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CHOICE BASED CREDIT SYSTEM (CBCS)

SYLLABUS FOR THE

MASTER OF SCIENCE

in

ENVIRONMENTAL SCIENCE

TWO YEAR FULL-TIMES PROGRAMME



Department of Zoology

FACULTY OF SCIENCE

DEEN DAYAL UPADHYAYA, GORAKHPUR UNIVERSITY,

GORAKHPUR – 273009

2019

MASTER OF SCIENCE
(ENVIRONMENTAL SCIENCE)

TWO-YEAR FULL-TIME PROGRAMME

AFFILIATION

The proposed programme shall be governed by the Department of Zoology, Faculty of Science, D.D.U. Gorakhpur University, Gorakhpur – 273009, Under Self-finance Scheme.

PROGRAMME STRUCTURE

The M.Sc. Programme is divided into two Parts as under. Each part will consist of two Semesters as given below.

	Semester – Odd	Semester – Even
Part I First Year	Semester – 1	Semester – 2
Part II Second Year	Semester – 3	Semester – 4

Each semester would consist of four papers. Semesters I and II (Part I) would have Core Papers to be studied by all students of the M.Sc. – Environmental Science programme. Semesters III and IV (Part II) would comprise Optional Papers from which each student would have to select four papers in Semester III and two papers of his/her choice in Semester IV. Selection of papers in Semesters III and IV would be based on merit (performance in the Part I Examinations), choice and other specific guidelines as outlined below. It is mandatory for each student to complete a Dissertation and Project work, assigned at the end of 2nd Semester and goes on until 4th semester. Dissertation would be theoretical and not involve any laboratory components, whereas Project work will be based on experimental/field studies.

The schedule of papers prescribed for various semesters shall be as follows:

PART I: Semester – I

- 1 ENVRN 101 Fundamentals of Ecology
- 2 ENVRN 102 Wild Life Biology
- 3 ENVRN 103 Environmental Chemistry
- 4 ENVRN 104 Tool and Techniques in Environmental
Science

PART I: Semester – 2

1	ENV 201	Environmental Pollution & Monitoring
2	ENV 202	Environmental Impact Assessment
3	ENV 203	Current Socio Environmental Aspects
4	ENV 204	Environmental Microbiology

PART II: Semester – 3**ELECTIVE MODULE:**

Two papers ENV 301 and ENV 302 (inter-disciplinary) are compulsory.

One paper from ENV 303, ENV 304 or ENV 305

One paper from ENV 306, ENV 307 or ENV 308.

1	ENV 301	Eco-Biotechnology and Remote Sensing	} Open elective
2	ENV 302	Computational Biology, Biostatistics and Bioinformatics	
3	ENV 303	Natural Resource, Conservation and Management	
4	ENV 304	Environmental Monitoring and Toxicology	
5	ENV 305	Atmosphere and Global Climate Change	
6	ENV 306	Environmental Communication and Education	
7	ENV 307	Culture and Environment	
8	ENV 308	Biodiversity and Conservation Biology	

PART II: Semester – 4**ELECTIVE MODULE:**

Student will select two papers out of four papers from ENV 401, ENV 402, ENV 403 and ENV 404.

Besides this, each student will have to present two Seminars, (COMPULSORY - ENV 405) on current topic in Environmental Science.

Each Student will have to submit an allotted Dissertation (ENVONR 406), which would be theoretical and not involve any laboratory components. Student have to submit a report of Project Work on which Viva-Voce will be conducted.

1	ENVON 401	Environmental Ethics and Philosophy
2	ENVON 402	Disaster Management
3	ENVON 403	Environmental Economics, Policies and Law
4	ENVON 404	Technology, Environment and Society
5	ENVON 405	Two Seminars (Internal Assessment)
6	ENVON 406	Dissertation

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Course No.	Course title	Page No.	Credits
Semester 1			
ENV 101	Fundamentals of Ecology	1	4
ENV 102	Wild Life Biology	2	4
ENV 103	Environmental Chemistry	3	4
ENV 104	Tool and Techniques in Environmental Science	4	4
ENV 105	Practical	5	8
	Seminar		1
Semester 2			
ENV 201	Environmental Pollution & Monitoring	6	4
ENV 202	Environmental Impact Assessment	7	4
ENV 203	Current Socio Environmental Aspects	8	4
ENV 204	Environmental Microbiology	9	4
ENV 205	Practical	10	8
	Seminar		1
Semester 3			
(Any two combination : one from ENV 303 - ENV 305 and one from ENV 306 - ENV 308)			
ENV 301	Eco-Biotechnology and Remote Sensing	11	4
ENV 302	Computational Biology, Biostatistics and Bioinformatics	12	4
ENV 303	Natural Resource, Conservation and Management	14	4
ENV 304	Environmental Monitoring and Toxicology	15	4
ENV 305	Atmosphere and Global Climate Change	16	4
ENV 306	Environmental Communication and Education	17	4
ENV 307	Culture and Environment	18	4
ENV 308	Biodiversity and Conservation Biology	19	4
ENV 309	Practical	20	8
	Seminar		1
Semester 4			
ELECTIVE MODULE (any two course from ENV 401-ENV404)			
ENV 401	Environmental Ethics and Philosophy	21	4
ENV 402	Disaster Management	22	4
ENV 403	Environmental Economics, Policies and Law	23	4
ENV 404	Technology, Environment and Society	24	4
ENV 405	Two Seminars	25	6
ENV 406	Dissertation**	25	6
ENV 407	Project***	25	4

* Open elective may be taught by Zoology, Botany, Chemistry, Geography, Computer Science or Guest Faculty.

