The University of Burdwan
Syllabus for B.Sc. Honours
(1+1+1 Pattern)
in
Environmental Science
with effect from 2005-2006 onwards

HONOURS SYLLABUS FOR 3 - YEAR DEGREE (HONOURS) IN ENVIRONMENTAL SCIENCE

(with effect from the Session:2005-2006 onwards)
Total Marks - 800
Theoretical – 500 (Part I -200, Part-II – 100, Part-III - 200)
Practical – 300(Part II – 100, Part- III- 200)

	Part I		
Papers	**Subject**	**Full Marks**	**Time**
Paper-I		**100**	**4 hours**
Gr-A	**Fundamentals of Environment**	**50**	
Gr-B	**Environmental Biology**	**50**	
Paper-II		**100**	**4 hours**
Gr-A	**Environmental Chemistry**	**50**	
Gr- B	**Environmental Physics**	**50**	
	Part II		
Paper-III		**100**	**4 hours**
Gr-A	**Environmental Pollution-I**	**50**	
Gr- B	**Earth Sciences**	**50**	
Paper-IV	**Practical**	**100**	**6 : 30 hours**
	Part III		
Paper-V		**100**	**4 hours**
Gr-A	**Resources and its Economy**	**50**	
Gr-B	**Environmental Management**	**50**	
Paper-VI		**100**	**4 hours**

Gr-A	**Environmental Laws, Policy and EIA**	**50**	
Gr-B	**Environmental Health, Accounting & Auditing**	**50**	
Paper-VII	**Practical**	**100**	**6 : 30 hours**
Paper-VIII	**Practical**	**100**	**6 : 30 hours**

PART- I
PAPER- I (Theoretical)

Time : 4 hours **Full marks: 100**

Gr-A
Fundamentals of Environment

Lectures - 50

Marks - 50

I Concept of Environment: Concepts, ideas, and types and components of environment; objectives, historic roots, nature and scope of the subject, need for environmental studies, man-environment relationships, moral and aesthetic nature of environmental science; environmental perspectives, ecofeminism, sustainability and carrying capacity

II Environmental Education : Goals of environmental education, guiding principals; environmental literacy, environmental careers, environmental justice, individual organisms, radical environmental groups, environmentalism, green politics, green plans, Environmental education at primary, secondary and tertiary level

III Matter, Energy and Life

Cell **–** Fundamental units of life, ultrastructure and functions of plasma membrane, cellular organelles *e.g.*, mitochondria, ribosome, Golgi body, chloroplast, edoplasmic reticulum, nucleus

Energy **–** Energy types and qualities, energy and heat, energy capture by photosynthesis, energy flow, light energy, solar energy, nuclear energy and environment; energy sources and consumption, energy conservation, energy policy.

Life **–** Biological evolution of life on earth, Darwinism and modern synthetic theory of evolution; isolating mechanism and speciation; biochemical basis of origin of life; interaction between species; Hardy Weinberg Equilibrium; genetic drift

Gr- B

Environmental Biology

Lectures - 50

Marks - 50

I Taxonomy: Definition of taxonomy, systematics and classification; morphological and taxonomical studies of flora and fauna

II Concepts of Ecology : Subdivisions and developmental phases of ecology, ecological classification (hydrophytes, xerophytes, halophytes, mesophytes, lithophytes, chosmophytes, epiphytes) and their morphological, physiological and biochemical adaptation, ecological factors - climatic, edaphic, physiographic and biotic Autecology - botanical, identification, distribution, phonological studies etc Synecology - basic ideas, definition, food chains, food webs and trophic levels

III Concepts of Ecosystem: Types, structural and functional aspects of major ecosystems, ecological pyramids, productivity, community structure and characters, predation, competition, symbiosis, defensive mechanism, resilience and stability

IV Population ecology : Characteristics, dynamics, growth, human population & growth, world population

V Biotic Community : Definition, characteristic, ecotone and edge effect, habitat and ecological niche, ecotypes, ecophene , ecological indicators; elementary idea on biogeochemical cycles, natural ecosystems *e.g.*, Sundarbans Mangroves, Indian Mangroves, Beach forests, estuaries; forest classification of India.

