

# P.G. DEPARTMENT OF ENVIRONMENTAL SCIENCES

## Pataliputra University

Date : August 06, 2018

To ,

Shri P.C. Choudhary  
OSD (J)  
Raj Bhawan, Patna.

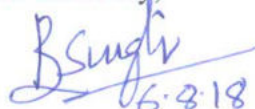
Sub: Implementation of Choice Based Credit system (CBCS) Curriculum for Environmental Sciences during Session: 2018-20.

Sir,


With reference to your letter No. BSU (regulation) – 20/2018- 2015 /GS(I), Date. 30.07.2018, on the subject- matter under reference a meeting of the panel of subject experts in Environmental Sciences was held on 06.08.2018 at 11:00 am at Raj Bhawan, to finalize the curriculum of Environmental Sciences degree under the Choice Based Credit System (CBCS) Curriculum. The final copy of Curriculum/ Syllabus of M. Sc. (Environmental Sciences) under CBCS is enclosed herewith.

With regards,

Yours Sincerely,



Prof. (Dr.) Bihari Singh (Retd.)  
Ex HOD, PG Dept.  
of Environmental Sciences  
A.N. College, Patna.



Prof. (Dr.) Shatrunjay kr Singh  
HOD, Environment and  
Water Management  
A.N. College, Patna



Prof. (Dr.) Preeti Sinha (Convenor)  
HOD, PG Dept. of  
Environmental Sciences  
A.N. College, Patna.

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**SYLLABUS FOR M.Sc. (ENVIRONMENTAL SCIENCES)  
(SEMESTER SYSTEM)  
CHOICE BASED CREDIT SYSTEM**

Prepared by a committee constituted and communicated vide Letter no BSU (Regulation)-  
20/2018-2015/GS(I) Dated 30.07.2018 of Governor's Secretariat, Bihar

**Prepared By:**

The Committee of Subject Experts comprising of

- (1) Prof. (Dr.) Bihari Singh (Retd.)  
Ex. HOD, PG Dept. of Environmental Sciences  
A. N. College, Patna.
- (2) Prof. (Dr.) Shatrunjay Kumar Singh  
HOD, Environment and Water Management  
A.N. College, Patna.
- (3) Prof. (Dr.) Preety Sinha  
HOD, PG Dept. of Environmental Sciences  
A.N. College, Patna.

**For the Universities of Bihar**

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## OUTLINE OF THE CHOICE BASED CREDIT SYSTEM (CBCS) for PG degree courses:

It consists of a number of courses i.e. **Core Course (CC)**, **Elective Course (EC)**, **Discipline Specific Elective Course (DSE)**, **Generic Elective Course (GE)**, **Ability Enhancement Courses (AEC)**, and **Ability Enhancement Compulsory Courses (AECC)**. Each course is equivalent to a paper. The nature of these courses is defined below.

### **1.1 Core Course (CC):**

A course, which should compulsorily be studied by a candidate as a core requirement on the basis of subject of M. Sc. studies and is termed as a Core course.

### **1.2. Elective Course (EC):**

Generally a course, which can be chosen from a pool of courses (Basket) and which may be very specific or specialized or advanced or supportive to the subject/ discipline of study or which provides an extended scope or which enables an exposure to some other subject/discipline/domain or nurtures the candidate's proficiency/skill is called an Elective Course.

### **1.3 Discipline Specific Elective Course (DSE):**

An elective course that may be offered by the main discipline/subject of study is referred to as **Discipline Specific Elective**. The University/Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).

### **1.4 Generic Elective (GE) Course:**

An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a **Generic Elective**.

P.S.: A core course offered in a discipline/subject may be treated as an elective by other discipline/subject and *vice versa* and such electives may also be referred to as Generic Elective.

### **1.5 Ability Enhancement Courses (AEC):**

The Ability Enhancement Courses (AEC) / Skill Enhancement Courses (SEC): "AEC" courses are the courses based upon the content that leads to life skill enhancement.

### **1.6 Ability Enhancement Compulsory Courses (AECC):**

**(Qualifying and Non-CGPA course):**

University will run a number of **Ability Enhancement Compulsory Courses (AECC)**, which are qualifying in nature and student from all faculties have to qualify in all such courses.

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## 1.7 Dissertation/Project/ Internship/ Industrial Training:

Elective courses are designed to acquire special/advanced knowledge to supplement/ support the main subject through a project work/internship/ Industrial Training/ Field work. A candidate studies such a course on his/her own with a mentoring/ advisory support by a teacher / faculty member called the guide/ supervisor. In case of internship/ industrial training the student will work under the joint guidance of one teacher – supervisor from the parent department to be termed as Supervisor I and one suitably qualified personnel at the research institute/ research laboratory/ industrial organization, to be termed as Supervisor II. A student may join any recognised research Institute/ research Laboratory/ Industrial Organisation with the approval of the parent department. The student has to work for a minimum number of days/ hours as decided by the parent department. On completion of the project work/ training at the research institute/ research laboratory/ industrial organisation, the student will submit a written project report certified by both the Supervisors to the parent department. Supervisor II will issue a letter certifying that the candidate has successfully completed the project and also award mark/ grade to him/ her. The certificate will be submitted to the parent department confidentially. The Board of Course Studies of the concerned Subject / Department will draft and design the certificate and other documents as per requirement. The parent department will also assist the students to choose proper organisations for their project work/ industrial training / Field work etc.

## 2.0 CREDIT

The total minimum credits, required for completing a PG program is 100.

The details of credits for individual components and individual courses are given in Table.1.