** Assigned at the end of Semester II and goes until Semester IV. It would be theoretical and not involve any laboratory components.

*** Assigned at the end of Semester II and goes until Semester IV. It may be theoretical as well as field based work.

THEORY

- ### Suggested Literature:

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ENV 102: WILD LIFE BIOLOGY

THEORY

Unit-I : Value of wildlife, field observations, study of sign and symptoms, foot prints; locomotory patterns in tetrapod; Types of movement; Tiger pug marks, foot prints of other animals; Feeding sign, Animal dropping, wildlife photography.

Unit-II : Wildlife census method (Waterhole survey point count and line transect methods, pug mark count methods, king's census method); Major wildlife habitat biomes, tropical and temperature habitats; Components of Wildlife habitat (Cover, Food, Water and Space); Common flora and fauna of India.

Unit-III : Sociobiology of wild animals, Terrestrial behaviour, Migratory behaviour, Breeding behavior; Visual, Acoustic and olfactory communications and their socio-biological importance; India Wildlife (Introduction, distribution of wildlife in ecological subdivision of India); IUCN categories, Cinctures, Biosphere, reserves, National Parks, Sanctuaries and Zoos in India; Gene pool, Habit, habitat and Breeding biology of a representative wildlife and Weaver bird.

Unit-IV : Reasons for wild life depletion (Habitat, distribution, commercial wildlife exploitation, over-grazing etc.); Wildlife eco-tourism management, measures for Wildlife conservation, (Policies and Programmes); Special Projects for endangered species (Project tiger, Gir lion Sanctuary, Project, Crocodile breeding Project, Project Hangul).

Suggested Literature:

1. Wild Life Ecology, A.N. Moen.
2. Wild Life Ecology & Management, E.G. Balen.
3. Indian Wild Life, Ramesh Bedi.
4. Wild Life Management, Rajesh Gopal.

[Handwritten signatures and initials are present below the suggested literature list.]

THEORY

Unit-IV : Toxicology: Introduction, Basic concepts of toxicology, Toxicants of Health hazards (Lead, Mercury, Cadmium, Arsenic, Vanadium, Cyanide, Cobalt, Iron), Xenobiotics (Absorption, Transport and Execution of chemicals). Biological magnification, Biomonitoring of Toxic chemicals, Bioindicators,

1. Environmental Chemistry, Ian Williams.
2. Environmental Chemistry, Colin Baird, M. Cann.
3. Environmental Chemistry, F. Helmat.
4. An Introduction to Environmental Chemistry, J.E. Andrews.
5. An Introduction to Environmental Chemistry, Andrews et. al.
6. Chemistry of the Environment, T.G. Spiro, W.M. Stigliani.

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ENV 104: TOOLS AND TECHNIQUES IN ENVIRONMENTAL SCIENCE

THEORY

Unit-I : Principles of analytical methods: Titrimetry, Gravimetry, Colorimetry, Spectrophotometry, spectrophotofluorometry.

Unit-II : Chromatography- Paper/thin layer, column chromatography, gel exclusion/ion exchange affinity chromatography, Gas chromatography (GLC), High Liquid Performance Chromatography (HPLC), Electrophoresis.

Unit-III : Atomic absorption, Flame photometry X-ray fluorescence, X-ray diffraction.

Unit-IV : Differential centrifugation, Lyophilizer, basic principles of electron microscope.

Suggested Literature:

1. Essential Laboratory Techniques, S.R. Gallagher, E.A. Wiley.
2. An Introduction to Practical Biochemistry, D.T. Plummer.
3. Techniques in Live Sciences, D.B. Tembhare.
4. Modern Experimental Biochemistry, R.F. Boyer
5. Principles and Techniques of Biochemistry and Molecular Biology, K. Wilson, J. Walker.

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ENV 105 : PRACTICAL COURSE OF THEORY COURSES ENV 101 – ENV 104

Distribution of Marks:

Time : 8 hours of two sittings

Exercise
 Exercise on environmental chemistry
 Techniques and instrumentation
 Wildlife exercise
 Ecological exercise
 Spotting (10 Spots) on ecological specimens and instruments
 Viva-voce
 Total Marks

1. Study of different structural adaptations to ecological conditions.
2. Measurements of physico-chemical ecofactors: Temperature, pH, turbidity and light intensity in freshwater samples.
3. Study of seasonal variation in plankton population.
4. Demonstration of parallax vision and height perception.
5. Analysis of plant community and biodiversity and biomass.
6. Study of different structure adaptation to ecological conditions.
7. Study of seasonal variation in plankton population both qualitative and quantitative.
8. Study of Wild Life of local and suburban areas and submission of the report.
9. Study of the wild animals and their behavior.
10. Study on wild life in adjoining area with biodiversity of wild flora & fauna.
11. Comparison of Dissolve oxygen (D.O.) in water samples from different sources.
12. Determination of the chloride demand and chlorine residue.
13. Estimation of Chemical oxygen demand.
14. Estimation of Biological oxygen demand.
15. Estimation of Free Carbon Dioxide demand.
16. Estimation of chloride concentration.
17. Determination of turbidity.
18. Estimation of pH.
19. Determination of temperature, colour, odour.
20. Determination of conductivity.
21. Determination of total solids in water sample.
22. Determination of alkalinity.
23. Determination of total kjeldol Nitrogen and Sulphate.
24. Demonstration of Basic principles of Microtomy, Spectrophotometry, Flame Photometry, Atomic absorption spectrophotometry, Paper and thin layer chromatography, Column Chromatography, G.L.C., H.P.L.C., Centrifugation.