VI Biogeography: Endemism, phyto – and zoogeographical realms, biomes (terrestrial and transitional)

PART- I

PAPER- II (Theoretical)

Time : 4 hours **Full marks: 100**

Gr- A

Environmental Chemistry

Lectures - 50

Marks -50

I Fundamental Concepts of General Chemistry : Molecular weight, equivalent weight, molarity, normality, valency, oxidation state and bonding, oxidation and reduction reactions, metals and nonmetals, aromatic and aliphatic organic compounds saturated and unsaturated hydrocarbons

II **Chemical Equilibrium and Kinetics Fundamentals:** Stochiometry, chemical equilibrium, Gibbs energy, chemical potential, acid-base reactions (acidity, alkalinity, buffers and buffer capacity), solubility product

III **Aquatic Chemistry:** Principles of sedimentation, coagulation, filtration and absorption processes Distinguish between surface water according to their chemical compositions

IV **Atmospheric Chemistry :** Structure of the atmospheres, classification of elements, particles, ions and radicals in the atmosphere. Chemical processes for formation of inorganic and organic particulate matter

V **Chemical Analytical Methods :** Sampling, preservation, storage and processing techniques. Principle and application of titrimetry, gravimetry, potentiometry, spectrophotometry, conductimetry

Gr- B
Environmental Physics

Lectures - 50

Marks - 50

I **Dynamic Meteorology :** First and Second law of thermodynamics, entropy, enthalpy, free energy, chemical potential, heat transfer processes. Diffusion and transport of pollutants in air

II **Environmental Biophysics :** Energy budget concept: Radiation energy fluxes, metabolism of latent heat exchange energy, equilibria between biotic and abiotic environmental components

III **Radiation Physics :** Radioactivity, radioactivity disintegration, units of radioactivity, characterization of various rays. Application of radio-isotopes, nuclear radiation

IV **Techniques related to Environmental Physics :** Ultrasound-characteristics, measurement and applications, acoustic radar, application of Laser radiation

V **Application of Statistics in Environmental Sciences :** Mean, mode, median, standard error and deviation. Probability, correlation and regression, advantages of sampling, sampling unit, random sampling, estimation of sample size

PART- II
PAPER- III (Theoretical)

Time : 4 hours **Full marks: 100**

Gr- A
Environmental Pollution-I

Lectures - 50

Marks - 50

I **Understanding Pollution :** Definition, pollutants, global pollution, pollution in underdeveloped countries, poverty, and population

II **Air Pollution :** Ambient air pollutants—primary and secondary and particulate matter, HAPs(hazardous air pollutants), smog, *El Nino* phenomenon, pollution from fossil fuels, Indoor pollution

III **Water Pollution :** Water pollutants, direct and indirect sources, impact of pollution on water bodies—groundwater, coastal, wetlands, drinking water standards

IV **Wastes :** Sources, characteristics, types, and fate of solid wastes

V **Metal pollution:** Metals in soil, food and water, sources of metal pollution, and elementary idea on metal pollution

VI **Noise Pollution :** General features, measurement of noise, human acoustics, noise classification, effects of sound pollution

VII **Radiation Pollution :** Man-made radiation, radiation hazards, nuclear accidents

VIII **Pesticide Pollution :** Definition categories, pesticides in water, effects, bioaccumulation and biomagnification, toxicity, alternative pesticides

IX **Soil Pollution :** Sources, types, effects of soil pollution

PAPER- III (Theoretical)

Gr- B
Earth Sciences

Lectures - 50

Marks - 50

I **Earth Processes :** Origin and evolution of earth, geological time scale, continental drift

II **Climatology :** Elements of climates, spatial and temporal patterns of climate, climate parameters in India and climatic classification

III **Earth resources :**Mineral resources, classification, Processing of minerals and environment.

