admission –

A candidate who has passed his/her graduation course in Environmental Sciences/Biological sciences/Chemistry/Earth sciences/Agriculture/Physical Sciences/Allied sciences with 45% marks in aggregate from any recognized Indian University/Institute or any other recognized organization is eligible to seek admission in M. Sc. (Environmental Sciences).

1. (a) Minimum qualification required for admission to the academic programs shall be as provided in the academic bulletin, acquired from any University/Institute in India or abroad, recognized by this University.


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(b) Those appearing in the final year of the qualifying examination shall also be eligible to apply, provided that they submit specific proof of having passed the final year examination, with minimum requirement, at the time of admission/ personal interview, if qualified and called for.

2. **PROCEDURE OF ADMISSION:** Admission to eligible candidates will be given strictly on merit, drawn on the basis of merit in the Common Admission Test for Environmental Sciences or as per procedure decided by appropriate authorities of the University.

3. **NORMAL INTAKE:** The intake for the various academic programs will be as provided in the academic bulletin of each academic year. Statutory reservation, as applicable, shall be applied as per rules.

4. **MEDIUM OF INSTRUCTION** shall be English or Hindi.

5. **METHOD OF TEACHING** in the academic program will consist of a combination of class lectures by the regular faculty, in-house visiting faculty and visiting faculty from other academic institutions/ organizations. Tutorials, Seminars, Site visits and Project-work shall be essential components of the curriculum. Quality study material will also be supplied besides computer-aided instructions and audio-visual teaching methods.

1.4 Choice of Subject and Course Structure

i. University/ College shall admit students as per the eligibility criteria and availability of seats decided by the university.

ii. A student shall take admission to post graduation first year of fourth year of Higher Education program of NEP 2020 after successful completion of Graduate course from NEP 2020 or old course of Science/ Arts/ Commerce/ Management, etc. He/she shall have to choose respective faculty courses as per guidelines of NEP 2020 depending on the number of seats available in concerned subject and eligibility criteria. In case a candidate is willing to change the faculty, the following condition is required-

The candidate should have passed Bachelor degree in Science/ Commerce of NEP 2020 or old courses may take admission in some subjects of Arts faculty (excluding practical subjects like geography, psychology etc). Similarly, the Student from Commerce of NEP or old course of commerce may also be eligible to take admission in Arts subjects. Arts, Management and Commerce candidates cannot be admitted in Science subjects.

iii. Student(s) shall select subjects for Post graduation course from the major subjects that he / she had opted in the graduation course and shall continue with the same subjects in all the four semesters of the PG programme.

iv. The course structure shall be as follows:

There shall be four compulsory theory papers in the first semester. In the second and third semester there shall be two compulsory papers and one/two elective papers. The elective papers are the specialization papers.

Student(s) shall have to select one Minor Elective Course as **Minor subject** from any other faculty (except own faculty) or interdisciplinary subject in the first semester of the first year.

v. Student(s) shall take a Research Project /Survey/ Industrial /Field training program in both the years (Semester II and IV). No pre-requisite shall be required for this.

vi. List of Minor Elective Course: The candidate shall select any one subject from the following as minor subject in first year of post graduate course.

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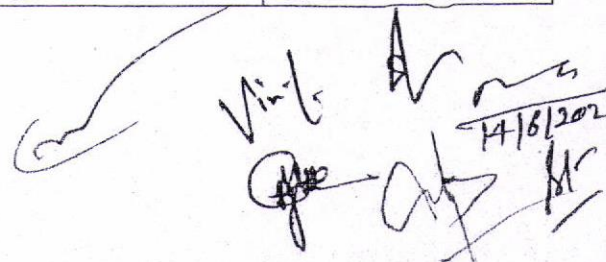
S No	Science	Arts	Commerce	Interdisciplinary
1.	Mathematical Biology	Tribal Culture and Heritage	Customer Relation Management	Ancient Medical Sciences
2.	Conservation and Water Resource Management	Principle of Administration and Implications	House Keeping and Hospitality	Traditional Medical Therapy
3.	Natural Resources and Conservation	Socio-Economics and Social Security	Share Market and Banking	Vedic Mathematics
4.	Pollution: Causes and Mitigation	Archeological Sites and Monuments	Retail Management and Accounting	Bio Medical Instrumentation and Health
5.	Computational Resources	Indian Constitution	Insurance Policy and Finance	Disaster, Mitigation, & Management
6.	Organic and Natural Farming	Communication and Soft Skill		Mining Plan and Resource Mapping
7.	Computer Hardware Handling	Sanskrit Knowledge System		Water Treatment System
8.	Computer Software Handling	Technical Translation and Trans creation		Climate Change and Environmental Degradation
9.	Solar and Non Conventional Energy	Urban Economics and Planning		Medicinal and Aromatic Plants Cultivation, extraction and nutraceutical Values
10.	Cyber Crime	Actuarial Economics		
11.	Bee Keeping, Aquaculture and Fish Farming	Social Sector and Gender Economics		Non Conventional Energy Resource
12.	Entrepreneurship in Microbial and Botanical Products	Environmental Economics		Soil and Water Testing
13.				

2. SEMESTER AND CREDIT DISTRIBUTION

An academic year for post graduate program is divided into four semesters. The Odd semester may be scheduled from July to December and Even semester from January to June.

Fourth Year

	VII Sem	Credits	VIII Sem	Credits
Major	Theory – 04 Papers	5 Credits each Total Credits=20	Theory – 04 Papers	5 Credits each Total Credits=20
	Or	Or	Or	Or



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	Theory – 04 Papers Practical -02	4 Credits each Total Credits=16 2 Credit each Total Credits=4 Total Credits=20	Theory – 04 Papers Practical -02	4 Credits each Total Credits=16 2 Credit each Total Credits=4 Total Credits=20
Minor	Minor Elective- 1 paper of 04 credits	04 Credits Total Credits=04		
Research Project/ Industrial training/ Survey/ Field Training	One of each 04 Credits	04 Credits Total Credits=04	One of each 04 Credits	04 Credits Total Credits=04
Total Credits		28		24
Total in Both Semester				52 Credit

Fifth Year

Semester	IX	Credits	X	Credits
Major	Theory – 04 Papers Or Theory – 04 Papers Practical -02	5 Credits each Total Credits=20 Or 4 Credits each Total Credits=16 2 Credit each Total Credits=4 Total Credits=20	Theory – 04 Papers Or Theory – 04 Papers Practical -02	5 Credits each Total Credits=20 Or 4 Credits each Total Credits=16 2 Credit each Total Credits=4 Total Credits=20
Research Project / Industrial training / Survey	One of each 04 Credits	04 Credits Total Credits=04	One of each 04 Credits	04 Credits Total Credits=04
Total Credits		24		24
Total in Both Semester	48 Credit			

3. ATTENDANCE


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The expression "a regular course of study" wherever it is used in these Ordinances, means attendance of at least 75% of the lectures and other teaching in campus / affiliated college in the subject for the examination at which a candidate intends to appear and at such other practical work (such as work in a laboratory) as is required by any Statute, Ordinance or Regulation in force for the time being in the University.

A shortage up to 5% of the total number of lectures delivered or practical work done in each subject may be condoned by the Principal of the college/ Head of the Department (in case of University Campus) concerned.

A further shortage up to 10% may be condoned only by the Vice- Chancellor on the specific recommendation of the Principal of the college/Head of the Department concerned (in case of University Campus).

4. EXAMINATIONS

1. There shall be examinations at the end of each semester as, for odd and even semesters in accordance with the academic calendar of the university. A candidate who does not pass the examination in any course(s) shall be permitted to appear in such failed course(s) in the subsequent examinations upto the maximum duration of the course.
2. A candidate should get enrolled/registered for the first semester examination and is mandatory. If enrolment/ registration is not possible owing to shortage of attendance / rules prescribed OR belated joining or on medical grounds, such students shall not be permitted to proceed to the next semester. Such students shall re-do the first semester in the subsequent term of that semester as a regular student; however, a student of first semester shall be admitted in the second semester, if he/she has successfully completed the first semester.
3. It shall be mandatory for the student(s) to register for examination in each and every semester (i.e. to fill up the examination form with the requisite fee). If a student fails to register for the examination in any semester, he or she shall not be allowed to appear in that semester as a back paper student. Such student(s) shall appear in the (next) subsequent examination of that semester.