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ENV 201: ENVIRONMENTAL POLLUTION AND MONITORING

THEORY

- Unit-I:** Air-pollution: Sources of air pollutants (Natural) sources & man made sources), Types of air pollutant (Primary pollutants- Aerosols, Gaseous particulates, Metallic, pesticides, Radioactive, Carcinogen, Biological contamination, Secondary pollutants- smog), Effect of air pollutants (Biological, physical and economical) and their control. Factors affecting air pollutants wind, Temperature, Height, Precipitation, Topography, Turbulent diffusion, separated flows and plume behaviour), Green House effect, Ozone depletion, Acid rains, El-nino and La-nino effect, Bhopal Gas Tragedy.
- Unit-II:** Water pollution: Types of water pollution (Ground Water, surface water, Lake water, River water and Marine water), Sources of water pollution Sewage & Domestic wastes, Industrial effluents, Agricultural discharges, Fertilizers, Detergents, Toxic metals, Siltation, Thermal pollutants and Radio active materials), Eutrophication, Effects of water pollutants and their control.
- Unit-III:** Terrestrial Pollution: Sources of terrestrial pollution, Industrial wastes, Urban wastes, Radio- active substances, Agricultural practices, Chemical and metallic pollutants, Sedimentation, Biological agents Effects of terrestrial pollutants, Bio-indicators of terrestrial pollution.
- Unit-IV:** Radio-active pollution: Introduction, Types of Radiation, (Ionising and nonionising), Sources of radiation (Natural sources and Anthropogenic sources), Biological effects of radiation, Noise pollution: Introduction, sources of noise (Industrial, transport, Neighborhood), noise exposure levels and standards, effects of noise pollution and its control.

Suggested Literature:

1. Toxicology, Earnest Hodgson.
2. Environmental Pollution & Management, G.R. Pathade, P.K. Goel.
3. Pollution, A.D. Stern.
4. Pollutants and their Determination, Gryson.
5. Assessment and Management of Carbon, Nitrogen and Sulphur, P.A. Debarry.

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ENV 202: ENVIRONMENTAL IMPACT ASSESSMENT

THEORY

- Unit-I: Environment impact assessment: Introduction, Aims, Objectives, Constraints in EIA, Environmental assessment process (Impact prediction, evaluation, mitigation and monitoring).
- Unit-II: Environmental Impact Statement (EIS), methods of impact analysis (check list, over lays, Matrices, Models, Comparative studies), Environmental items in Leopold's identification matrix, questions for impact identification, impact interpretation, impact communication, impact statements.
- Unit-III: Prediction, Evaluation, Assessment and Monitoring of impacts of different developmental activities on the Air Environment, Water Environment, Socioeconomic Environment.
- Unit-IV: Impacts of urbanization, Socioeconomic and Environmental Impacts of tourism, impact of coal mining, Impact of hydroelectric development, Impact of fly ash, Impact of sewage and other effluents, Impact of leather tanning, Impact of green revolution.

Suggested Literature:

1. Environmental Impact Assessment & Management, Hosetti
2. Environmental Impact Assessment, L.W. Canter
3. Environmental Impact Assessment for Wetland Protection, K. Kaul
4. Environmental Impact Assessment, Lawrence

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THEORY

- Suggested Literature:**

1. Environment and Society, Francis Moore
2. Environmental Sociology, I. Sundar, P.K. Muthukumar
3. Socio-Economic Aspects, A. Kumar.

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THEORY

- Suggested Literature:**

1. Microbiology, Braude
2. Principles of Microbiology, R.M. Atlas.
3. Soil Microbiology, Tate.
4. Diagnostic of Microbiology, F. S. Weissfeld.
5. Environmental Microbiology, Maier, Pepper & Gerba.
6. Microbiology of Water Borne Diseases, Percival, Chalmers, Embrey Hunter, Stellwood Wyn Jones.

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ENV 205 : PRACTICAL COURSE OF THEORY COURSES ENV 201 - 204

Distribution of Marks:

Time : 8 hours of two sittings

Exercise

Experiments on environmental pollution

Microbiology exercise

Environmental impact assessment exercise

Exercise on current socio-environmental aspects

Viva-voce

Total Marks

1. Determination of gas pollution in different localities of the city.
2. Measurement of Noise Pollution in different Area of City.
3. Demonstration of vectors of different diseases.
4. Measurement of humidity by hair hygrometer.
5. Measurement of temperature by Max. Min. thermometer.
6. Study on environmental awareness in different group of society.
7. Effect of certain common toxicant on the acetylcholinesterase activity in the nervous tissue of fish.
8. Epidemiological study of certain common microbial diseases of local area.
9. Isolation and enumeration of microorganism from soil/water.
10. Demonstration of bacterial microflora present in soil/water/food smear by gram stain reaction.
11. Isolation of genomic DNA from bacterial culture.
12. Quantification and purity checking of DNA Isolated from samples by UV Spectrophotometer.
13. Maintenance and preservation of pure cultures of microbes.
14. Study of selected pollutants such as Ammonia, Mercuric Chloride and Malathion on the behavior of animals.
15. Study the physical characteristics of soil (Temperature, Texture, Color) and moisture content.
16. Measure the common pollutant as oil/gas and fluoride in water sample.