Table 1: Structure of the 2 Yrs (Four Semesters) Post Graduate Degree course under CBCS:

Semester	No of COURSE / Papers	Credit per Course/ paper	Total credit	Minimum No. of Learning Hours#	No of Core Courses/ PAPER	No of ELECTIVE Course/ PAPER	Code & Nature of Elective Course/ paper
I	05	05	25	250	4	1	AECC-1
SEMESTER BREAK							
II	06	05	30	300	5	1	AEC-1

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SEMESTER BREAK							
III	06	05	30	300	5	1	AECC-2
SEMESTER BREAK							
IV	03	05	15	150	1	3	EC -1* EC -2* DSE-1 or GE-1
<b>Total</b>	<b>20</b>		<b>100</b>	<b>1000</b>	<b>14</b>	<b>6</b>	

#For Tutorial (T)/ Practical (P)/ Field Work (FW)/ Internship etc. extra working hour to be added as per requirement and will be decided by the BOCS of the respective subject.

\* The two **Elective Courses (EC)** to be studied in semester IV may be

Both theory papers  
/ One Theory paper and One Practical paper  
/ One Theory paper and One Project work  
/ One Theory paper and One Field work  
/ Both Project work/ Internship

**IMP :** It is desirable that all students of all courses be given adequate exposure over and above the class room teaching to enhance the scope of skill development/ entrepreneurship and employability.

**2.1.** The distribution of the six elective papers shall be - two EC, one DSE or one GE, two AECC, one AEC. Students may opt for any elective course out of a list of elective papers (**Basket**) offered by the parent department or any other department/s as per his/her choice with the prior permission of the parent department. The list of elective papers, syllabus and prerequisite of the elective course will be as decided by the Board of Courses of Studies (BOCS) of the concerned subject/ department.

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2.2. The final CGPA/ class will be decided on the performance of the student in the 16 courses/ papers including the 14 Core Courses (CC) / papers and two EC /papers.

2.3 One DSE or one GE, two AECC, one AEC papers will be qualifying in nature and a student has to score at least 45% marks in these papers. Grade will be awarded separately for these courses, however, performance in these elective courses/ papers will not be considered for awarding the final CGPA/ class.

#### 2.4 Ability Enhancement Compulsory Courses (AECC):

University will run two **Ability Enhancement Compulsory Courses (AECC)**, which are qualifying in nature and a student has to qualify in both these courses. The courses are:

**AECC-1** : Environmental Sustainability (3 Credits)  
& Swachchha Bharat Abhiyan Activities (2 Credits)

**AECC-2** : Human Values & Professional Ethics (3 Credits)  
& Gender Sensitization (2 Credits)

**Students will do assignments/project work related to institutional social responsibilities including Swachchha Bharat Abhiyan Activities during SEMESTER BREAK.**

2.5 University will run a number of **Ability Enhancement Courses (AEC)** and Skill Enhancement Courses; a student can choose one from these. For example:

#### **Basket of Ability Enhancement Courses (AEC)**

- Computers and IT Skill
- Web Designing
- Financial Risk Management
- Solid waste Management
- Mushroom Culture
- Bio-fertilizer production
- Environmental Law
- Tourism & Hospitality Management
- Life skill & skill development
- Yoga Studies
- etc.

#### 2.6 Discipline Specific Elective (DSE):

In each subject the CC / paper -5 being taught in the second semester will be open to be selected as a DSE paper. In the first phase a student will be allowed to choose a paper from any subject other than his/ her Core Course (CC) from the same faculty in the same university.

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## 2.7 Generic Elective (GE) Course:

University will run a number of **Generic Elective Courses (GE)**; a student can choose one from these. For example:

### Basket of GE courses

- Music
- Dramatics
- Fine Arts
- Graphic Design
- Inclusive Policies
- Human Rights
- Any course run by any department

**Each paper will be of 5 credits, meaning thereby that the Total course will be of 100 credits. Maximum of 10 hours will be devoted to each credit.**

In Post Graduate course, there will be four semesters in all, each of six months duration. The structure of M.Sc. Course in Environmental Sciences is shown in Table as per CBCS ordinance and regulation for 2 year Post Graduate degree course in the faculty of Science. This course of M.Sc. in Environmental Sciences shall consist of 20 papers spread over four semesters. There shall be five papers in first semester, 6 papers in 2<sup>nd</sup> and 3<sup>rd</sup> semester each and three papers in 4<sup>th</sup> semester carrying 100 marks in each paper. The entire curriculum shall be of 2000 marks taken together. However, the class shall be awarded on the performance of the candidate on 16 papers including 14 CC and 2 EC papers having an aggregate of 1600 marks

**Table-02 Description of Papers for M.Sc. (Environmental Sciences) under CBCS**

SEM ESTER	COURSE/ PAPER CODE	Nature of Course/Paper	Credit	Marks	Marks of CIA*	Marks of ESE#	Passing Criterion	Qualifying Criterion
<b>I</b>	ENVCC-01	Fundamentals of Environmental Science and Ecology	5	100	30	70	45% in CIA 45% in ESE	Marks decide class/ CGPA
	ENVCC-02	Environmental Chemistry	5	100	30	70	45% in CIA 45% in ESE	Marks decide class/ CGPA
	ENVCC-03	Statistics and Computer Application	5	100	30	70	45% in CIA 45% in ESE	Marks decide class/ CGPA
	ENVCC-04	Practical (Based on 01,02 &03)	5	100	30	70	45% in CIA 45% in	Marks decide class/ CGPA