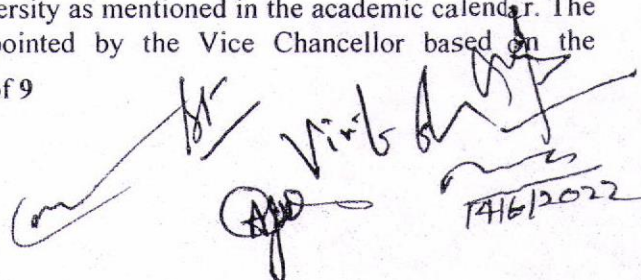
5. EVALUATION

The performance of a student in each course is evaluated in terms of percentage of marks with a provision for conversion to grade point. Evaluation for each course shall be done by a Continuous Internal Assessment (CIA) by the concerned course teacher as well as by end semester examination and will be consolidated at the end of course. The evaluation must be continuous and holistic and should be based on following parameters:

- i. Academic assessment
- ii. Skill assessment
- iii. Physical assessment
- iv. Personality assessment
- v. Extra-curricular assessment

5.1 THEORY PAPER

Semester Examinations shall be conducted by the university as mentioned in the academic calendar. The Question paper will be set by the examiners appointed by the Vice Chancellor based on the

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recommendation of the board of studies. The pattern of the question paper shall be as given in annexure II.

- i. Internal Assessment(C.I.A.) –25%weightage of a course
 - Test/ Mid-Term Assessment - 10 marks
 - Term paper/Presentation on given project/assignment - 10marks
 - Attendance/activities – 05marks
- ii. End Semester Exam (External examination)– 75% weightage of course

5.2 PRACTICAL PAPER

Practical examinations will be conducted by the examiners appointed by the Vice Chancellor on the recommendations of the Board of Studies. Each student has to present the practical records.

- i. Internal Assessment(C.I.A.) –25%weightageofacourse
 - Test/ Mid-Term Assessment - 10 marks
 - Term paper/Presentation on given project/assignment - 10marks
 - Attendance/activities – 05marks
- ii. End Semester Exam (External examination)– 75% weightage of a course

MINIMUM PASSING STANDARD

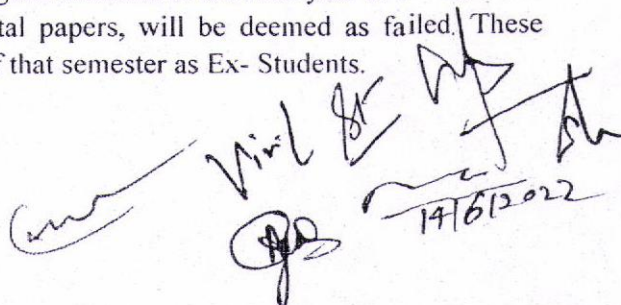
1. The minimum passing standard for combined external and internal examinations for each subject/paper shall be 45%,i.e. 45 out of 100 marks for theory and practical courses. The minimum passing standard for Aggregate in a semester end Examination shall be 45%.
2. Continuous Internal Assessment (CIA) shall be ensured by the Principal of the colleges / HODs for the Campuses courses. The Principal of the colleges / HODs of the Campus shall provide the marks of the same to the university and it shall be mandatory to maintain the records of the same till the maximum duration of that course.
3. The internal assessment, field training and practical examination awards of a student who fails in any semester examination shall be carried forward to the next examination.
4. It shall be mandatory for a student to secure minimum 45% marks (i.e. 34/75) in the theory and practical paper separately.

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PROVISION FOR BACK PAPERS AND EX-STUDENTS

A Back Paper (B.P.) candidate shall be promoted to next semester. The back paper facility in a semester provides promotion to the next semester and another opportunity to obtain a minimum of the pass marks assigned for an individual paper or in the aggregate. Following category of students of Bundelkhand University shall be eligible for back paper facility as under,

1. A student shall be required to pass in minimum two subject papers in each semester. However, at the end of each year, it shall be mandatory for a student to pass in at least two subjects papers and minor paper otherwise he/she shall be deemed as failed and will be treated as a year back / ex- student.
5. Students shall get the attempts to appear in the Back paper examination in the subsequent odd /even semester till the maximum duration of the said course.
6. Special back paper examination shall be held only for regular students of the final year of PG course.
7. The candidates who fail in more than three of the total papers, will be deemed as failed. These candidates can appear only in subsequent examination of that semester as Ex- Students.

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8. PROMOTION RULES

8.1 Semester Course & Examination:

The students who have taken admission in any post-graduation programme in a session and who have put in the minimum percentage of attendance for appearing at the Examination, presented himself/herself for internal assessment and have filled in the examination form in time for appearing at the End Semester Examination shall be allowed to appear at the respective examinations.

8.2 Declaration of results

After appearing in the Examination of both the semesters in a particular year, the student can be put in the following categories in the context of declaration of the results of the Semester Examination:

- Passed
- Promoted with Back Paper(s)
- Failed

8.3 Promotion to next Semester:

All students under category Passed and promoted with back papers shall be promoted to the next Semester.

“Failed” students may clear their UNCLEARED courses in subsequent examinations as ex-students.

Students promoted with back papers shall clear their back papers in subsequent examinations as ex-students.

A student who has failed in a course shall get two more chances to clear this course subject to the maximum duration for passing the course. Further, each candidate shall have to clear all the courses within the maximum period of seven years from the date of his/her latest admission.

A candidate who has qualified for the Degree shall be placed in the First / Second Division as per following table:

9. COMPUTATION OF SGP AND CGPA

The guidelines formulated by Bundelkhand University shall be followed in order to bring uniformity in evaluation system of every CBCS based Course and computation of the SGPA (Semester Grade Point Average) and CGPA (Cumulative Grade Point Average) based on students' performance in examination. The number of core, elective, open elective papers and foundation papers and the required credit for each paper shall be formulated by respective Board of Studies (BOS) and faculty board. For the purpose of computation of work load the UGC proposed mechanism is adopted i.e. one credit=1 Theory period of one hour duration, 1 credit= 1 Tutorial period of one hour duration, 1 credit=1 Practical period of one hour duration. The credit(s) for each theory paper/practical/tutorial/dissertation will be as per the respective Board of Studies of departments.

Letter Grade	Numerical grade
O (outstanding)	10
A+ (Excellent)	9
A (very good)	8

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B+(Good)	7
B(average)	6
F(Fail)	<5
Ab (Absent)	0

The minimum passing marks shall be 45% of the maximum marks as prescribed in the University Examination and 45% of marks in the aggregate marks in the subject including internal / sessional marks. i.e. Minimum Passing Grade is "B".

A student who obtains Grades "O" or "B" shall be considered as PASSED. If a student secures "F" grade, he/she shall be considered as FAILED and shall have to reappear in the examination. It is mandatory for a student to earn the required SGPA as in each semester. If a student is not able to secure 45% / B grade in any theory / practical / internal / sessional / viva-voce / internship / project examination, the awarded grade point shall be ZERO (0).

9.1 The University, adopts absolute grading system where in the marks are converted to grades, and every semester results will be declared with semester grade point average (SGPA) and year result will be declared with year grade point average (YGPA). The Cumulative Grade Point Average (CGPA) will be calculated in end of final semester. The grading system except pharmacy department will be with following letter grades and grade points scale as given below:

Table

Level	Outstanding	Excellent	Very Good	Good	Average	Fail
Letter Grade	O	A+	A	B+	B	F
Grade Points	10	9	8	7	6	0
Score (Marks) Range (%)	≥ 90 (90-100)	$< 90,$ ≥ 80 (80-89.99)	$< 80,$ ≥ 70 (70-79.99)	$< 70,$ ≥ 60 (60-69.99)	$< 60,$ ≥ 45 (50-59.99)	< 45 (0-35.99)

- A student obtaining Grade "F" shall be considered failed and will be required to reappear in the examination. Such students after passing the failed subject in subsequent examination / will be awarded with grade respective of marks he/she scores in the subsequent examination/s.

- The University has the right to scale/moderate the theory exam / practical exam / internal exam / sessional marks of any subject when ever required for converting of marks into letter grades on the basis of the result statistics of university as in usual practice, i.e. marks obtained in decimal will be converted in nearest integer.

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10. CONVERSION OF GRADES INTO PERCENTAGE

- Conversion formula for the conversion of CGPA into Percentage is $\text{CGPA Earned} \times 10 = \text{Percentage of marks scored}$.