ENV 301: ECOBIOTECHNOLOGY AND REMOTE SENSING

THEORY

- Unit-I : Vermiculture biotechnology waste management: Introduction Ecology and distribution of earthworm, vermiculture and vermicomposting methods, Chemical composition of Waste based vermicompost, Economics of vermiculture and vermicomposting, Species of earthworms for vermicomposting, in situ application of vermiculture and crop productivity, use of earthworms in land improvement and reclamation.
- Unit-II : Biological waste and aquaculture: Generation of wastes, Recycling and conservation measures, Biofertilizers from waste products. Use of micro algae, Intensive aquaculture (Integrated fish farming system and sewage fed fish cultures). Use of sludge, Biogas slurry and Livestock wastes. Vermicomposting application in aquaculture; Bio-fertilizer technology: Introduction, Rhizobium culture, green algae culture, Azolla culture and Micorhizas culture, Benefits and significance of bio-fertilizers in agriculture, Fermentation technology.
- Unit-III : Principles of Remote sensing; Energy sources and radiation principles, Introduction of EMR with atmosphere, Energy interaction with earth's surface spectral reflectance of vegetation, Soil and water components, Characteristics of real remote sensing system, Aerial photography, Characteristics of aerial photography, photogrametry, seasons and platforms, Airphoto interpretation.
- Unit-IV : Application of aerial photographs in forestry mapping of forest types, Species analysis, Characteristics Remote sensing for land scape analysis and environmental monitoring, Environmental impact analysis, Habitat management, Geographical information system (GIS), Application of GIS in Environmental management.

Suggested Literature:

1. Environmental Biotechnology, Bannerjee
2. Remote Sensing Principles and Interpretation, F.F. Sabins
3. Remote Sensing and Image Interpretation, T.M. Lillesand, R.W. Kiefer
4. Environmental Remote Sensing-An Introduction to Animal, Mukherjee.
5. Introduction to Remote Sensing, J.B. Campbell.
6. Environmental Biology and Biotechnology, H. Kreuzer, A. Massey.
7. Biofertilizers, A.K. Sharma.

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ENV 302: BIOSTATISTICS & COMPUTATIONAL BIOLOGY

THEORY

Unit-I: Basic components of computers- hardware (CPU, input, output, storage devices), Software (operating systems), Application software; Introduction to MSEXCEL- use of worksheet to enter data, edit data, copy data, move data; Use of in- built statistical functions for computations of mean, S.D., correlation, regression coefficients etc., Use of bar diagram, histogram, scatter plots, etc.; Graphical tools in EXCEL for presentation of data; Introduction to MS-WORD word processor- editing, copying, moving, formatting, table insertion, drawing flow charts etc; Introduction to Power Point, image and data handling.

Unit-II: Sampling techniques: methods of sampling, choice of sampling methods, sampling and non-sampling errors; Tabulation and graphic representation of data: frequency distribution, tabulation, bar diagram, histograms, pie diagram; and their significance and limitations; Measures of dispersion : interquartiles range, variance and standard deviation, coefficient of variation, measures of skewness, coefficients of skewness, kurtosis; Probability : theorems on probability, application of permutation and combination, conditional probability; Probability or theoretical distributions : (a) Binomial distribution : mean, variance, conditions for application, Pascal's triangle, characteristics of binomial distribution; (b) Poisson distribution : condition under which it is used, mean and variance of and binomial approximation to Poisson distribution; (c) Normal distribution : properties and applications of normal distribution.

Unit-III: Probit analysis; Correlation covariance, correlation analysis, correlation of coefficient, Spearman's Rank correlation coefficient, graphical method of presentation; Regression: regression analysis, Fitting of lines of regression, regression coefficient and its properties, coefficient of determination; standard error of estimates, linear and non-linear lines or equations; Hypothesis testing : Standard error of a statistic, estimation theory, confidence limit, testing of hypothesis; test of significance of mean (large sample), of difference between two means (large sample); Students' t-test : assumption for t-test, properties and application of t-distribution, computation of t-statistic (t-values), tests of significance of a single mean (small samples), of difference between two means (small sample); paired t-test for difference of means.

Unit-IV: Chi-square-test: degree of freedom, properties and uses of chi-square, conditions for using the chi-square; Analysis of variance - one way and two way of classification, f-test; Types of Non-parametric tests, its advantages/disadvantages and use, sign-test for paired data, Mann-Whitney U-test, Spearman's rank correlation test; Experimental design: basic concepts and principles, completely randomized design; Duncan's multiple range test, randomized block design; Latin square design, Tukey's test of additivity, simple lattice design; Leslie matrix model, point source stream, pollution model, box model, Gaussian plume model.

Suggested Literature:

1. Biostatistics by P.N. Arora and P.K. Malhan, Himalaya Publishing House,
2. Principles of Biostatistics by Pagano M., Gauvreau, K. (2000), Duxbury Press, USA
3. Fundamental of Biostatistics by I.A. Khan and A. Khanum, Ukaaz Publications, Hyderabad.

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ENV 302: NATURAL RESOURCE, CONSERVATION AND MANAGEMENT

THEORY

- Unit-I: Sun as a source of energy, Solar radiation and its spectral characteristics, Fossil-classification, composition, physico-chemical characteristics of coal; petroleum and natural gas, Hydroelectric power, Tidal, Wind and geothermal energy.
- Unit-II: Principal forest types in India. Causes of forest degradation (Forest fires, Forest land degradation illicit felling, Grazing, Shifting, cultivation etc.), Forest conservation measures- social forestry (Farm forestry, Agro-forestry, Extension forestry), Role of forestry in eco-development of rural areas, Ethnobotanical studies in India.
- Unit-III: Fundamentals of Biodiversity, Global Biodiversity Conservation /strategies, Biodiversities Conservation plans in India. Hot spots of Biodiversity, Significance of Biodiversity to human society, reason for its depletion, scope of biodiversity.
- Unit-IV: Land use and planning, soil characteristics (mineral matter, soil water, organic matter, soil air and soil organisms), causes of soil degradation. Soil conservation methods. Mineral resources and reserves; Global water balance, ice-sheets and fluctuations of sea levels, origin and composition of sea-water, Hydrological cycle, Factors influencing the surface water, Run off process and water resources of India.