Water resources, the hydrological cycles, geological formation as aquifers, type of aquifers and groundwater basin

IV **Soil :** Weathering processes and soil formation. Soil profile development, chemical and mineralogical composition of soil, types of soil in India, basic concept of physical and chemical properties of soil

V **Natural Hazard :** Basic concept of natural hazards, *e.g*., flood, earthquake and landslide in Indian context

VI **Remote Sensing :** Elementary idea of remote sensing

PART- II
PAPER- IV (Practical)

Time-6 : 30 hours **Full Marks-100**

Description of Items
Distribution of Marks

1) One Major experiment

20

2) One Minor experiment

15

3) One preparation/fixation/mounting/staining

15

4) Identification with reasons (4 items)

12

5) Submission of Field report

20

6) Laboratory Note Book

06

7) *Viva voce*

12

Practical Courses

1) **Major Experiments**

a**) Estimation of water parameters—Temperature, pH, conductivity (Secchi disk), DO, free CO_2, combined CO_2, salinity, hardness, alkalinity, acidity, chloride**

b) **Estimation of soil parameters—pH, acidity, alkalinity and organic carbon**

2) **Minor experiments**

a) **Determination of Soil parameters—Colour, density, porosity, temperature and conductivity**

3) a**) Process of narcotization, preparation of fixatives and staining materials—Bouin's, Neutral Formalin Carnoy's (Fixatives) ; Eosin-Haematoxylin, Aceto-carmine, Methylene blue (Stains)**

b) **Cytological preparation of salivary gland chromosome of *Drosophila* or Chromosome of *Chironomus***

c) **Identification of Meiotic stages from grasshopper testis**

4) **Identification with reasons of the following (at least two from each a & b must be set during examination)**

a) **Study of microfauna of water (identification of plankton), *viz.*, *Brachionus, Keratella,* *Cyclops, Cypris, Diaptomus,* Nauplius larva, *Bosmina, Moina, Eubranchipus***

b) **Study of aquatic flora, *viz.*, Pistia, Eichhornia, Hydrilla, Ceratophyllum, Ipomoea, Azolla, Lemna(minor and major), Limnophilia, Marsilia, Nympha, Nelumba**

5) **Submission of field report**

a) **Flora and fauna of the localities**

b**) Description and identification of plant species**

c**) Study of soil types**

6) **Laboratory note book**

7) ***Viva - voce***

Suggested Books

1. **Environmental Science : S.C.Santra , new Central Book Agency**
2. **Pollution Prevention : Fundamentals and Practice Int. Ed.-2000, Paul L. Bishop, Mc Graw Hill'**

3. **A text book of Environmental Chemistry and Pollution Control : S.S.Dara., S.Chand & Company Ltd.**
4. **Ecology and Environment : P.D. Sharma., Rastogi Publication.**
5. **Fundamental of Ecology : E.P.Odum.,W.B.Sauders Company,USA**
6. **Microbiology; Pelzar, M.J.,Chan, E.C.S. and Kreig, N.R., Mc Graw-Hill Publishing Company**
7. **Wastewater Microbiology; Bitton, G.,John Wiley, NY**
8. **Environmental Chemistry : A.K.De, New age(p) Ltd.**
9. **Chemistry for Environmental Engineering : Clair N Sawyer, Perry L. Mccarthy & Gene F. Parkin., Mc Graw – Hill lnc.**
10. **Standard Methods for the Examination of Water and Wastewater 20th eds. ; Lenore, S.Clesceri, Arnold E.Greenberg, Andrew D. Eaton; American Public Health Association**
11. **Clean technology, Johansson, A., Lewis Publishers.**
12. **Zero Pollution Industry, Nemerow, N.L. Wiley Intersciences**
13. **Industrial Pollution Prevention Handbook, Freeman, H.M., McGraw Hill**
14. **Environmental Impact Assessment, Canter, L. McGraw Hill**
15. **The Economic Approach to Environmental & Natural Resources, James R. Kahn., George Proval**
16. **Economics of Environment, Dorfman and Dorfmann**
17. **Hazardous Waste Management, M.D.Lagrega et al., McGraw Hill**
18. **Landfill Waste Pollution and Control, Kenneth Westlake., Albion Publishing**
19. **Hazardous waste Management, Wentz, C.A., McGraw Hill**
20. **Biology of Wastewater Treatment, Oxford Gray, N.F., University**

PART- III
PAPER- V (Theoretical)

Time : 4 hours **Gr- A** **Full marks: 100**

Resources and its Economy

Lectures (50)

Marks - 50

I **Resources :** Definition, classification and status of major natural resources. Ideas on some major resources, *viz..,* water, land, biological, fishery, energy, wildlife, ocean, forest, human resources—a brief study.