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	AECC-01	Ability Enhancing Compulsory Elective	5	100	50	50	45% in CIA 45% in ESE	Qualifying
<b>II</b>	ENVCC-05	Environmental Geosciences	5	100	30	70	45% in CIA 45% in ESE	Marks decide class/ CGPA
	ENVCC-06	Environmental Biology	5	100	30	70	45% in CIA 45% in ESE	Marks decide class/ CGPA
	ENVCC-07	Environmental Pollution and Abatement	5	100	30	70	45% in CIA 45% in ESE	Marks decide class/ CGPA
	ENVCC-08	Biodiversity and Conservation	5	100	30	70	45% in CIA 45% in ESE	Marks decide class/ CGPA
	ENVCC-09	Practical (Based on 05,06,07 &08)	5	100	30	70	45% in CIA 45% in ESE	Marks decide class/ CGPA
	AEC-I	Ability Enhancing Course	5	100	30	70	45% in CIA 45% in ESE	Qualifying
<b>III</b>	ENVCC-10	Natural Resources and Their Conservation	5	100	30	70	45% in CIA 45% in ESE	Marks decide class/ CGPA
	ENVCC-11	Environmental Planning, Policy and Legislation	5	100	30	70	45% in CIA 45% in ESE	Marks decide class/ CGPA
	ENVCC-12	Environmental Management Programme and EIA	5	100	30	70	45% in CIA 45% in ESE	Marks decide class/ CGPA
	ENVCC-13	Waste Generation and Management	5	100	30	70	45% in CIA 45% in ESE	Marks decide class/ CGPA
	ENVCC-14	Practical (Based on 10,11,12 &13)	5	100	30	70	45% in CIA 45% in ESE	Marks decide class/ CGPA

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	AECC-II	Ability Enhancement Compulsory Course	5	100	50	50	45% in CIA 45% in ESE	Qualifying
IV	ENVEC-01	1. Environmental Toxicology 2. Disaster Management 3. Environmental and Occupational Health 4. Social Issues and Environment 5. Environmental Education And awareness	5	100	Will be decided by the department/BOCS	Will be decided by the department/BOCS	45% in CIA 45% in ESE	Qualifying
	ENVEC-02	Project Work in any branch of Environmental Sciences related to air, water, soil, waste management and forest	5	100	Will be decided by the department/BOCS	Will be decided by the department/BOCS	45% in CIA 45% in ESE	Marks decide class/ CGPA
	DSE-01		5	100	30	70		Qualifying
	or GE-01		5	100	30	70		Qualifying

**\*CIA – Continuous Internal Assessment**

**# ESE – End of Semester Examination**

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## SEMESTER-I

### ENVCC-01

#### Fundamentals Of Environmental Science and Ecology

1. **Introduction to environmental sciences:** Definition, principles and scope of Environmental Sciences, interdisciplinary nature of Environmental Sciences, history of Environmental Sciences and Environmental education.
2. **Components of Environment:** Structure and composition of atmosphere, hydrosphere, lithosphere, biosphere and their linkage.
3. **Evolution Of Living forms:** Origin of life, concept of Evolution, theories of organic evolution (Lamarckism, Darwinism and Synthetic theory) speciation, isolating mechanism and its role in evolution, fossil history of man.
4. **Fundamental of Ecology:** Definition, principle and scope of ecology.
5. **Ecosystems:** Structure and functioning, abiotic and biotic component, energy flow, food chain, food web, ecological pyramids. Major ecosystem-Forest, grassland and pond.
6. **Ecological Succession:** Community structure, prey and predator relationship.
7. **Population Ecology:** Definition, characters viz. - spacing, density, growth, growth curve, law of population growth, human ecology and human settlement.
8. **Concept of Habitat:** Biodiversity and its type (species diversity, genetic diversity), hotspot of biodiversity, endangered and threatened species, conservation of biodiversity - sanctuaries, national parks and biosphere reserves, conservation projects (tiger, lion, elephant etc.)
9. **Nutrient cycle and productivity:** Hydrological cycle, biogeochemical cycles- carbon, nitrogen, phosphorus and sulphur cycles. Human impact on nutrient cycle, primary and secondary productivity, biomass and productivity.

#### Books recommended :

1. Environmental Ecology, Biodiversity and Climate change, H.M. Saxena.
2. Ecology and Environment, P.D Sharma.
3. Ecology, P.S. Verma.
4. Concept of Ecology, Edward J. Kormondy.
5. Environmental Chemistry, A.K. De.
6. Fundamental of Ecology, Odum, E.P.

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## SEMESTER-I

### ENVCC-02

#### ENVIRONMENTAL CHEMISTRY

- 1. Fundamentals of Environmental Chemistry:** Concept and scope of environmental chemistry and definition /explanation of various terms-Atomic weight and molecular weight, valency, oxidation state, chemical equation, distinction between true solution, colloidal solution and suspension, strength of solution, acid base reaction of water, pH of solution, buffer solution, buffering in water, the carbonate system of water, solubility product, solubility of gases in water, fundamentals of first and second law of thermodynamics, work done in isothermal reversible process, entropy and Gibb's free energy.
- 2. Air Chemistry:** Chemical composition of air, particles, ions and radicals in atmosphere, thermochemical and photochemical reactions in atmosphere, formation of smog, PAN and acid rain, oxygen and ozone chemistry, depletion of ozone layer .
- 3. Water Chemistry:** Structure and physicochemical properties of water, distribution of water on earth, concept of DO, BOD,COD, sedimentation, coagulation, filtration, redox potential, role of water in environment.
- 4. Soil chemistry:** Inorganic and organic components of soils, properties of soil-texture, bulk density, water holding capacity, pH ,buffering capacity, acidity, alkalinity, macro and micro nutrients of soil, nitrogen pathways, NPK in soils.
- 5. Chemical toxicology:** Toxic chemicals in air and water, pesticides in water, biochemical aspects of As, Cd, Pb,CO, O<sub>3</sub> and PAN biodegradation of hydrocarbons, pesticides and plastics.