Suggested Literature:

1. Assessment and Management of Carbon, Nitrogen and Sulphur, P.A. Debarry
2. Elements of Nature and Properties of Soil, Brady and Weil
3. Environmental Management, B. Narayan.
4. Integrated Environmental Management, O. Callaghan.

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ENV 304: ENVIRONMENTAL MONITORING AND TOXICOLOGY

THEORY

- Unit-I: Air pollution Monitoring, Air quality standards, sampling methods, Instruments, Duration of sampling period, Location of sampling sites, Air sampler operation, stack sampling techniques, control of gases contaminants, combustion, Adsorption, Adsorption recovery system.
- Unit-II: Physico-chemical and bacteriological sampling and analysis of water quality. Waste treatment: Primary, secondary, and tertiary treatment, Criteria for the application of aerobic and anaerobic biological treatment. Types of Biological treatment, treatment for various industrial effluents with reference to distillery paper and pulp, textile and dyeing wastes, Industrial pollution abatement.
- Unit-III: Pollution control in Petroleum Refineries and petro-chemical unit. Odours and their control. Threshold concentration oxidation, Water supply management: Introduction, Demand of water, need of water supply. Treatment of ground water, pollution control in petroleum refineries and petrochemical unit, oil spies. Sources and generation of Solid-waste and its control. Sewage treatment, physico-chemical and bacteriological sampling as analysis of soil quality, control of soil pollutants, Remedial measures of soil pollutants. Protection and control from Radiation, Disposal of Radio-active wastage, control of Thermal pollution.
- Unit-IV: Toxicology: Introduction, Basic concepts of toxicology, Toxicants of Health hazards (Lead, Mercury, Cadmium, Arsenic, Vanadium, Cyanide, Cobalt, Iron), Xenobiotics (Absorption, Transport and Execution of chemicals). Biological magnification, Biomonitoring of Toxic chemicals. Bioindicators, Environmental carcinogens and their impact in health.

Suggested Literature:

1. Toxicology, Earnest Hodgson.
2. Environmental Pollution & Management, G.R. Pathade, P.K. Goel.
3. Pollution, A.D. Stern.
4. Pollutants and their Determination, Gryson.
5. Assessment and Management of Carbon, Nitrogen and Sulphur, P.A. Debarry.
6. A Text Book of Modern Toxicology, E. Hodgson

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1. Barry, R. G., 2003. Atmosphere, Weather and Climate. Routledge Press, UK
2. Critchfield, Howard J., 1998, General Climatology, Prentice Hall India Pvt. Ltd., New Delhi.
3. Eiror, J., and J. E. Jacobsen, 2002. The crowded greenhouse: population, climate change and creating a sustainable world. Yale University Press.
4. Glantz, M. H., 2003. Climate Affairs: a primer. Island Press.
5. Harvey D., 2000, Climate and Global Climate Change, Prentice Hall.
6. Kump, L. R., Kasting, J.F., and Carne, R. G., 2004. The Earth System. 3rd Ed. Prentice-Hall

ENV 306: ENVIRONMENTAL COMMUNICATION AND EDUCATION THEORY

- Unit-I:** Environmental education and environmental literacy: Need for public awareness; Fundamentals of Mass communication: What is communication? Defining Communication; Types of Communication; Mass Communication: an introduction; Role of Mass media.
- Unit-II:** Basics of Science & Technology (S&T) Communication: Role of Communication in Modern Science; 'Public' nature of science; Science and Public: Historical overview; Why communicate S&T; When public meets science; **Channels of S&T Communication:** What are channels; Broadcast media and S&T; Print media and S&T; Telecast Media and S&T; Science through little media; Use of group media for S&T communication.
- Unit-III:** Pragmatic aspect and contexts of science & environmental communication: Strategies for Communication; Use of analogies; Metaphor and Simile; Human and With Examples and illustrations; Anecdotes and personalizing; Context for science and environmental communication; Human interest; Cultural needs; Survival needs; Sources of information; ethics in reporting & fundamentals of media laws.
- Unit-IV:** **Educating Consumers:** Consumer Behavior and Environment: Role of Information, Eco-Labeling Environmental communication Today: Introduction; Over view of the scenario in the country; International scenario; Canonical texts (Critical reading of Books on Environmental communications such as Silent Spring); case studies of media reports that had impact; Analysis of mass media coverage of complex environmental issues and the media's effects on public opinion and government environmental policies.

Suggested Literature:

1. Greenough, Paul et al., 2003, Nature in the Global South: Environmental Projects in South and South-East Asia, Orient Longman.
2. Einarup, S. and Russell, C. S., 2005, Environment, Information and Consumer Behaviour (Ed.), Edward Elgar, UK.
3. Orr, D., 1994, Earth in mind: on education, environment and the human prospect, Island Press, Washington, D.C.
4. Saherwal, Vasanti et al., 2001, People, Parks, Wildlife: Towards Co-Existence, Orient Longman.
5. Valdiya, K.S., 2004, Geology, Environment and Society, Universities Press.

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ENV 307: CULTURE AND ENVIRONMENT

THEORY

- Unit-I :** **Introduction:** Concepts and Theories: Concept of Culture, Material Culture, technology; role of culture in adaptation of human populations; **Basic Forms of Human adaptation to environment:** Hunting and Food gathering Pastoralism; Shifting Cultivation; Agriculture; Transition to Market economy and Industrialization.
- Unit-II :** **Social and Cultural implications of various forms of adaptation:** Evolution of political organizations, distribution and exchange of resources; Political economy of the state (land and forest policies: colonial to post-colonial).
- Unit-III :** **Environmental Culture in Business Organizations:** Development of environmentally aware corporate cultures, Linkage between Organizational Environmental Culture and Environmental Strategy.
- Unit-IV :** **Development and Environment:** Current debates; How development policy defines degradation in largely physical terms, and not in terms of access inequities and exploitation; **Landscapes:** how landscapes are invested with cultural meaning, changes in landscape over time and their cultural and ecological implications.