Use of resources for sustainable lifestyles, effects of population growth on resource depletion

II **Conservation of Resources :** Value of natural resources, conservation of mangrove forest, conservation of coral reefs, conservation of water, land resources, conservation of agricultural ecosystem, afforestation and eco-

development, joint forest management, conservation of wild life resources in India

III **Environmental Economics :** Environmental economics - concept, scope and interrelation, concept of supply and demand
Environmental economics and environmental policy; or environmental economics and ecological economics. Environmentalism and economic growth
Indicators-sustainable accounting-environmental ;Kuznet'ss curve. Economics of pollution control; environmental accounting of natural resources. Cost : benefit analysis

Gr- B

Environmental Management

Lectures - 50

Marks - 50

I **Principles of Management :** Definition and concept on environmental management, environmental quality measurement, Environment Quality Index, environmental management system; certification for EMS
Management of sustainable development: Principles from Rio declaration Business charter for sustainable development
Functions of management: Forecasting, planning, organizing, motivating, coordinating, controlling, and communicating, leadership, directing, and decision making

II National Committee on Environment Planning and coordination

III Management of air pollution, water pollution, noise pollution, water pollution management issues and Indian scenario, strategies for sustainable water management; Ganga Action Plan (GAP) , Yamuna Action Plan (YAP)

IV Integrated system for waster management, Municipal Solid Wastes (MSW), management of biomedical wastes, plastic waste management, management of hazardous wastes, biosafety Protocol.
Management of forests; Forestry and Agenda 21

PART- III

PAPER- VI (Theoretical)

Time : 4 hours **Gr- A**

Full marks: 100

Environmental Laws, Policy and EIA

Lectures - 50

Marks - 50

I **Laws & Policies :** Policy statement on environment and development; Public Policy and PILs, role of NGOs, Environmental Policy Act, Environmental provisions in the Indian Constitution
Water and air pollution boards; Air (Prevention and Control of Pollution) Act, 1981; The Water (Prevention and Control of Pollution) Act, 1974; Cess Act, 1977; The River Boards Act, 1956
The Noise Pollution(Regulation and Control) Rules, 2000
Factories Act, 1948
Industrial (Development and Regulation) Act, 1951; Mines and Minerals (Regulation and Development) Act, 1957
Wildlife Protection Act, Forest Conservation Act,
National Forest Policy of 1952, National Forest Policy of 1988

II **Environmental Impact Assessment :** Environmental Impact Assessment; goals of impact assessment; evolution of impact assessment; ecological impact assessment; hazard and risk assessment; technology ass ; essment; Environmental inventory; Life Cycle Assessment, the methodology of LCA; Eco-auditing; eco-labeling. Public involvement with impact assessment; a brief idea about impact assessment process; techniques and methods; application of impact assessment to related sectors. Evaluation methodology. EIA at the International level
National Committee on Environmental Planning and Coordination (NCEPC) under DST and replacement of National Committee on environmental planning
Indian National Environmental Policy

Gr- B

Environmental Health, Accounting & Auditing Lectures - 50 Marks - 50

I **Environmental Health :** Concept of health and disease, principles of epidemiology and epidemiological methods - aims of epidemiology; measurement of mortality, measurement of morbidity

II **Diseases :** Concept of screening the diseases, some communicable diseases like small pox, cholera, acute diarroheal disease, viral hepatitis, Water-borne pathogens, vector-borne diseases, diseases caused by contaminated food and water, soil-borne infections, insect-borne diseases . Immunology - elementary idea about antigens and antibody; hypersensitivity, allergic reactions, pollen and their allergens

III **Health Programs :** Health Programs in India, demography and family planning; nutrition and health, occupational health, mental health, communication for health education, health care of the country

IV **Environmental Accounting & Auding :** Environmental accounting, objectives of environmental accounting, financial accounting, social accounting, accounting

for environmental sustainability, accountability and transparency. Accountants and environmental attitudes