Illustration: CGPA Earned 8.2 $\times 10 = 82.0\%$

2. AWARD OF DIVISION

Division shall be awarded only after the final semester examination based on integrated performance of the student for all the semesters as per following details.



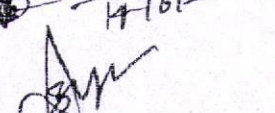
- A student who qualifies for the award of the degree securing "B" or above grades in all subjects pertaining to all semesters, and in addition secures a CGPA of 8.0 and above shall be declared to have passed the examination in **FIRST DIVISION WITH HONOURS**.
- A student who qualifies for the award of the degree securing "B" or above grades in all subject pertaining to all semesters, and in addition secures a CGPA of 7.0 and above shall be declared to have passed the examination in **FIRST DIVISION**.
- A student who qualifies for the award of the degree securing "B" or above grades in all subjects pertaining to all semesters, and in addition secures a CGPA of 5.0 and above shall be declared to have passed the examination in **SECOND DIVISION**.

11. UNFAIR MEANS:

Cases of unfair means in the End Semester Examinations and Mid-Term Tests shall be dealt as per the rules laid by the University.

Note:

1. Those students who are NOT eligible for promotion to next year shall have to reappear in the coming examination as ex-students. However, the marks of internal assessment shall be carried forward in such cases.
2. Scrutiny facility and Challenge evaluation facility shall be available for those students who want to improve their grades.


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**Institute of Environment and Development Studies
Bundelkhand University, Jhansi**

Syllabus M.Sc. Environmental Sciences

Semester	Subject Code	Subject Title	Credits	Marks		
				Int.	Ext.	Total
1 st Semester	DES - 101	Principles of Environment & Ecology	4	25	75	100
	DES - 102	Environmental Chemistry	4	25	75	100
	DES - 103	Abiotic Environment	4	25	75	100
	DES - 104	National and Global Environmental Issues	4	25	75	100
	DES - 105	Minor Elective	4	25	75	100
	DES - 106	Practical I	4	50	150	200
	DES - 107	Educational Tour	4		100	100
			28			800
2 nd Semester	DES - 201	Biological Process and System	4	25	75	100
	DES - 202	Biodiversity Forestry and Wildlife	4	25	75	100
	DES - 203	Water Soil pollution management	4	25	75	100
	DES - 204	Air pollution and its management	4	25	75	100
	DES - 205	Practical II	4	50	150	200
	DES - 206	Industrial Training, report submission and presentation	4		100	100
				24		
Total Credits (1 st Semester + 2 nd Semester)			52			1500
3 rd Semester	DES - 301	EIA, Environmental Audit and Disaster Management	4	25	75	100
	DES - 302	Environmental Management and Laws	4	25	75	100
	DES - 303	Elective - 1 1. Ecotoxicology and Human Health 2. Occupational Health and Safety management	4	25	75	100
	DES - 304	Resource Conservation & Management	4	25	75	100
	DES - 305	Practical III	4	50	150	200
	DES - 306	Case Assignment and field trip			100	100
				24		





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4 th Semester	DES - 401	Ecotourism	4	25	75	100
	DES - 402	Current Research Methodology in Environment	4	25	75	100
	DES - 403	Sustainable management and sustainable development	4	25	75	100
	DES - 404	Elective - 1 1. Environmental Microbiology 2. Environmental biotechnology	4	25	75	100
	DES - 405	Practical IV	4	50	150	200
	DES - 404	Project work	4		100	100
				24		
Total Credits (3 rd Semester + 4 th Semester)			48			1400
TOTAL			100			2900






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Course Syllabus
M. Sc. I Year
Semester – I (Environmental Sciences)

DES – 101 : PRINCIPLES OF ENVIRONMENT & ECOLOGY

Unit – I : Introduction to Environmental Sciences

Definition, scope and importance; Human ecology and human settlement. Earth, Man and Environment Interactions. Geographical Classification and Zones – Torrid, Temperate and Frigid Zones.

Unit II: Fundamentals of Ecology

Definition, Principle, Branches and Scope of Ecology. Ecological Factors: Abiotic – Physical and chemical Factors, Biotic – Limiting Factors - Species Interaction: Commensalism, Amensalism, Mutualism, Competition, Parasitism, Prey-Predator Relationship. Sedimentary Cycles (P, S, Fe), Gaseous Cycles (C, N, O) and Hydrological Cycle.

Unit III: Population Ecology

Population - Definition, Characteristics, Population Density, Natality, Mortality, Age Distribution, Growth Patterns, Population Fluctuation, Population Equilibrium, Biotic Potentials, Population Dispersion and Regulation of Population. Ecological Age Pyramids. Survivorship Curves and its Types

Unit IV: Community Ecology

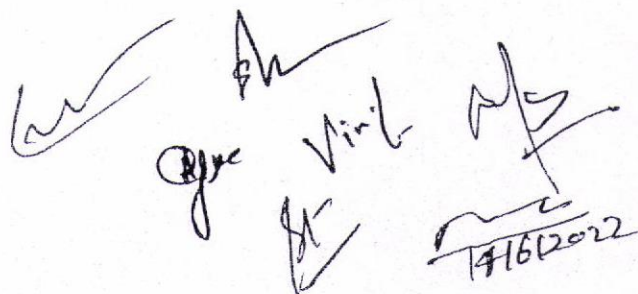
Definition, Characteristics, Dominance, Structure, Stratification, Periodicity, Fluctuation within Community, Communal Interdependence, Ecotone, Edge Effect, Ecological Niche and Ecological Equivalents. Ecological Succession, Types, Process, Climax and Significance of Succession.

Unit – V: Evolution

Evolution, origin of life and speciation; Theories of organic evolution, Hardy Weinberg genetic equilibrium, Genetic polymorphism and selection; Economically important microbes, plants and animals.

Suggested Readings:

- Environmental Science and Technology, Stanley E. Manahan, (2007), Lewis Publishers.
- A Text Book of Ecology, S. K. Dubey (2006), Dominant Publishers.
- Environment, Peter H. Raven, Berg, David M. Hassenzahl (2010), John Wiley & Sons.
- Fundamentals of Ecology, Eugene P. Odum, Gary W. Barrett (2012), Cengage Learning.
- Ecology Principles and Applications, J. L. Chapman & M. J. Resiss (2010), Cambridge University Pre
- Environmental Science, G. Tyler Miller, Scott E. Spoolman (2014), Cengage Learning
- Environmental Science, Botkin, Keller (2012), John Wiley & Sons.
- Environmental Science, S. C. Santra (2016), New Central Book Agency Pvt. Ltd.,


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DES - 102 : ENVIRONMENTAL CHEMISTRY

Unit - I :Introduction

Fundamentals of environmental chemistry, stoichiometry, laws of thermodynamics, oxidations-reduction,

Unit II: Fundamental Concepts of General Chemistry

Formation of Molecules, Molecular Weight, Equivalent Weight, Strength of the Solution - Molality, Molarity, Normality, Valency and Oxidation State, Oxidation and Reduction Reactions, Metals and Nonmetals, Aromatic and Aliphatic Organic Compounds, Saturated and Unsaturated Hydrocarbons.

Unit - III :Atmospheric Chemistry

Structure and Composition of Atmosphere, Classification of Elements, Particulate Matter, Ions and Radicals in the Atmosphere. Chemical and Photochemical Reactions, Formation of Smog, PAN, Acid Rain. Oxygen and Ozone Chemistry., Green House Gases and Global Warming, Wind Direction, Wind Speed and Temperature.

Unit IV: Soil Chemistry

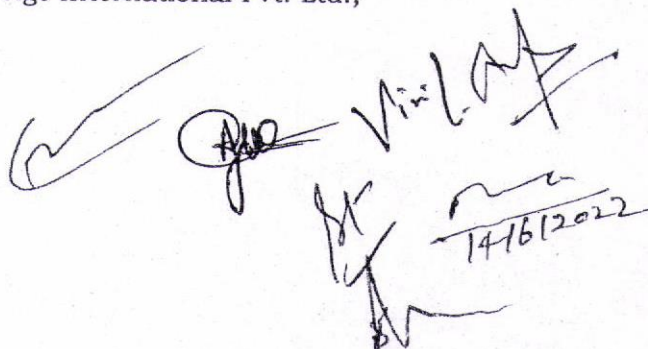
Soil Profile, Soil Horizons - Physical, Chemical and Biological Characteristics, Nature of Soil - Soil Structure and Texture. Soil Macro and Micro Nutrients - Soil Water - Soil Air - Soil Temperature - Soil Organic Matter. Soil Colloids - Ion Exchange Capacity. inorganic and organic components of soil, nitrogen pathway and NPK in soil

Unit - V: Hydrospheric Chemistry

Water chemistry, Physico-chemical characteristics of water, Physical and chemical aspects of inland water bodies like lakes, streams, river and wetlands, heavy metals in water, pesticides, organic pollutants.