#### Books recommended :

1. Environmental chemistry, Samir K. Banerji.
2. Environmental Sciences, S.C. Santra (NCBA).
3. Environmental Chemistry, B.K. Sharma, GOEL Publishing House, Meerut
4. Environmental Chemistry, A.K. De.
5. Environmental Chemistry, C.Baiyd.

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## SEMESTER - I

### ENVCC-03

#### Statistics and Computer Application

1. **Biostatistics** : Definition, scope and limitation of statistics, elementary statistics, mean, mode, median, standard deviation, graphical representation/ pie diagram, histogram of data frequency polygon, Ogive
2. **Simple correlation and regression**: Rank correlation, sampling techniques- simple, random and stratification random sampling.
3. **Probability**: Definition, term used in probability theory, addition and multiplication theorem (without Proof) binomial application, Poisson and Normal distribution and their property.
4. **Test of significance**: Hypothesis (null and alternative) Chi square test of goodness of fit, tests based on 't'.
5. **MS Office**- i. MS Word editing feature, reviving of files and preparation of file.  
ii. MS Excel budgetary presentation  
iii. PowerPoint presentation and preparation of project  
iv. MS Outlook, mail management, address book creation
6. Introduction to web browsing software and search engines with special reference to online environmental resources.
7. **Introduction to Environmental System analysis** : Approaches to development of models ; linear, simple and multiple regression models.
8. **Application of computer in Environmental sciences**

#### Books recommended:

1. Biostatistics, P.K. Jasra, Gurdeep Raj, Krishna Prakashan Media (P) Ltd. Meerut.
2. Methods of Biostatistics, (Sixth Edition), B.K. Mahajan.
3. Fundamentals of Computers, Rajaraman (PHI).
4. IT Tools, Taxali
5. Biostatistics, S. Prasad.
6. Statistics for management, R.I. Levin & D.S. Rubin (Pearson)

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# SEMESTER - I

## ENVCC-04

(Practical based on papers ENVCC-01, 02 & 03)

### Unit-I (Any one of the following)

1. Identification of different environmentally affected specimen.
2. Preparation of food chain/ ecological pyramids in different ecosystems.
3. Estimation of primary productivity in water body.
4. Identification of medicinal plants/ bioindicators/ phytoremedial plants.
5. Field ecology
  - (a) Determination of density, abundance, frequency and importance value index with the help of quadrat method.
  - (b) Determination or minimum size of quadrat for grassland/ forest by species area curve method.

### Unit-II (Any one of the following)

1. Preparation of solutions and reagents and their standardization.
2. Estimation of alkalinity, hardness and chloride in water and soil sample.
3. Estimation of DO in water sample.
4. Estimation of pH and conductivity of water and soil.
5. Estimation of phosphate, nitrate and sulphate by spectrophotometer.
6. Estimation of transparency, turbidity, total solid, suspended solid and dissolved solid of water samples.

### Unit-III (Any one of the following)

1. Calculation of standard deviation, mean, median, mode, correlation, regression, t and chi square test of environmental data.
2. Graphical representation of data.
3. Use of MS Office for environmental data analysis.
4. Preparation of short PowerPoint presentation.

### Unit-IV Field work report based on:

1. Visit to some natural terrestrial ecosystem/ hazards affected area.
2. Visit to some aquatic ecosystem and learn methods for collection of water sample and biota.
3. Visit to some industry/ area for environmental study of its functioning.

- Practical records/field collection/models/charts
- Viva voce

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## SEMESTER - II

### ENVCC-05

#### Environmental Geosciences

- 1. Fundamentals of Geosciences and Ecosystem:** Origin of the earth (solar system), composition and internal structure of the earth on the basis of seismic waves, rock formation, classification of rocks, ecosystem, environmental degradation, co-existence among communities-food chain, major ecosystems of India, Monsoon biome, Savannah biome.
- 2. Meteorology:** Composition of atmosphere, horizontal distribution of temperature, humidity, precipitation, pressure belts and permanent winds, local winds, energy budget of the earth, climate of India with seasons, Indian monsoon, El Nino phenomena, Tropical cyclone, westerly disturbances, air masses.
- 3. Soil and Mineral resources:** Soil profile, classification of soils and their characteristics, humus: formation, nature and properties, soil-erosion and conservation, soil pollution, resources and reserves of minerals, ocean as new areas for exploration of mineral resources, environmental impact of exploitation, processing and smelting of minerals, ground water pollution.
- 4. Water resources and environment:** Water resources of India, surface and ground water aquifers, rivers of India, hydrological cycle, fresh water resource and its conservation, resources of oceans.
- 5. Environmental Hazards:** Flood, drought, earthquake, landslide, avalanches, tsunami, tornado.
- 6. Remote sensing:** Principle, components and its application in Environmental Sciences, land use plans.

#### Books recommended:

1. Fundamentals of Remote Sensing, George Joseph.
2. Environmental Science, S.C. Santra (NCBA).
3. Physical Geography, Savindra Singh.
4. Principles of Remote Sensing, Curran, P.J.
5. Introduction to Environmental Geology, E.A.Keller

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## SEMESTER - II

### ENVCC-06

#### Environmental Biology

1. **Microbiology:** History of Microbiology, classification of microorganisms, role of microbe in biogeochemical cycles, industrial uses of bacteria and other microbes.
2. **Aerobiology and Microbial Technique:** Micro flora of atmosphere, air sampling technique, identification of aeroallergens, air borne diseases and allergies, isolation and culture of micro-organism and medium preparation.
3. **Limnological Studies:** Limnological study of fresh water bodies (lentic and lotic)
4. **Principles of Immunology:** Resistance immunology, antigens, antibody, binding and reaction mechanism, immunological responses to infectious diseases, inflammation and complement system, hypersensitivity (allergy).
5. **Cytogenetics:** Cell structure, mitosis, meiosis, chromosomal aberrations, eugenics, genetic counselling, concept of gene pool, application of genetic engineering for human welfare.
6. **Environmental Biotechnology:** Fermentation technology, vermiculture technology, biofertiliser technology.