Overview of environmental audit, the environmental survey, developing the environmental audit, eco-management and audit scheme; typical audit programme, benefits of environmental auditing; environmental audit programme in India; ICC basic steps of an environmental audit

Books

1) **Agrawal, Sikdar and Deb (2002) : A Text book of Environment; MacMillan**
2) **Fischer (1984) : Resources and Environment Economics, CUP**
3) **Dasgupta (1982) : The Control of Resoursces; Basil Blackwell**
4) **Georgeacus-Roger (1971) : The Entropy Law and Economic Process ; HUP**
5) **Concard and Clerk(1987): Natural Resources Economics; CUP**
6) **Pearce and Turner(1991): The Economics of Natural Resource and Environment, Harvester & Wheatsheaf**
7) **Dasgupta and Heal(1979): Economic Theory of Exhaustible Resources; CUP**
8) **Kneese & Sweeny(1993): Handbook of natural Resource and Energy Economics/3 Volumes; North-Holland**
9) **Crooper & Dates(1992): Environmental Economics: A survey/OEL**
10) **Dorfman & Dorfman(1994): Economics of Environment/3**
11) **Parikh(1993): Natural Resources Accounting : A Framework for India**
12) **Botkin & Keller(1998): Environmental Science : Earth as a Living Planet; John Wiley & Sons**
13) **Barrow (1997) : Environmental and Social Impact Assessment: An Introduction, John Wiley & Sons**
14) **Canter (1996): Environmental Impact Assessment; McGraw-Hill, Inc**
15) **Charles D Kolstad (2000): Environmental Economics, Oxford University Press**
16) **Park (2005): Preventive and Social Medicine; M/S Banarsids Bhanot**
17) **Kolstad(2000): Environmental Economics; OUP**

PART- III
PAPER- VII (Practical)

Time : 6 : 30 hours **Full marks: 100**

Description of Items
Distribution of Marks

1) **One Major experiment** **20**

2) One Minor experiment
15
3) Introduction to computer software
15
4) Interpretation of satellite imagery
10
5) Analytical report
20
6) Laboratory Note book
08
7) *Viva - voce*
12

Practical Courses

1. **Major Experiments**
   a) Estimation of water parameters: Iron, phosphate, sodium, potassium, residual chlorine b) Staining and counting of zooplankton
   c) Estimation of soil parameters—N,P,K
2. **Minor Experiments**
   a) Estimation of TSS, TDS of water
   b) Estimation of moisture (%) from soil sample
   c) Colony counting and gram staining of bacteria
   d) Preparation of basic liquid/solid media for culture of bacteria
3. **Introduction to computer software (MS-Office)**
4. **Visual interpretation of satellite imagery**
5. **Submission of Analytical report**
   a) Physico-chemical characterization of municipal/industrial/agricultural water
   b) Biodiversity of the locality
   c) Quantitative character of plant community, density, frequency dominance
   d) Soil profile
6. **Laboratory note book**
7. ***Viva voce***

PART- III
PAPER- VIII (Practical)

Time : 6 : 30 hours Full marks: 100

Description of Items
Distribution of Marks

1) One Major experiment
20
2) One experimental Study (Major)
15

3) One experimental Study (Minor)
15
4)) Study of meteorological parameters
10
5) Educational tour
20
6) Laboratory Note Book
08
7) *Viva - voce*
12

Practical Courses

1) Major experiments

a) Estimation of protein, carbohydrate, fat
b) Estimation of chlorophyll from green leaves

2) Major Studies

a) Principal and measurement technique of BOD and COD
b) Principal and monitoring of technique of air quality (SOx,NOx,SPM)
c) Principal and techniques of heavy metal toxicity test on plants and animals
d) Principal and measurement technique of primary productivity

3) Minor Studies

a) Model of rainwater harvesting system
b) Model of watershed system
c) Principal and measurement technique of noise
d) Principal and measurement technique of MPN test

4)) Study of meteorological parameters *viz*., rainfall, relative humidity, wind velocity, temperature

5) Educational tour (related to Industry / Mining/ Forestry)

6) Laboratory Note Book
7) *Viva - voce*