Suggested readings

- Environmental Chemistry, Stanley E. Manahan (1999), CRC Press.
- Environmental Chemistry, Peter O'Neil, (2004), Blackie Academic & Professional.
- Basic Concept of Environmental Chemistry, Des W. Connell (2005), Taylor & Francis.
- The Principles of Environmental Chemistry, James E. Girard (2005), Jones & Bartlett.
- Environmental Science & Technology, Stanley E. Manahan (2007), Taylor & Francis, CRC Press.
- Environmental Chemistry, Colin Baird & Michael Cann (2008), W. H. Freeman & Co.,
- Environmental Chemistry with Green Chemistry. Asim K. Das & Mahua Das (2012), Books & Allied Pvt. Ltd.,
- Fundamentals Concepts of Environmental Chemistry, G. S. Sodhi (2011), Narosa Publishing House.
- Environmental Chemistry, A. K. De (2010), New Age International Pvt. Ltd.,

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DES - 103 : ABIOTIC ENVIRONMENT

Unit - I : Origin of earth

Geological time scale, Internal Structure and composition of Earth, Rocks, Tectonic framework of India; Plate-tectonics, Volcano, Soil profile, Physical, chemical and biological properties of soil, Soil erosion, Mineral resources, Soils of India, Major natural hazards – earthquake, cyclone, landslides, etc.; concept of isostasy.

Unit - II : Atmosphere:

Atmospheric profile, Climatology, Types of wind, Wind as ecological factor. Classification of Climate of India, Meteorological analysis, Inversion,

Unit - III : Hydrosphere:

General physico-chemical properties of water, types of water, Global water balance & Ice sheet, Distribution & precipitation, Water as an ecological factor, Hydrological cycle, Water resources – oceans, surface and ground water.

Unit IV: Rocks

Major rock and ore forming minerals: Properties of minerals; Igneous, sedimentary and metamorphic rocks. Impact of mining on environment

Unit V: Climate

Köppen's climate classification system; General relationship between landscape, biomes and climate.

Suggested Readings:

1. T. R. Oke. 2006. Boundary layer climates. Methuen & Co. Ltd.
2. S. Pal Arya. 2001. Introduction to Micrometeorology. Academic Press.
3. H. R. Byers. 2006. General Meteorology. McGraw-Hill.
4. K. S. Valdiya. 1987. Environmental Geology. Tata McGraw-Hill.
5. J. M. Wallace and P. V. Hobbs. 2006. Atmospheric Science – An introductory survey

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DES - 104 : NATIONAL & GLOBAL ENVIRONMENTAL ISSUES

Unit - I :Global climatic change

Ozone layer depletion and protection, El-Nino, International treaties, protocols and conventions on emission reduction, ozone layer protection and trans-boundary movement of hazardous waste. United Nation's efforts for environmental protection & sustainable development, Other international and national organizations for environmental protection, environmental movements, Agenda -21.

UNIT II:Climate Change & Green House Gases

Definition of Climate Change - Causes and Impacts of Climate Change, Green House Gases (Sources, Effects), Extreme Weather Events. Role of Oceans and Forests as Carbon Sinks, Effect of Climate Change on Weather and Climatic Patterns, Ice Caps, Glaciers, Agriculture, Biodiversity, Sea Level, Tourism.

Unit - III : Environmental Management

Oil pollution, GAP, National Lake conservation program, Some environmental fragile areas, Desertification & its control, Water crisis & conservation of water,

Unit - III : National Environmental Issues

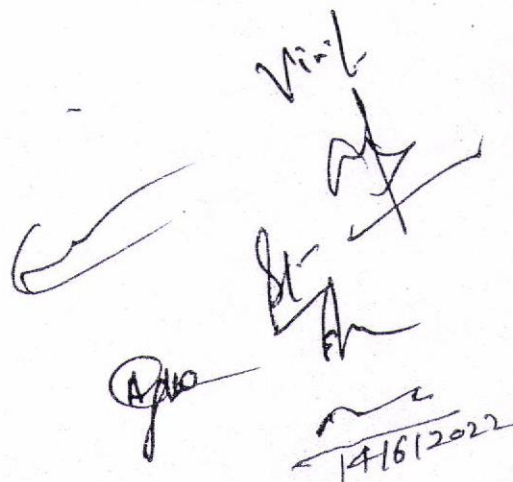
Indian environmental problems, National calamities (earthquake, floods etc.), Different environmental episodes, Population explosion and birth control measures, Conventional & non-conventional sources of energy. Eco-ethics, Rehabilitation & resettlement problems, Urban problems related to energy,

Unit V: Social issues and environment

Principles of green chemistry- nuclear accidents and holocaust, case studies. - wasteland reclamation - consumerism and waste products. Environmental education & awareness, Community participation, Role of women in Environmental protection.

Suggested readings

1. Gilbert M.Masters, "Introduction to Environmental Engineering and Science", 2nd edition, Pearson Education, 2004.
2. Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, New Delhi, 2006.
3. . Rajagopalan, R, "Environmental Studies-From Crisis to Cure", Oxford University Press, 2005.

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Semester – II (Environmental Sciences)

DES – 201 : BIOLOGICAL PROCESSES & SYSTEMS

Unit –I : Biochemical ecology

Elements of Biochemistry; Principles of physical chemistry; Kinetics, dissociation & association constants; Nucleic acid structure & functions; Genetic code; Energy yielding pathways & metabolism; Proteins, Nitrogen metabolism; Lipids, vitamins and biological clock; process of fatty acid oxidation.

Unit II: Biogeochemistry

Microbial Flora of Soil – Interactions among Soil Microorganisms – Nitrogen Cycle – Carbon Cycle – Sulfur Cycle – Phosphorous Cycle – Nitrogen Fixation by Photosynthetic Bacteria, Cyanobacteria and Methanogenic Bacteria – Biotechnology in the Reduction of Carbon Dioxide Emission.

Unit – III : Stress ecology

Environmental stress and adaptations; Plant & animal hormones; Nutrition, Reproduction, Learning & behavior; Water balance; Photo-regulation; angiospermic seeds, seed germination, anatomy and seed dormancy.

Unit – IV : Microbial ecology

Microbes – classification & significance; Mineral growth & nutrition; Food, medical, industrial & soil microbiology; Culture & media; Fermentation; Control agents of microbes; Role of microbes in soil; Water & degradation of xenobiotics; Recent issues in microbiology.

Unit – V: Environmental Microbial Applications

Microbial Interactions, Sedimentary Biogeochemical Cycles – Fe, P and S, Gaseous Cycle – C, N and O, Soil Microorganisms Associated with Vascular Plants, Bioindicators, Biosensors, Biofertilizers, Biopesticides, Bioplastics, Bioleaching & Biomining, Biodeterioration and Biofuels.

Suggested Readings

1. Microbiology, K. J. Pelzer, E. C. S. Chan & N. R. Kreig (2008), Tata Magraw.
2. Environmental Microbiology, Raina M. Maier & Lanl. Pepper (2000), Elseiver
3. Environmental Biotechnology Principles and Applications, Bruce. E. Rittmannn (2001), Graw- Hill Book Co
4. Environmental Microbiology, John F. T. Spencer & A. L. R. Spencer (2004), Humana Press.
5. Microbiology An Introduction, Tortara, Funke & Case (2007), Benjamin Publishers.
6. Fundamentals of Microbiology, Jeffrey C. Pommerville (2007), Johns & Bartle.
7. Microbiology, Jacauelyn G. Black (2008), John Wiley & Sons.

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DES- - 202 : BIODIVERSITY - FORESTRY & WILDLIFE

Unit - I : Biodiversity

Definition, levels and types of biodiversity; Value of biodiversity; Threat to biodiversity; Biodiversity conservation, Conservation through legal aspects; Biodiversity at Global & National level; Future strategies for India; Bio-geographical classification, Hot-spots of Biodiversity.