#### Books recommended:

1. Microbiology, P.D.Sharma
2. Microbiology, Dubey & Maheswari.
3. Immunology, Kuby.J.
4. Immunology, CV Rao.
5. Elements of Biotechnology, Gupta, P.K.

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**Environmental Pollution and Abatement**

1. **Air Pollution:** Definition, sources and classification of air pollutants, primary and secondary pollutants, transport and diffusion of pollutants, gas laws governing the behaviour of pollutants in the atmosphere, methods of monitoring and control of air pollution- SO<sub>x</sub>, NO<sub>x</sub>, CO, hydrocarbons and SPM, effects of air pollution on human beings, plants, animals, materials and on climate, greenhouse effect, global warming and climatic change, air quality standards.
2. **Water Pollution:** Definition, sources and classification of water pollutants, consequences of water pollution, physicochemical and bacteriological sampling and analysis of water quality, water quality standards and methods of prevention of water pollution.
3. **Soil Pollution:** Definition, source and classification of soil pollutants, impact of soil pollutants on physicochemical and biological properties of soil, analysis of soil quality, soil pollution control, degradation of insecticides, fungicides and weedicides.
4. **Noise, Radioactive and Thermal Pollution:** Sources of noise pollution, noise exposure limits and standards, noise control and abatement measures, effect of noise pollution on human beings.
5. **Radioactive Pollution:** Their source, standard limits, threats of radioactive pollution, effect on human beings and its abatement measures.
6. **Thermal Pollution:** Source and type of thermal pollution, its effect on living organisms, abatement measures.
7. **Principles of Analytical Methods:** Theoretical principles of Titrimetric, Gravimetric, Conductometric, Nephelometric, Colourimetry, spectrophotometry, chromatography, gas chromatography, atomic absorption spectrophotometry, GLC, HPLC, Electrophoresis.

**Books recommended :**

1. Air pollution, V.P.Kudesia
2. Hand book of environmental radiation, Allen Brodsky (Editor-in-Chief), Alfred W. Klement.
3. Environmental Chemistry, A.K.De
4. Environmental Sciences, S.C. Santra (NCBA).
5. Environmental Chemistry, B.K. Sharma, GOEL Publishing House, Meerut.

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## SEMESTER - II

### ENVCC-08

#### Biodiversity and Its Conservation

- 1. Biodiversity and its conservation:** Introduction, definition, genetic, species and ecosystem diversity, Bio-geographical classification of India.
- 2. Value of Diversity:** Consumptive use, productive use, Social, Ethical, Aesthetic and option value, Biodiversity at global, national and local levels. India as a mega diversity nation, hot spots of Biodiversity
- 3. Threats to Biodiversity:** habitat loss, poaching of wildlife, man-wildlife conflicts. Industrialization, urbanization, road and recreation, wildlife conservation in India, conservation of Vulture, Tiger, Gangetic Dolphin, Elephant, Lion etc.
- 4. The IUCN Red list:** Endangered and endemic species of India, threat of loss of biodiversity.
- 5. Conservation of Biodiversity:** Traditional knowledge, sacred groves, In-situ and ex-situ conservation.
- 6. Forest and Environment:** Awareness in local people regarding destruction of forest and their participation for protection, equitable use of forest resources for sustainable life style, Social Agro forestry, Forest and Industry.  
Man and Biosphere programme, Biodiversity Conventions.

#### Books recommended:

1. Environmental Ecology, Biodiversity and Climate change, (H.M. Saxena).
2. Environmental Science, S.C. Santra (NCBA).
3. Environmental Chemistry, B.K. Sharma, GOEL Publishing House, Meerut.
4. Forest Biodiversity & its Conservation Practices in India: Nautiyal & A.K. Kaul
5. Ecological diversity and its measurements: Anne E. Magurran.

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## SEMESTER - II

### ENVCC-09

#### Practical based on papers ENVCC-05, 06, 07 & 08

##### Unit-I (Any one of the following)

1. Collection of plankton/ benthos and estimation of diversity.
2. Survey of vehicular traffic at two important traffic intersections.
3. Noise monitoring at two contrast sites.
4. Preparation of media for microbial culture.
5. Inoculation technique, isolation and colony counting.
6. Estimation of fluoride in the given sample of water.

##### Unit-II (Any one of the following)

1. Description of cross section and interpretation of geological maps and topo sheet.
2. Identification of rocks and minerals.
3. Elementary knowledge of principle and working of weather instruments, minimum maximum thermometers, wet and dry bulb thermometer, barometer and rain gauge.
4. Representation of climatic data: temperature graph, rainfall graph, climatograph.
5. Survey by plane table and prismatic compass.

##### Unit-III (Any one of the following)

1. Preparation of Gram (+ve) and Gram (- ve) bacteria.
2. Study of ecological adaptation of plant and animal.
3. Coliform count using MPN/Hetrotrophic plate count methods.
4. Principle and application of biological instruments.
5. Plant tissue culture in bacteria.