Suggested Literature:

1. Baruah, Sanjib. 2005. Durable Disorder: Understanding the Politics of Northeast India. O.U.P.
2. Ghidgi Madhav and Guha Ramachandra. 1992, This Fissured land: An Ecological History of India, O.U.P.
3. Gold, Ann and Bhoja Ram Gujar, 2002, In the Time of Trees and Sorrows: Nature, Power, and Memory in Rajasthan, Durham, Duke University Press.
4. Guha, Ramachandra. Social Ecology, 1998, Oxford University Press.
5. Ingold Tim, 1994, Companion Encyclopedia of Anthropology, Routledge.
6. Kelley Ailey, 2002, On the banks of the Ganga: when waste water meets a sacred river. University of Michigan Press. Ann Arbor.
7. Leach, M. and R. Meams (Ed.). 1996, The Lie of the Land: Challenging Received Wisdom on the African Environment. London and Oxford: The International African Institute and James Curry.
8. Milton, Kay, 1993, Environmentalism: The view from Anthropology, Routledge
9. Mehta, Lyia, 2001, The Manufacture of Popular Perceptions of Scarcity: Dams and Water related Narratives in Gujarat, India. World Development 29 (12), pp. 2025-2042.
10. Schama, Simon, 1995, Landscape and Memory, London. Harper Collins.
11. Savyasachi, 1994, The Tiger and the Honeybee. Seminar 423: 30-35
12. Thorner, Daniel ed, 1996 Agricultural Atlas of India, 1920, Karachi, Oxford University Press.
13. White, Leslie A., 1959, The Evolution of Culture, McGraw-Hill, New York.
14. Zimmerman, S. 1982, The Jungle and the Aroma of Meats, Berkeley, University of California Press.

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ENV 308: BIODIVERSITY AND CONSERVATION BIOLOGY

THEORY

- Unit-I:** Concepts: Organic Evolution through geological time scale. Ecosystems, Biomes etc.; **Levels of Biodiversity:** Community diversity (alpha, beta and gamma biodiversity), Gradients of Biodiversity (latitudinal, insular), Ecosystems diversity: biomes, mangroves, coral reefs, wetlands and terrestrial diversity (equilibrium mix of G and W.); **Species diversity:** richness and evenness, loss of species. Magnitude of biodiversity (Global and Indian data). Direct and indirect benefits, Bioprospecting (molecular techniques like RAPD, RFLP, AFLP; DNA sequencing etc).
- Unit-II:** **Genetic diversity:** sub species, breeds, race, varieties and forms. Variation in genes and alleles at DNA sequence levels (selected case studies). Microbial diversity and useful prokaryotic genes. Speciation (amount of genetic variation is the basis of speciation). Consequences of monotypic agricultural practice (Detailed case studies); **Threats to Biodiversity:** Habitat loss and fragmentation; Disturbance and pollution; introduction of exotic species; extinction of species; **Human intervention and Biodiversity loss:** Global Environmental changes, land in water use changes.
- Unit-III:** History of Conservation movements: International and National. Ecologically relevant parameters (viable population, minimum dynamic area, effective population size, metapopulations); reproductive parameters in conservation (breeding habitats, mating systems, inbreeding depression, genetic bottlenecks, genetic constraints); IUCN categorized-endangered, threatened, vulnerable species. Red data book and related documentation.
- Unit-IV:** Methods of conservation. *In situ* (Biosphere reserves, National Parks, Sanctuaries, Sacred groves etc) & *ex situ* (Botanical gardens, ENVogical gardens, Gene banks, Pollen, seed and seedling banks, tissue culture and DNA banks etc) modes of conservation; Benefits of conservation: Biodiversity as a source of food and improved varieties; source of drugs and medicines; Aesthetics and cultural benefits. Sustainable development. Ecosystems services (maintenance of gaseous composition of the atmosphere, climate control by forests and oceanic systems. Natural pest control, pollination of plants by insects and birds; formation and protection of soil, conservation and purification of water, nutrient cycling).

Suggested Literature:

1. Daily, G.C., Ed., 1997, Nature's Services: Societal Dependence on Natural Ecosystems. Island Press, Washington, D.C.
2. Dobson, A.P., 1996, Conservation and Biodiversity. Scientific American Library, New York, NY.
3. Gaston, K.J. and J.L. Spicer, 1998, Biodiversity: An Introduction. Blackwell Science, London, UK.
4. Groom bridge, B., and M. Jenkins, 2000, Global Biodiversity: Earth's Living Resources in the 21st Century. World Conservation Press, Cambridge, UK.
5. IUCN, 2004, Red list of threatened species. A global species assessment. IUCN, Gland, Switzerland.
6. Loreau, M., and P. Inchausti, 2002, Biodiversity and Ecosystem functioning: Synthesis and Perspectives. Oxford University Press, Oxford, UK.
7. Primack, R.B., 2002, Essentials of Conservation Biology, 3rd Edn., Sinauer Associates, Sunderland, Ma. USA
8. Wilson, Edward O., 1993, Diversity of Life. Harvard University Press, Cambridge, MA.