Unit - II : Forest ecology

Role of vegetation in nature; Forest types of India; Forest management & conservation; Silviculture, Rangeland management, Minor Forest Produce, JFM, Agro-forestry.

Unit - III : Importance of wildlife

Common flora and fauna in India; Endangered and threatened species; Protected Areas; National Parks and Sanctuaries; Role of National and International organizations for protection of wildlife; Biodiversity Laws, Red Data Book.

Unit IV:Threats to Biodiversity

Habitat Alteration, Invasive Species, Pollution, Population Explosion, and Overexploitation of Resources- Habitat Destruction, Fragmentation, Transformation, Degradation and Loss: Causes, Patterns and Consequences on the Biodiversity of Major Land and Aquatic Systems Invasive Species Pathways, Biological Impacts on Terrestrial and Aquatic Systems. Extinction: Types of Extinctions, Processes Responsible for Species Extinction, Current and Future Extinction Rates, IUCN Threatened Categories, Sixth Extinction/Biological Crisis.

Unit V:Biodiversity Management

Conservation and Management, Protection of Natural Habitats, National and International Protected Area, Current Practices in Conservation - In Situ Conservation and Ex Situ Conservation of Threatened Species - Cryopreservation, Gene Banks, Gene Pool and Species Conservation. National Parks and Sanctuaries. Common Flora and Fauna in India, The Biological Diversity Act, 2002, Biological Diversity Rules, 2004 - Patent Act - Intellectual Property Rights (IPR). Agenda 21.

Suggested readings

1. Biodiversity and Human Health, Aguirre, A. Alonso (2009), Eco Health, 6 (1), 153-156.
2. Ecology: from Individuals to Ecosystems, Begon M, Townsend CR & Harper JL (2006), John Wiley and Sons.
3. Ecology, Environmental and Resource Conservation, Singh JS, Singh SP and SR Gupta (2008), Anamaya Publishers, India
4. Ecology and Field Biology, Smith R and Smith RM (2000),6th ed., Prentice Hall.
5. Global Biodiversity - Status of the Earths Living Resources, Brian Groombridge (1992) Chapman & Hall, London



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DES - 203: WATER, SOIL POLLUTION AND MANAGEMENT

UNIT I :Sources of water and pollution

Distribution, Hydrological Cycle, Structure and Polarity of Water Molecule, Properties of Water Sources - Availability & Quality of Surface Water (River, Stream Lake, Dam) & Ground Water (Open Well & Bore Well)- Sources of Pollution-Point and Non Point-Types and Effects of Water Pollutants, Water Borne Diseases

Unit II: Characteristics of waste

Characteristics of Domestic Sewage and Industrial Effluents with Reference to Paper, Electroplating, Pharmaceutical, Dairy, Distillery, Dyeing, Nuclear, Fertilizer Industries.

UNIT III: Control and management of water pollution

Primary Treatment, Conventional Biological or Secondary Treatment, Tertiary or Advanced Treatment, Membrane Process, Sludge Stabilization and Disposal. Case Studies - Minamata Disease (Hg), Itai-Itai (Cd), Fukushima Daiichi Nuclear Disaster.

UNIT IV:Soil Pollution

Characteristics of Soil - Structure, Texture, Colour, Porosity, Ph, EC, Organic Matter, Micro and Macro Nutrients, Cation Exchange Capacity, Physical Properties - Bulk Density, Porosity, Soil Water, Soil Temperature, Soil Acidity, Salinity - Main Sources of Soil Pollution (Agriculture, Cattle Raising, Industry and Urban Centres) - Main Types of Soil Pollutants- Organic and Inorganic Contaminants (Pesticides and Heavy Metals) - Methods for Soil Remediation-In-Situ Decontamination, Ex-Situ Decontamination: On-Site and Off-Site; and Confinement/Isolation of The Affected Area.

Unit V: Water Pollution Management

Specifications for Drinking Water Acts (The Water (Pollution And Control Of Pollution) Act, 1974 and The Environmental (Protection) Act, 1986), Water Quality Index (WQI) - Watershed Management-Types, Objectives and Factors Affecting Watershed Management,

Suggested readings

1. Wastewater Engineering: Treatment and Reuse. G. Tchobanoglous, F. L. Burton, and H.D.Stenscl.(2003),4th cd. Metcalf & Eddy Inc., New York, NY: McGraw-Hill.
2. Environmental Chemistry, De AK, (2003), 5th Edition, New Age International (P) Limited, Publishers, New Delhi, ISBN 81 - 224 - 1488 - 5.
3. Environmental Chemistry, Sharma BK and Kaur H,(1994), Goel Publishing House, Meerut.
4. Environmental Chemistry, Bhatia SC,(2002),CBS Publishers and Distributors. New Delhi.
5. Chemistry for Environmental Engineering, Sawyer CN, Mc Carty PL and Perkinn GF, (1994), II edition. McGraw Hill.
6. Watershed Management in India, Murty JVS, (1994), Wiley Eastern Ltd., New Delhi.

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DES - 204: AIR POLLUTION AND MANAGEMENT

UNIT I: Sources And Effects Of Air Pollutants

Classification of air pollutants – Particulates and gaseous pollutants – Sources of air pollution – Source inventory – Effects of air pollution on human beings, materials, vegetation, animals – global warming-ozone layer depletion, Sampling and Analysis – Basic Principles of Sampling – Source and ambient sampling – Analysis of pollutants

Unit II :Dispersion Of Pollutants

Elements of atmosphere – Meteorological factors – Wind roses – Lapse rate – Atmospheric stability and turbulence – Plume rise – Dispersion of pollutants – Dispersion models – Applications.

UNIT III: Air Quality Standards

Air Quality Standards, Air Quality Index, Indoor Air Quality, Control Methods Absorption, Adsorption, Condensation, Chemical Reactions, Incinerations.

Unit IV: Air Pollution Control

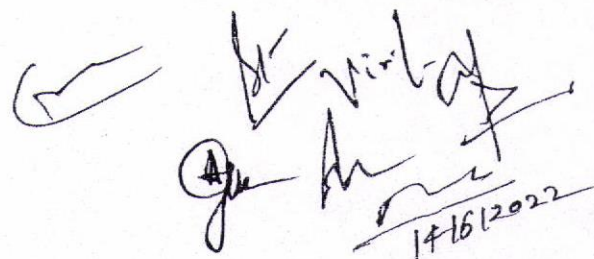
Concepts of control – Principles and design of control measures – Particulates control by gravitational, centrifugal, filtration, scrubbing, electrostatic precipitation – Selection criteria for equipment – gaseous pollutant control by adsorption, absorption, condensation, combustion – Pollution control for specific major industries.

Unit V: Air Quality Management

Air quality standards – Air quality monitoring – Preventive measures – Air pollution control efforts – Zoning – Town planning regulation of new industries Environmental Impact Assessment and Air quality Biological abatement of air pollution, scope of green belt development, phytoremediation. Economic aspects of air pollution control.

Suggested readings

1. Air Pollution, M. N. Rao and H.V.N. Rao, (2014), McGraw Hill Education
2. Advanced Air and Noise Pollution control, Lawrence K. Wang, Norman C. Pereira, Yung-Tse Hung, (2005), Humana press.
3. Pollution Management (I Air Pollution), S.K. Agarwal, (2002), A.P.H Publishing Corporation.
4. Environmental Science and Technology, Stanley E. Manahan, (1997), Lewis Publishers.
5. Fundamentals of Air Pollution, Richard W. Boubel, Donald L. Fox, D. Bruce, Turner and Arthur C. Stren, (2005), Academic press.
6. Pollution Management (V- Noise Pollution), S. K. Agarwal, (2002), A.P.H. Publishing Corporation.
7. Atmospheric Science for Environmental Scientists, C.N. Hewitt and A. V. Jackson, (2009), Wiley- Blackwell.


14/16/2022

3rd Semester

DES -301: EIA, ENVIRONMENTAL AUDIT & DISASTER MANAGEMENT

UNIT-I: Introduction

Generalized approach to impact analysis; concept of significant effect; Development of EIA; Elements of EIA; Procedures for reviewing EIA & statement; Methodologies of EIA; Models used in EIA; Public participation of EIA; Assessment of impacts on energy generation projects, dams, mining, cement industries, fertilizer plants, tourism, highway projects, port and harbors.