##### Unit-IV (Field work report based on)

1. Visit to nearby meteorological station/ remote sensing centre to understand its functioning.
2. Visit to nearest industries/dam/ barrage.
3. Visit to some Biodiversity rich centre/ National forest/ Wildlife sanctuary/ Bird sanctuary/ Biological park.
4. Visit to some nearby Thermal power/ Hydel power generation station/Solar power plant/ Sewage treatment plant etc.

##### Unit-V

1. Practical records/ field collection/ models/ charts
2. Viva Voce

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## SEMESTER - III

### ENVCC-10

#### Natural Resources and Their Conservation

1. **Concept and classification of natural resources**
2. **Forest Resources:** Types and distribution (Indian forest types and world forest types), importance of forests. Threat to forests use and overexploitation, deforestation, timber extraction, overgrazing, mining, dam construction and their effects on forest cover and tribal people. Afforestation policies and programmes, social and agroforestry, Joint forest management (JFM)
3. **Land Resources:** Land as a resource. General and agricultural land use pattern, land degradation, soil erosion and desertification, causes and effects, formation and reclamation of user, alkaline and saline soil.
4. **Mineral Resources:** Mineral reserves and distribution in India, production, uses and explication, environmental effects of extraction and uses of mineral resources.
5. **Marine Resource:** Seas and oceans as source of food, mineral and energy, Marine resources extraction and utilization causing coastal environmental degradation, Marine pollution and global efforts for the conservation of coastal environment.
6. **Energy resources:** Sun as source of energy, Fossil Fuels-coal, oil and natural gases, renewable sources of energy- Hydroelectric power, Geo-thermal energy, Bio energy, Nuclear energy, etc.
7. **Wildlife Conservation and Management:** Biosphere reserves, Sanctuaries, National parks, Conservation projects (Tiger, Elephant, Crocodile, Lion, Gangetic dolphin, vulture etc.)
8. **Role of Government,** Non- government organizations and community groups in the conservation of natural resources.
9. Equitable use of resources for sustainable development.

#### Books recommended :

1. Forest Biodiversity and its conservation practices in India, S.Nautiyal & A.K.Kaul
2. National Resources and Renewable Energy, M.P.Singh
3. Resource Geography, A.Gautam & S.Rastogi
4. Environmental Science, S.C.Santra

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## SEMESTER - III

### ENVCC-11

#### Environmental Planning, Policy and Legislation

1. Global awareness for Environmental protection, Environmental issues for developed and developing Countries, Indian Environmental Policy, Environmental Planning.
2. Environmental Protection, International and National organizations and their efforts for environment Protection, Global conferences and declarations: Stockholm Summit, Montreal protocol, Kyoto protocol, Ramsar Convention, Earth Summit etc.
3. Provisions of Constitution of India regarding Environmental protection, Strategies in Pollution control
4. **Wildlife Protection Act, 1972:** Its importance and impact, Forest Conservation Act 1980, revised 1982.
5. **The water (prevention and control of pollution) Act, 1974**
6. **The Air (Prevention and control of pollution) Act, 1981**
7. **The Environment (protection) Act 1986: Salient Features**
8. **The Motor Vehicle Act, 1988**
9. **Public Liability Insurance Act, 1991 and Rules 1991.**
10. **Scheme of labelling of environmentally friendly products** – Eco mark, Agmark, ISO: ISO 900 & series; ISO 1400 & series.
11. **Role of Judiciary for Environmental protection.** The National Green Tribunal 2010, Green Benches.
12. **Recent Legislations related to Environmental Protection.**

#### Books recommended :

1. Comments on water, Air pollution & Environmental (Protection Law), S. Lal.
2. Environmental Laws. 2005. Universal Law Publishing.
3. Environmental Law and Policy in India, S. Diwan and A. Rosencranz. 2005.
4. Environmental Law, International and National perspectives, G.Singh

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## SEMESTER - III

### ENVCC-12

#### Environmental Management Programme and EIA

- 1. Environmental Monitoring**  
Principles of environmental monitoring – Water, air and soil, Principal of site selection and sampling distribution as per IS: 3025 and IS: 2720, Concept of Indicator species and their ecological significance
- 2. Environmental quality Indices and standards**  
Air quality indices, Water quality indices, Noise Quality indices, Soil/Land quality indices.
- 3. Environmental Impact Assessment**  
Introduction to EIA, EIA and environmental management plan, EIA guidelines 1994, 2006. Notification by Government of India.
- 4. Impact Assessment Methodologies**, EIA process, prediction and EIA report, procedure for reviewing environmental impact analysis and statement.
- 5. Environmental Management**  
Key concept of Environmental Management, Some Environmental Management approaches, Standard Setting, Economic policies, Environmental organizations, Environmental Indicators.
- 6. Environmental Audit:** Concept and guidelines

#### Books recommended:

1. Environmental Science, S.C. Santra (NCBA).
2. Environmental Impact Assessment – Charles H. Eccleston
3. Environmental Impact Assessment – R.R. Barthwal.
4. Environmental Impact Assessment theory & Practice- Anji Reddy Mareddy
5. Environmental Impact Assessment, L.W. Canter
6. Environmental Planning & Management, J.H.Baldwin

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## SEMESTER - IV

### ENVCC-13

#### Waste Generation and Management

##### UNIT -I Sources and classification

Definition, sources and classification of waste: Biodegradable and non-biodegradable waste. Hazardous and non-hazardous waste, Infectious and non-infectious waste. Solid Waste Management and Disposal : Generation of solid waste, their characterization, chemical composition and classification. Different methods of disposal and management of solid waste. Recycling of waste materials.

##### UNIT -II Hazardous Waste Management

Cyanides, Dioxins, detergents, Plastics, nylon, PCBs, Monitoring and management strategies, Degradation of pesticides, detergents, plastics and polymers, hazardous waste management and Handling Rules, 1989, Disaster Management and Risk analysis.