ENV 309: PRACTICAL COURSE OF THEORY COURSES ENV 301-ENV 308

Distribution of Marks:

Time : 8 hours of two sittings

Exercise

Exercise based on vermiculture;vermiwash and vermicompost

Mathematical exercise

Exercise on natural resources, conservation and management

Exercise on environmental monitoring and toxicology

Exercise on atmospheric and global climatic change

Exercise on environmental communication

Exercise on culture and environment

Exercise on biodiversity and conservation

Viva-voce

Total

Any one

Any one

Course ENV 301-ENV 302 : Demonstration of vermiculture.; Preparation of vermicompost from different biological waste products; Preparation of vermiwash from different vermicompost and earthworms; Identification of different species of earthworms of Gorakhpur; Small Dissertation/ Project/ Seminar lecture on remote sensing; Use of excel sheet for data processing; Simple experiments on probability; Sample data collection and calculation of mean, median and mode, variance and standard deviation.

Course ENV 303 : Study on the solar radiation and its spectral characteristics; Study on physico-chemical characteristics of coal, petroleum and natural gas; Measurement of wind speed by anemometer; Measurement of light intensity by luxmeter in different day time; Measurement of rainfall by rain fall gauge; Submission of small reports on any of the natural resources in adjoining area of Gorakhpur; Demonstration of hot spots of different natural resources on national map.

Course ENV 304 : Effect of UV Radiations on animals/plants; Effect of certain toxicants on alkaline phosphatase activity in the nervous tissue of snail/fish; Estimation of LC50, LC10 and LC90 measurement of selected toxicants for selected organism. Determination of upper and lower confidence limits, slope with value of each study; Analysis of Heavy metals in water/air/soil etc. by Atomic absorption spectrometer; Study of selected pollutants on the behavior of animals;

Course ENV 305 : Project reports based on any of the above topics. Out of these one should be based on long term data collected from India Meteorological Department (IMD) and National Physical Laboratory (NPL) on various atmospheric parameters and their analysis; Visit to IMD to learn about real time monitoring and prediction of weather; Viva-Voce based on the above two project reports/practical or Seminar.

Course ENV 306 : Study on environmental awareness in different locality, age, sex, education and job profile; Study on the awareness of recent environmental issues of the world; Demonstration of Certain Environmental problems in between the different groups of urban and rural area (Sound Pollution, Air Pollution, Soil Pollution and Water Pollution); Educate different groups in remote areas about the biodiversity of native flora fauna and their conservation; Use of print and audio visual media about the environmental issues and

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Course ENV 307 : Submission of small dissertation on the relationship between culture and environment in adjoining area of Gorakhpur;

Course ENV 308 : Measurement of species diversity (calculation of diversity indices from data collected on plant species in the adjoining forest; Measurement of the diversity of Flora of University Campus; Study on the Biodiversity of Animal Species in Ramgarh Tal and Imahesara Lake.

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ENV 401: ENVIRONMENTAL ETHICS AND PHILOSOPHY THEORY

- Unit-I:** An Introduction to Environmental Ethics and Philosophy: Ethics in society; Environmental Consequences; Responsibility for Environmental Degradation; **Theories of Environmental Ethics and Philosophy:** Different types of schools of thought vis-à-vis nature and environmental management. Values in modernity, anti-modernity, eastern and western cultures, nature and religion etc.
- Unit-II:** **Geo Centric Theories of Nature:** Deep ecology and animal rights theories, environmental rights, environmental racism; **Cross-cultural views on Nature:** The relationship between humans, nature and adaptation. Theoretical frameworks of cultural and social ecology; debates on culture/nature divide.
- Unit-III:** **Environment and Business Ethics:** Foundations of Environmental Ethics for Business, Corporate Environmental Ethics, Environmental Disclosure, Social and Ethical Issues for Sustainable Development, Business Ethics and Corporate Environmental Performance; **Environmental Ethics and Issues of National and International Governance:** changing nature of environmental ethics in relation to international and national paradigms of environmental governance.
- Unit-IV:** Resource consumption patterns and the need for equitable utilization; Equity disparity in the northern and southern countries; Urban – rural equity issues; Need for gender equities; Preserving resources for future generations; The ethical basis of Environmental education and awareness; The conservation ethics and traditional value system of India.

Suggested Literature:

1. Aggarwal Anil & Narain Sunita, 1991, Global warming in an unequal world: A case of environmental colonialism, Centre for Science & Environment.
2. Cooper, D.E. & Palmer, J.A., (Ed.), 1992, The Environment in question: Ethics & Global Issues, London, Routledge.
3. Des Jardius, J.R., 2001, Environmental Ethics: An invitation to Environmental philosophy (3rd Ed.), Wadsworth Publ., Belmont, California.
4. Grim, John, A., 2001, Indigenous Traditions and Ecology (Ed.), Harvard University Press.
5. Granda, J.B. and Schilizzi, S.G. M., 2001, The Environment in Corporate Management: New Directions and Economic Insights, Edward Elgar, UK.
6. Vandaveer, D.C.P. and Vandaveer, D., 2002, The Environmental Ethics and policy book: Philosophy, Ecology, Economics (3rd Ed.), Wadsworth publishing, California.

[Handwritten signatures and initials are present below the suggested literature list.]