UNIT-II: Environmental audit

Approach & methodology; concept of Eco-audit; Industrial safety audit; ISO 14000 & 18000 series; Total quality management (TQM); Ecological footprints, Cost-benefit analysis, economics of pollution control.

Unit III: Environmental Ethics

Implementation of International Emission Trading, Resource Consumption Patterns and the need for Equitable Utilization-Equity-Disparity in the Northern and Southern Countries, Urban and Rural Equity Issues- The need for General Equity, World Summit 1972, RIO Conference Agenda 21, Montreal Protocol, Kyoto Protocol, Climate Change Mitigation.

UNIT-IV: Basic concept of disaster

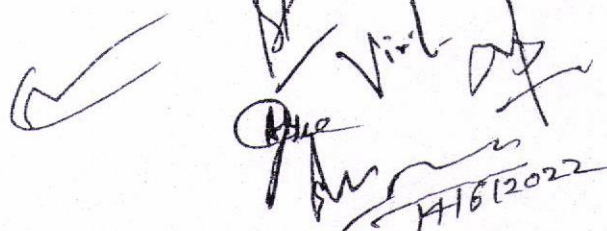
Industrial & technological disaster; disaster profile of India; Institutional framework & disaster management in India; Natural hazards and their zoning & risk assessment; Role of media, government and Non government agencies in disaster management; Emergency planning for floods, landslides, earthquakes, volcanoes and cyclones, etc.

Unit V: Disaster Preparedness and management

Community Preparedness in Natural Disasters- Role of Information, Education, Emerging Trends in Disaster Management International Decade for Natural Disaster Reduction (IDNDR), Policy for Disaster Reduction, Problems of Financing and Insurance. Training for Emergency. Regulation/Guidelines for Disaster Tolerance Building Structures.

Suggested readings

1. Environmental Impact Statements, Bregmam J.I (1999), Lewis Publishers, London.
2. Environmental Science and Engineering, Suresh K.Dhameja, (2005), Published by Sanjeev Kumar Kataria, Delhi.
3. Effective Environmental Assessment, Eccleston C.H, (2000), Lewis Publishers, London.
4. Natural Hazards, Bryant Edwards (2005), Cambridge University Press, U.K.
5. Space Technology for Disaster management: A Remote Sensing & GIS Perspective, Roy, P.S. (2000), Indian Institute of Remote Sensing (NRSA), Dehradun.
6. Natural Disaster, Sharma, R.K. & Sharma, G. (2005), (ed) APH Publishing Corporation, New Delhi

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DES - 302 : ENVIRONMENTAL MANAGEMENT & LAWS

L T P (Hours)

60 5 25

Total credits: 4

Total hours: 90

Unit – I : Environmental Protection

issues and problems; International & national efforts for Environmental protection; Issues involved in enforcement of environmental legislation;

Unit – II:Environmental Policies

Constitutional Provision of India regarding Environment ((Article 48 A, 51A and 21)). Policy strategies in pollution control & Conservation; Wildlife Protection Act; Forest Conservation Act 1980; Indian Forest Policy.

Unit – III : Environmental management in industries

Urbanization & municipal environmental issues; Rural environmental problems & solutions

Unit IV: Remote Sensing and GIS

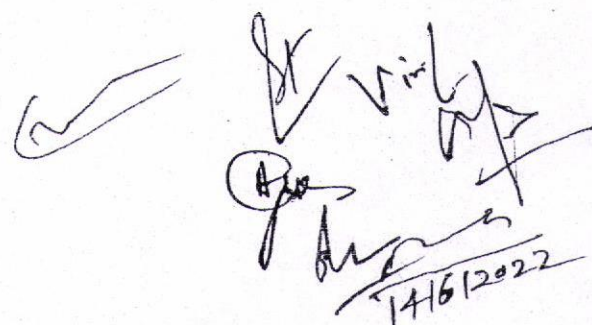
Basic concepts & technique of remote sensing; GIS application in environment, agriculture, forestry & land use planning; Indian remote sensing programme and future strategies

Unit – V :Environmental Acts

Air (Prevention and Control of Pollution) Act and Rule 1982; The Water (Prevention & Control of Pollution) Act. The Environment Protection Act and Rules; Rules on Hazardous Wastes & Hazardous Chemicals; Ozone Protection;

Suggested readings

1. N. K. Uberoi, Environmental Management, Excel Books, New Delhi
2. Frederick and Lutgens, The Atmosphere, Pearson
3. Principles of Geographical Information System, Burrough P.H and McDonnelli (1998), Oxford University Press.
4. Fundamentals of Remote Sensing (2nd edition), George Joseph (2008) ,Universities press, Hyderabad.
5. Remote Sensing and Image Interpretation,Lillie's T. M. and Kiefer R.W (2003) , John Wiley and Sons.
6. Environmental Production, Law and Policies,Jane Holder and Maria Lee, (2007), Second Ediction.
7. Introduction to Environmental Impact Assessment,Natural and Built Environment Series. John Glasson (2005), Routledge, Taylor and Francis.

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Selective paper for Environmental Biotechnology and Natural Resource Management

DES - 303 (1) : ECOTOXICOLOGY & ENVIRONMENTAL HEALTH

Unit - I : Toxicants & toxicology

Definition of Toxicology, Toxicity and Toxicants. Classification of toxic agents - natural toxins (Animal, Plant and microbial toxins) and Anthropogenic toxicants (Chemical toxins). Classes of environmental toxicants;

Unit - II: Toxicity assessment

Pathological problems peculiar to ecotoxicology; Dose-response relationship; Exposure assessment; Influence of ecological factors on effects of toxicity; Somatic & germinal effects.

Unit - III : Risk assessment

Bioaccumulation, Biotransformation, Biomagnification, Biodegradation (with examples); Mutagenesis & carcinogenesis; Biomonitoring.

Unit - IV : Effect of toxicants

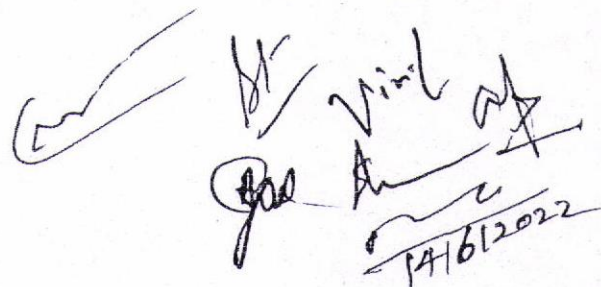
Impact on individual species, community & ecosystem level; Occupational health; problems, safety, chemical hazards; Environmental health - air, water, food & soil borne diseases;

Unit - V: Prevention & control

Epidemiological issues (related to Arsenic, Fluoride, Silica etc.), Population growth, explosion, family welfare programme, Value education, Human Rights, Women & Child Welfare, HIV / AIDS.

Suggested Readings

1. Principles of Ecotoxicology, C. H. Walker, S.P. Hopkin, R. M. Sibly and D.B. Peakall, (2006), Third Edition, CRC Press (Taylor & Francis Group).
2. Hazardous Materials Chemistry for Emergency Responders, Robert Burke, (2000), Lewis Publishers.
3. Fundamentals of Ecotoxicology, Michael C. Newman, (2001), Lewis Publishers.
4. LU's Basic Toxicology (Fundamentals, Target Organs and Risk Assessment), Sixth Edition, Samkacew and Byung-Mu Lee,(2013), CRC Press (Taylor & Francis Group).
5. Environmental Toxicants-Human Exposure and Their Health Effects, Morton Lippmann, (2000), John Wiley and Sons Publication.
6. Environmental Contaminants-Assessment and Control, Daniel A. Vallero, (2005), Academic Press.
7. Environmental Toxicology - Biological and Health Effects of Pollutants, Ming-Ho Yu, (2004), Second Edition, CRC Press (Taylor & Francis Group).


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DES – 303 (2): OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT

UNIT – I: Introduction and Scope

Definition of Occupational Health as per WHO/ILO. Occupational Health and Environmental Safety Management - Principles practices. Common Occupational diseases:

Unit – II: Characteristics of toxicants

Dangerous properties of chemical, dust, gases, fumes, mist, Vapours, Smoke and aerosols. Route of entry to human system, recognition, evaluation and control of basic hazards, concepts of dose response relationship, bio-chemical action of toxic substances.