##### UNIT -III Hospital & Radioactive Waste Management

Disposal types, Quantity, Characterization and Segregation, Preventive measures.

Radioactive waste : Sources, half-life of radioactive elements, modes of decay, Effects on plants, animals and man : Low-level and high- level radioactive waste management, Waste minimization and treatment, Radiation standards by the Nuclear Regulatory Commission.

##### UNIT -IV Recycling of Waste

Waste types, sources, waste generated per capita, Composition of waste, Recycling of waste for industrial agriculture and domestic purposes, Recycling of metal products: Reuse, Recovery and Reduction of paper, plastics etc. recycling of food manufacturing, beverages, leather, paper and pulp, Fly ash utilization.

##### UNIT- V Pollution Prevention and Quality Management

Definition, benefits and overview of waste reduction techniques. Barriers and regulations. Pollution prevention in different kinds of industries at source, during processing and packaging. Pollution incentives.

##### Books recommended:

1. Environmental Chemistry, B.K. Sharma.
2. Environmental Chemistry, A.K. De.
3. Text book of Solid Waste Management –I.H. Khan & N. Ahsan
4. Hand book of Solid Waste Management – G. Tchobanoglous

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## SEMESTER - III

### ENVCC-14

#### Practical based on ENVCC- 10, 11, 12 & 13

##### Unit I (Any one of the following)

1. Preparation of list of local endangered species.
2. Analysis of biomedical waste.
3. Collection and estimation of hazardous component from municipal waste.
4. Estimation of degradation of natural sources of your nearby locality.
5. Analysis of water quality and its comparison with water quality standard <sup>Boh</sup> quality.

##### Unit II (Any one of the following)

1. Site selection and collection of soil and water samples.
2. Determination of different water quality parameters.
3. Determination of soil moisture, water holding capacity, bulk density porosity, N, P, K and Organic carbon in the given soil sample.
4. Preparation of any culture studied by you.
5. Estimation of heavy metals in water and soil – Iron, Arsenic, Lead, Zinc and Copper.

##### UNIT: III (Any one of the following)

1. Finding water quality index/air quality index based on given data.
2. Principle and application of pollution measuring instruments.
3. Study of ambient air quality at light and low traffic zones with respect to parameters SPM, SO<sub>x</sub>, NO<sub>x</sub>, O<sub>3</sub>.
4. Estimation of sewage quality.
5. Estimate of chlorophyll in given sample of green leaves collected from nearby locality.

##### UNIT : IV Field work report based on

1. Visit to some Garbage disposal unit and study of collection methods.
2. Visit to the nearest natural resource destruction (anthropogenic) activity site.
3. Visit to agro-forestation/social forestry developed in nearby area.
4. Visit to aquaculture Projects.

##### UNIT: V

1. Practical records/field collection/models/charts.
2. Viva Voce.

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**SEMESTER - IV**  
**ENVEC-01**

**Environmental Toxicology**

**Unit I**

**Toxicant and Toxicity:** Definition and scope of Toxicology, Acute and Chronic toxicity, Selective Toxicity, Dose, Synergism

**Unit II**

**Dose-Response Relationships:** Graded response, Quantal response, Time action curves, Threshold Limit Value (TLV), Margin of safety, Toxicity Cures, Cumulative Toxicity,  $LC_{50}$ ,  $LD_{50}$ .

**Unit III**

**Heavy metals Toxicology:** Metabolism, Toxicity monitoring and exposure standards for heavy metals such as Cadmium, Lead, Nickel, Mercury, Arsenic in humans – a brief account, Biomonitoring of Toxic chemicals – objective, Biomonitoring programmes, parameters for biomonitoring, Concepts of Bio-indicators, Bio-indicator groups and examples.

**Unit IV**

**Occupational hazards:** Recognition, evaluation and control of occupational health hazards, occupational health surveillance, Occupational health control programmes in context of Indian Factories Act.

**Unit V**

Needs, Strategies, Control and Remedial measures for some common environmental toxicants.

- (a) In global context
- (b) In Indian context

**Books Recommended:**

1. Environmental Chemistry, B.K. Sharma, GOEL Publishing House, Meerut.
2. Environmental Chemistry, A.K. De.
3. Toxicology, P.D. Sharma
4. Fundamentals of Toxicology, K. Pandey, J.P. Shukla & S.P. Trivedi

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## SEMESTER - IV

### ENVEC-01

#### Disaster Management

##### Unit I Meaning and Concept of Disaster

Natural disasters, nature, causes and effects, cyclone, tornadoes, tsunami, floods, earthquakes, avalanches, landslides, drought, diseases and fire, Forecasting and Warning System of Disasters.

##### Unit II Measurement of Disaster

Measurement of responses of disaster, community reaction to disaster, coping mechanism, classes of victims.

Disaster management, Pre-disaster phase, actual disaster phase, post disaster phase.

##### Unit III Disaster Education and Assistance

Disaster education, technological assistance, relief camps, organization camp layout, fire fighting camping and tent pitching, rope, knots and their use, rescue, emergency rescue.

Disaster education, Alternatives and new directions, conceptualizing disaster recovery.

##### Unit IV Disaster Mitigation

Mitigation and preparedness, Programme, planning and management.

Case studies of disasters.

##### Unit V Disaster Awareness

Environmental needs and social justice, Cultural significance of natural protection, participatory management of biological resources, role of traditional knowledge.

Human rights in relation to environment, role of Non-Governmental Organizations (NGOs), environmental protection.