ENV 402: DISASTER MANAGEMENT

THEORY

- Unit-I: Overview of disaster management: Emergency, Disaster, types of disaster, implication of disasters on your region and environment, Catastrophic geological hazards, study of floods, draughts, earthquakes, landslides, avalanche and volcanoes, prediction and perception of hazard and adjustment to hazardous activity; Disaster management cycle: mitigation (structural constructions and non structural activities), Preparedness (disaster risk reduction and emergency operation plans), Response, Recovery, Role of Technology, Media, Education and Public awareness in Disaster management, Physical and socioeconomic impact of disaster, Emotional impact of disaster, vulnerable groups in disaster.
- Unit-II: Volcanoes: nature, extent and causes of volcanism, Types of volcanoes, volcanic materials, geographic distribution of volcanoes, Case study; Earthquakes: cause, intensity and magnitude of earthquakes, geographic distribution of earthquake zones, seismic waves, travel time and location of epicenter, prediction and perception of hazard, implications on the environment, Action plan for earthquake disaster mitigation, Case study: Uttarkashi earthquake (implication and lesions), Latur (Killar) and Gujarat earthquake experiences.
- Unit-III: Landslides, mudflow and avalanche: cause, human activities and landslides, implications on the environment, prevention, Mitigation plans, case study; Floods: cause, nature and frequency of flooding, nature and extent of flood hazard, urbanization and flooding, effect of flooding, flood mitigation methods, case study; Draught: Causes, implications on the environment, Draught management through anticipatory multi-dimensional approach, case study.
- Unit-IV: Coastal hazards: tropical cyclone and tsunamis, Cause, nature and implications on the environment, coastal erosion, sea level changes and its impact on coastal areas, case study; Disaster associated health issues: Causes, Communicable diseases common according to disaster, Action plan to monitor evaluate and control health issues.

Suggested Literature:

1. G.H. F.G. E & FN Spon, 1999, Geological Hazards: Their Assessment, Avoidance and Mitigation, e Books der ULB Darmstadt.
2. Burton, I, Kates, R.W and White, G.F, 1993, Environment as Hazard Guilford Press.
3. Czeplak, R and Margottini, C. (Ed.), Springer, 2004, Natural Disasters and Sustainable Development
4. Hewitt, K., 1997, Regions of risk, Longman Press, 32
5. Henry J.G. and Heinke, G.W., 2004, Environmental Science and engineering, Pearson Education, Delhi, India.
6. Keller, Edward A, 1996, Introduction to Environmental Geology, Prentice Hall, Upper Saddle River, New Jersey
7. Smith Keith, 2001, Environmental Hazards: Assessing Risk and Reducing Disaster, Cambridge

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ENV 403: ENVIRONMENTAL ECONOMICS, POLICIES AND LAW THEORY

- Unit-1: Environmental Statement (ES), ES of Govt. of India and its contents: Introduction of Environmental audit, Guidelines and methodology, purpose and needs, Natural resource accounting for Indian condition, Economic development and environmental impact, Joint forest management for optimal property rights, Chipko experience and directive of economics and environment Irrigation projects and Environmental costings, some analytical techniques and policy, Economic value of India's forest stock and economics of forest production in India.
- Unit-2: Convention on Conservation of Antarctic marine (1980) and mineral resources, Treaty on principles governing the activities of state in the exploration and use of outer Space (1967), The citizens convention on biodiversity/ biological (1992), International convention on the high seas and fishing and living resources (1958) and Intervention of oil pollution casualties (1969);
- Unit-3: Environmental policies and laws: Introduction to International Environmental Law (Stockholm to ^{E.O.}), Introduction to National Law (Constitution and other relevant statutes), Air Act 1986 (prevention and control of pollution), water (prevention and control of pollution) act 1974, as amended 1988 and rules 1975 convention of International Trade in Endangered species of wild fauna and flora (CITES), Motor vehicle act, 1988.
- Unit-4: Forest Act 1927; Forest Conservation Act, 1980; Environmental Protection Act, 1986 and Rules 1986; Wild Life Protection Act 1972; Public Liability Insurance Act 1991; National Environmental Tribunal Act 1995.

Suggested Literature:

1. Principles of Environmental Economics, A. Hussen
2. Issues in Environmental Economics, N. Hanley & C. J. Roberts
3. Environmental Economics, M. S. Randhawa.
4. Environmental Protection Law and Policies in India, K. Thakur.
5. Environmental Law, G. Kaur.
6. Environmental Laws in India, A.K. Tiwari

[Handwritten signatures and initials are present below the suggested literature list.]

THEORY

- ### Suggested Literature

1. Elliot David, 2003, *Energy, Society and Environment, Technology for a Sustainable Future*, Routledge
2. Jasanoff Sheila, 2002, *New Modeenities: Reimagining Science, Technology and Development*, In *Environmental values*.
3. Jasanoff Sheila, 2003, *Technologies of Humility: Citizen participation in governing science*, In *Minerva*.
4. Juma, C. Konde, V., 2002, *Technical change and sustainable development, Developing country perspectives*, American association for the advancement of science (AAAS).
5. Makofske, W.J. and Karlin, E.F., 1995, *Technology and Global Environmental issues*, Addison Wesley Longman, Toronto.
6. Mawasley, E., 2004, *India's middle classes and the environment development and change*.
7. Vernon W. Ruttan, 2000, *Technology, Growth, and Development: An Induced Innovation Perspective*, Oxford University Press, New York.
8. Viswanathan Shiv, 2000, *Environmental values, Policy and conflict in India*, Strategiccouncil.org

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ENV 405 – TWO SEMINARS

Subject of the Seminar will be assigned to each student at the end of **Semester II** and goes until **Semester IV**. It would be theoretical and not involve any laboratory components. It will be evaluated for 35 marks.

ENV 406 – DISSERTATION

Subject of the dissertation will be assigned to each student at the end of **Semester II** and goes until **Semester IV**. It would be theoretical and not involve any laboratory components. It will be evaluated for 35 marks.

ENV 407 : PROJECT WORK

Assigned at the end of **Semester II** and goes until **Semester IV**. It may be laboratory as well as field based work. It will be evaluated for 70 marks (50 marks for project work and its presentation and 20 marks on the viva voce based on the project work).

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