UNIT – III: Occupational and Environmental Health education

Occupational Diseases, Silicosis, Asbestosis, Pneumoconiosis, Siderosis, Anthracosis, Aluminosis, Byssinosis, Bagassosis and Anthrax. Heavy Metals - Lead, Nickel, Chromium and Manganese Toxicity, Gas Poisoning (CO, Ammonia, H₂S) –

Unit – IV: Their Effects and Prevention


First Aid – Principles, Rules and Training, Personal Protective Equipments (PPE) - Respiratory and Non Respiratory Devices, Maintenance of Machines and Equipments, Fire Extinguishers – Types and Handling, Fire Detection and Alarm Systems, Water Spray Systems for Explosions,

UNIT –V: Occupational Safety, Health and Environment Management

Threshold Limit Values (TLV), The Factories Act, 1948, International Labour Organization (ILO) Convention, Safety Health and Environment (SHE), BIS on Safety and Health 15001-2000, OSHA, OHSAS-18001. National Policy on Occupational Safety, Hazardous Materials Transportation Rules . Case Studies: Major Industrial Disasters - The Bhopal Gas Tragedy 1984, Chasnala Mining Disaster 1975, Oppau Explosion, Germany 1921, Chernobyl Disaster, Ukraine 1986.

Suggested readings

1. Occupational Safety and Health for Technologists, Goetsch D.L., (1999), Engineers and Managers, Prentice Hall.
2. R. K. Jain and Sunil S. Rao , Industrial Safety , Health and Environment Management Systems, Khanna publishers, New Delhi (2006)
3. Safety and Environmental Management, Della D.E., and Giustina, (1996), Van Nostrand Reinhold International Thomson Publishing Inc.
4. Environmental Strategies–Hand Book, Kolluru R. V, (1994) McGraw Hill Inc., New York.
5. A B C of Industrial Safety, Walsh, W and Russell, L, (1984), Pitma Publishing United Kingdom
6. Environmental and Industrial Safety, Hommadi, A. H. (1989), I.B.B Publication, New Delhi.

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DES - 304 : RESOURCE CONSERVATION & MANAGEMENT

Unit - I : Introduction about natural resources

Kinds of natural resources; Need to manage; Resources management: Preservation, Conservation & Restoration; Extrinsic and intrinsic environmental resource potential values (the five E's); Patterns of resource depletion; Conservation of mineral resources, concept of five 'R'.

Unit - IV : Resources

Renewable & Non-renewable; Depletion of Natural resources; Water resources & environment: Factors influencing the surface water: Resources & reserves, Ocean ore and recycling of resources; Environmental Impact of exploitation, processing and smelting of minerals, Role of NGT, Swatch Bharat Abhiyan, OTEC

Unit - II : Resource Conservation

Reducing the need for resources; Resource economics; Jobs and life in a sustainable world; The Human population challenge (Earth's carrying capacity); Sustainable use of Energy resources; Conservation of Soils.

Unit - III : Resource Management

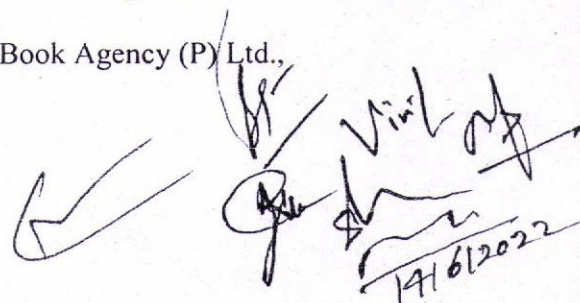
Gasohol; Use more methane fuel, Use genetically engineering methods to develop gasoline plants; Halt the deforestation in the tropics, Reforestation; Energy intensity index; Law of diminishing returns; Approach to Natural Resource Management: Exploitation, Utilitarian approach, Sustainable approach; Watershed management; Wasteland management, Wetland management; Rain water harvesting.

Unit - V: Sustainable Management of resources

Role of an individual in conservation of natural resources; Equitable use of resources for sustainable life styles; Urban problems related to energy; Water conservation: Rain water harvesting. Resettlement and rehabilitation of people, its problems and concerns; Environmental ethics, issues and possible solution

Suggested readings

1. Ecology of Natural Resources, FerancoisRamade (1991), John Wiley.
2. Text book of Environmental Studies, EranchBharucha (2005), Universities Press.
3. Environmental Studies, Kumarasamy K, Alagappa Moses A and Vasanthy M (2004), Bharathidasan University Publishers.
4. Environmental Science and Technology, Stanley E. Manahan (2007), Taylor & Francis, CRC Press.
5. Instant notes Ecology, Aulay Mackenzie, Andy S. Ball and Sonia R. Virdee (2002), Bios Scientific Pub. Ltd.,
6. Environmental Science, Physical Principles and Application, Egbert Boeker and rienk van Gondelle (2001), John Wiley & Sons.
7. Environmental Science, Santra, S.C (2005), New Central Book Agency (P) Ltd.,

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DES - 401:ECOTOURISM

Unit I: Definition and concept of ecotourism

Social and ecological impacts of tourism & Definition of ecotourism. Concept of Ecotourism, Ecotourism and related sub-sectors of the tourism industry • Ecotourism criteria, Quebec declaration on ecotourism Identifying and describing ecotourism products

Unit II: Components and approaches of Ecotourism

Components of ecotourism, Ecotourism and the environment, Ecotourism and conservation, Ecotourism and protected areas Components of ecotourism, Ecotourism and economic benefits, Ecotourism and social benefits, Ecotourism and local community, Ecotourism and education

Unit III: Ecotourism Practices

Ecotourism practices, Transportation, Facilities (reduce, replace, reuse, recycle), Services (types, activities, and code of ethics), The ecotourists (types, and code of ethics) Eco-labeling and green-washing

Unit IV: Ecotourism Management

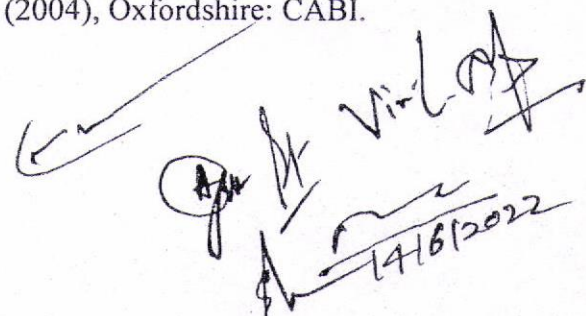
Developing an ecotourism product, Identifying products, Advantages and Disadvantages of Ecotourism- Eco-branding and Eco-labeling of Ecotourism Products - Marketing of Ecotourism, Ecotourism and Sustainable Development - Management Issues in Ecotourism, Ecotourism-based/related employment, Scope and areas of employment.

Unit V: Case Studies of Ecotourism

Case Study - Parambikulam Tiger Reserve, Kaziranga National Park, Ecotourism spots in Tamil Nadu (Ooty, Kodaikanal, Elagiri, Yerkaud). A World Heritage Site in Assam, Ecotourism in Bagalkot District, Karnataka, The Kabini River Lodge. Gender and Sustainable Development in Mountains in Garhwal Himalaya,

Suggested Readings

1. The Encyclopedia of Ecotourism, Weaver, D. B. (2001), CABI.
2. Encyclopedia of Ecotourism, Volume I, II and III, Sinha, P.C (2003), Anmol Publications Pvt. Ltd.,
3. Ecotourism and sustainable Development, N. Mukherjee (2008). Cybetech Publications
4. Global Ecotourism, Prabhas Chandra (2003), Kaniskha Publishers
5. Ecotourism. An Introduction, Fennell A David. (2003), Routledge, London and New York.
6. Ecotourism Impacts, Potentials and Possibilities, Wearing and Neil (2000), Oxford: Butterworth & Heinemann.
7. Case studies in ecotourism, Buckley, R. (2003), Cambridge: CABI.
8. Environmental impacts of ecotourism, Buckley, R. ed. (2004), Oxfordshire: CABI.

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DES – 402: Current Research Methodology in Environment

UNIT I: Research

Introduction to research, Concept and theory, Induction and deduction; Objectives of research. Types of research, Research process, Research Formulation – Defining and formulating the research problem

Unit II: Introduction to Statistics

Scope, Limitations of Statistics, Statistical Method and Experimental Method. Collection of Data, Sampling, Classification and Tabulation of Data. Diagrammatic & Graphic Presentation of Data. Information Technology: Information Types, Needs, Data Processing,

UNIT III: Descriptive Statistics

Introduction, Measure of Central Tendency- Mean, Mode, Median, Measure of Shapes. Properties of Mean, Variance and Standard Deviation, Co-Efficient of Variation. Sampling Theories and Hypothesis Testing, Techniques and Experimental Designs. Testing Hypothesis: Significance Level and X² Test, T and F Test.