#### Books recommended:

1. Environmental Hazard, Assessing: risk & Reducing disaster, K.Smith
2. Environmental Science, S.C. Santra (NCBA).
3. Disaster Management: A Disaster manager's handbook. – Carter, W.nick
4. Disaster Management – H. Gupta

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## SEMESTER - III

### ENVEC-01

#### Environmental and Occupational Health

1. **Basic principle of environmental health.**
2. Physiological responses of man to relevant stresses in the environment.
3. Cases and effects of pollution.
4. **Industrial Toxicology:** Study of environmental dose effect relationships. Evaluation of toxicity and threshold limits. Principles and methods of occupational health.
5. The relationship between occupational hygiene, safety and disease.
6. **Health maintenance:** Survey, analysis and recommendations regarding health and safety problems in the working and living environment.
7. **Biostatistics, epidemiology:** Application of statistical methods to medical records in the study of health problems of human population in a given environment.
8. **Treatment of variation** with demographic, vital statistics and epidemiological data.
9. Hazard evaluation in polluted environment with specific emphasis on radiological health.
10. **Industrial hygiene technology**-Laboratory methods illustrating the principles, methods of recognizing, evaluating and controlling environmental hazards like air pollution, etc.

#### Books recommended:

1. Natural Hazards, Cambridge University Press, E.A. Bryant
2. Environmental Hazards, K. Smith
3. Principles of Environmental Toxicology, I.C. Shaw and J. Chadwick.
4. Principles and Practices of Toxicology in public Health, Ira. S. Richards.
5. Environmental Science, S.C. Santra

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## SEMESTER - IV

### ENVEC-01

#### Social Issues and Environment

##### UNIT - I

Global Environmental problems and International Conventions/Treaties – Stockholm summit, Montreal Protocol, Kyoto Protocol, Earth summit, The United Nations Framework Convention on Climate Change (UNFCCC)

##### UNIT -II Environmental movements in India

Narmada dam, Almati dam, Tehri dam, Chipko movement, Resettlement and rehabilitation of people: its problems and concerns.

##### UNIT - III Current Environmental Issues in India

Soil Erosion and its control, Wastelands and their reclamation, Desertification and its control, Eutrophication and restoration of Indian lakes, Epidemiological issues – Goitre, Fluorosis and Arsenicosis. Vehicular Pollution and Urban air quality, urban problems related to energy. Water crisis and conservation of water : Rain water harvesting, watershed management, waste treatment and its reuse.

##### UNIT - IV

Consumer education, Consumerism and waste products. Use of efficient and eco-friendly technology. Carbon trading, Green chemistry and green marketing.

##### UNIT -V

Environmental Education and Awareness. Environmental Ethics.

Community participation, Role of NGOs and Public awareness programs, protection of wildlife, crusade against cruelty of animals. Organizations and people in the cause of environment.

##### Books recommended:

1. Environmental Chemistry, B.K. Sharma, GOEL Publishing House, Meerut.
2. Environmental Chemistry, A.K. De.
3. Society and Environment- S.C. Naik and T.N. Tiwari.
4. Environmental Science - S.C. Santra.
5. Textbook of Environment studies, E. Bharucha
6. Environmental movements in India, P.P.Renan
7. Environmental issues and sustainable development, S.C.Kalwar

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## SEMESTER - IV

### ENVEC-01

#### Environment education and awareness

##### UNIT - I

Environmental Ethics and Global imperatives. .

##### UNIT -II

Global Environmental problems-ozone depletion, global warming and climatic change.

Current Environmental issues in India. Narmada Dam, Tehri Dam, Soil Erosion, Formation and reclamation of Usar, alkaline and Saline Soil. Waste lands and their reclamation. Desertification and its control.

##### UNIT - III

Vehicular pollution: The Vehicular pollutants and their effect on humans, Plants and Physical environment, urban air quality.

##### UNIT - IV

Waste disposal, recycling and power generation, Fly ash utilization.

##### UNIT -V

###### **Water Crises:**

Eutrophication and restoration of Indian lakes. Epidemiological issues (e.g., Fluorosis, Arsenic toxicity). Wetland conservation. Need and techniques of water conservation; rainwater harvesting, watershed Management.

###### **Books recommended:**

1. Air Pollution. Pragati Prakashan, V.P Kudesia
2. Air Pollution, M.N. Rao, & H.U. Rao,
3. Environmental Science, S.C. Santra.
4. Global Environmental issues, P. Smith and K. Warr
5. Environmental Education: Principles, concepts and management, K.K.Srivastava.

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## SEMESTER - IV

### ENVEC-01

#### Major Project

The project work may include one or more of the following subjects of environmental pollution studies, pollution treatment measures and environmental management.

- Waste sewage water, Industrial waste, Mines, Thermal power plant, food processing plant and beverages plants etc.
- Biochemical effects of arsenic/cadmium/lead/mercury/CO/NO<sub>2</sub>/SO<sub>2</sub>/Cyanide/Pesticides.
- Study of problems and prospects of conservation of natural resources, survey of flora and fauna of Industrial area.
- Air monitoring experiment on polluted air. Effects of auto exhaust on vegetation of selected areas.
- Propagation of economically, important plants by tissue culture, hormones, cutting seed etc. Aquaculture, Pisciculture, Apiculture, Lac-culture, Sericulture.
- Qualitative and quantitative study of plankton and its productivity. Study of lakes and ponds for the study of negative and positive interaction between flora and fauna.
- Environmental engineering, Study of different treatment plants and their scope. Study of Ganga action plan and other riverine system.
- Effect of climate on life forms etc.
- Study of noise pollution and its impact on living organisms.

#### Project work evaluation

1. Practical records/field collection/models/charts
2. Viva Voce

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