UNIT III: Statistical Analysis

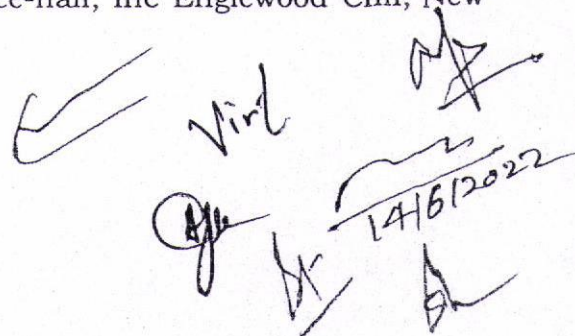
Correlation, Regression and ANOVA: Analysis of Variance: One Way and Two Way ANOVA, MONOVA, Regressions: Defining the Fit, Correlation, Polynomial Regression, Multiple Regression, P-Value.

UNIT V: BioStatistics & Computer Applications

Tabulation of Data. Graphical Presentation of Data; Line Graph, Bar Chart, Cumulative Bar Chart, Percentage Bar, Chart, Pie Chart and Three Dimensional Graphs. Frequency Analysis; Univariate and Bivariate Frequency Tables. Calculation of Mean, Median and Mode. Calculation of Modal Frequency; Grouping Table and Analysis Table. Testing and Hypothesis; Application of 'T' Test. Calculation of Correlation and Regression. Data Sheet and Data Management. Simple Statistical Work Using Excel Spread Sheet.

Suggested readings

1. Statistics for Environmental Science and Management, Bryan FJ, Manly (2008), ISBN 9781420061475.
2. Scientific methods for Ecological Research, Ford ED, (2000), Cambridge University Press.
3. Statistics for Earth and Environmental Scientist., John Schuenemeyer, Larry Drew, (2011).
4. Fundamentals of Biostatistics, Rosner B, (1986),, Duxbury Press, Boston
5. Statistical Methods, Snedecor W and G Cochran, (1967), Oxford and IBH Publishing Co. Calcutta
6. Biostatistical Analysis, Zar JH, (1984). Prentice-hall, Inc Englewood Cliff, New Jersey

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DES – 403: SUSTAINABLE MANAGEMENT AND SUSTAINABLE DEVELOPMENT

Unit I: Introduction to Sustainable Development

Concept, nature and scope of Sustainable development. Globalization and Economic growth. Economic development: Economic inequalities, Income and growth. Social development: Poverty, conceptual issues and measures, impact of poverty

Unit II: Environmental Economics, Energy and Sustainable Development

Trade-off between environmental stress and economic growth; Environmental Kuznet's Curve hypothesis - theory and empirical evidence; Environmental accounting; Externalities; Different types of goods, Common property resource and Tragedy of the Commons; Poverty and environment

Unit III: Energy Economics and Climate Change

Introduction to energy economics; Energy- environment interactions; Options to address energy related environmental problems – Regulatory approach to environmental management, economic instruments for pollution control, Assessment and selection of instruments, Nuclear energy and climate change; Promises and limits of bioenergy; International climate change agreements – UNFCCC, The Kyoto Protocol

Unit IV: Integrated approaches

Innovative models of sustainable development. Public private partnership, decentralization of power. Strategies to become a developed country. Future trends in integrated approaches.

Unit V: Environmental Protection measures

Environment protection policies, waste management, Pollution control, reduce the use, reuse and recycle, sustainable energy, preservation of forest and water sources, Demand and supply management.

Suggested readings

1. Downing, Theodore E. 2002. Avoiding New Poverty: Mining-Induced Displacement and Resettlement, International Institute for Environment and Development.
2. Falenda, Sudan K. 2009. Encyclopedia of Environment and Development, Serials Publication: New Delhi.
3. Gilbert, Alan and Josef Guglar. 1982. Cities, Poverty and Development: Urbanization in the Third World, New York, Delhi: Oxford University Press.
4. Gowdy, John and Aneel Salman. 2008. "Climate Change and Economic Development: A Pragmatic Approach", The Pakistan Development Review, Vol. 46, No. 4.
5. Held, David, Charles Roger and Eva-Maria Nag. 2013. Climate Governance in the Developing World, Cambridge: Polity. Human Development Report. 2006.
6. Beyond scarcity: Power, Poverty and the Global Water Crisis, New York: UNDP.

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Selective paper for Environmental Biotechnology and Natural Resource Management

DES - 404 (1) : ENVIRONMENTAL MICROBIOLOGY

Unit I : General Environmental Microbiology

Environmental Microbiology: Definition and Scope, Environmental microbial processes including nutrient cycle (Carbon, Sulphur Nitrogen and Phosphorus Cycle). Famous Environmental microbiologist and their work in India

Unit II: Microbial population in Air

Distribution and sources of air borne microorganisms
Air borne diseases
Bioleaching of metals, acid mine drainage

Unit III: Microbial Population in Water

Microbial communities in natural water, Sanitary quality of water : bacteriological evidence of faecal pollution, indicators of faecal pollution. Bacteriological analysis techniques of water

Unit IV: Microbial Diversity in Soil

Introduction and historical background of soil microbiology, Soil microflora- bacteria, fungi, actinomycetes, algae, protozoa and viruses. Interactions among soil microorganisms: neutralism, symbiosis, proto cooperation, commensalisms, ammensalism, parasitism and predation.

Unit V: Sewerage system

Composition of sewage, kinds of sewerage systems-sanitary, storm and combined sewers. Microorganisms in sewage-fungi, protozoa, algae, bacteria and viruses. Sewage treatment and disposal.

Suggested Readings:

1. Environmental Microbiology by Mitchell R, 2nd Edition WILEY INDIA publications, 2016.
2. Environmental Microbiology by **Buckley R G CBS Publications, 2005.**
3. Environmental Microbiology by Annet Blogger, Oxford Book Company, 2010.
4. Microbiology, K. J. Pelzer, E. C. S. Chan & N. R. Kreig (2008), Tata Magraw.
5. Environmental Microbiology, Raina M. Maier & Lanl. Pepper (2000), Elseiver
6. Environmental Biotechnology Principles and Applications, Bruce. E. Rittmann (2001), Graw- Hill Book Co

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DES - 404 (2) : ENVIRONMENTAL BIOTECHNOLOGY

Unit - I : Basic of environmental biotechnology

Fundamentals of biotechnology in pollution control; Wastewater treatment: aerobic and anaerobic; Bioremediation for hazardous waste and xenobiotic waste; Microbes use in mining and oil recovery; Bio-indicator for environmental quality monitoring.

Unit - II: Scope of environmental biotechnology

Scope Recombinant DNA technology; c-DNA; Genomic library; Plasmid Vectors; Cosmid vectors; Retrovirus; Vector for plants; Single celled proteins; Alleles; Heteroploidy; Euploidy; linkage;

Unit - III : Analytical Techniques

Dot Blot technique; Northern blot; Southern blot; Slot blot; DNA finger printing Western blot; Radio immuno assay; PCR; ELISA Test; SDS-PAGE; Hybridoma technique; Gene therapy; Cloning.

Unit - IV : Importance of Biotechnology in Environment

Transgenic plants; Plant tissue culture; somatic hybridization; Germplasm conservation: genetic erosion and genetic conservation; Plant genetic resource; Plant virus vector; Gene bank; Cry preservation; genetically engineered microbes; Human Genome project; present status and future prospects of biotechnology in India.

Unit-V: Eco-friendly Bioproducts from Renewable Sources

Eco-friendly Bioproducts from Renewable Sources, Environmental biotechnology and sustainability; Biocontrol agents: Biopesticide, Bioherbicides, Bioinsecticide; Biofertilizers; Biofilms; Biochips; Mushroom cultivation; VAM; Vermiculture and organic farming.

Suggested Readings

1. Environmental Biotechnology, B.C. Bhattacharya and R., Banerjee (2007), Oxford University Press.
2. Environmental Biotechnology: Concepts and Application, H.J. Jordening and J., Winter, (2005) Wiley -VCH Verlag GmbH & Co.
3. <http://www.uic.edu/classes/cmeng/cmeng525/>

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