

University of Kalyani

Syllabus and Regulations for 3 Years B.Sc. (Honours)

Course in Environmental Science

According to the New Examination Pattern

Part – I, Part – II & Part – III

Total Marks - 800

Theoretical: 540 (Part I – 150, Part II – 150 and Part III – 240)

Practical: 260 (Part I – 50, Part II – 50 and Part III – 160)

With Effect from the Session 2016 – 2017

University of Kalyani

Syllabus for 3-years B.Sc. (Honours) Course in Environmental Science
(w.e.f. the session 2016-2017)

Content

Paper	Topics	Page No.
	Detailed Marks Divisions	i
	Course Structure (Summary)	ii, iii
Part I		
Paper I (Theoretical)	Unit I : Fundamentals of Environmental Science Unit II : Environmental Biology Unit III : Environmental Chemistry	H-1 H-1 H-2
Paper II (Theoretical)	Unit I : Environmental Physics Unit II : Environmental Geology Unit III : Environmental Geography	H-2 H-3 H-3
Paper III (Practical)	Major and Minor Experiments, Identification relating to Environmental Biology, Environmental Chemistry and Environmental Physics, Field Studies, Lab Records and Viva Voce.	H-3 H-4
Part II		
Paper IV (Theoretical)	Unit I: Environmental Pollution Unit II: Environmental Physiology Unit III: Environmental Toxicology and Environmental Health	H-5 H-5 H-6
Paper V (Theoretical)	Unit I : Environmental Management Unit II : Remote Sensing and GIS Techniques – Application. Unit III : Soil Science	H-6 H-6 H-7
Paper VI (Practical)	Major and Minor Experiments, Identification relating to Environmental Geology & Geography, Environmental Pollution and Environmental Physiology, Field Study, Lab Records and Viva Voce.	H-7
Part III		
Paper VII (Theoretical)	Unit I : Environmental Laws, Rules, Policies and Movements Unit II : Environmental Economics Unit III : Environmental Statistics and Mathematical Modeling	H-8
Paper VIII (Theoretical)	Unit I : Environmental Microbiology and Environmental Biotechnology Unit II : Social Environmental Issues and Management Unit III : Environmental Technology for Pollution Control	H-9 H-9 H-9
Paper IX (Theoretical)	Unit I : Energy Management Unit II : Instrumentation and Analytical Techniques Unit III: Resource Assessment and Conservation	H-10 H-10 H-10
Paper X (Practical)	Major and Minor Experiments relating to Remote Sensing Study, Toxicology, Statistics and Viva Voce.	H-10
Paper XI (Practical)	Major and Minor Experiments relating to Environmental Microbiology and Environmental Biotechnology	H-11
	Suggested Reading	H-12

University of Kalyani

Syllabus for 3-year B.Sc. (Honours) Course in Environmental Science

Total Marks-800

Theoretical 540 (Part I -150, Part II-150 and Part III-240) and
Practical 260 (Part I-50, Part II-50 and Part III-160)

Detailed Marks Divisions

Part-I		
Paper I (Theoretical)	75 marks	Unit I- 25 marks Unit II- 25 marks Unit III- 25 marks
Paper II (Theoretical)	75 marks	Unit I- 25 marks Unit II- 25 marks Unit III- 25 marks
Paper III (Practical)	50 marks	
Part-II		
Paper IV (Theoretical)	75 marks	Unit I- 25 marks Unit II- 25 marks Unit III- 25 marks
Paper V (Theoretical)	75 marks	Unit I- 25 marks Unit II- 25 marks Unit III- 25 marks
Paper VI (Practical)	50 marks	
Part-III		
Paper VII (Theoretical)	80 marks	Unit I- 30 marks Unit II- 25 marks Unit III- 25 marks
Paper VIII (Theoretical)	80 marks	Unit I- 30 marks Unit II- 25 marks Unit III- 25 marks
Paper IX (Theoretical)	80 marks	Unit I- 30 marks Unit II- 25 marks Unit III- 25 marks
Paper X (Practical)	80 marks	
Paper XI (Practical)	80 marks	

[Each Theoretical Papers (75 / 80 marks) will be of 3/4 hours duration and each Practical paper (50 or 80) marks will be of 4/6 hours duration in examination]

Course Structure (Summary)

Part I

Paper	Topics	Full Marks
Paper I (Theoretical)		75
	Unit I : Fundamentals of Environmental Science	25
	Unit II : Environmental Biology	25
	Unit III : Environmental Chemistry	25
Paper II (Theoretical)		75
	Unit I : Environmental Physics	25
	Unit II : Environmental Geology	25
	Unit III : Environmental Geography	25
Paper III (Practical)	Major and Minor Experiments, Identification relating to Environmental Biology, Environmental Chemistry and Environmental Physics, Field Studies, Lab Records and Viva Voce	50

Part II

Paper	Topics	Full Marks
Paper IV (Theoretical)		75
	Unit I : Environmental Pollution	25
	Unit II : Environmental Physiology	25
	Unit III : Environmental Toxicology and Environmental Health	25
Paper V (Theoretical)		75
	Unit I : Environmental Management	25
	Unit II : Remote Sensing and GIS Techniques – Application	25
	Unit III : Soil Science	25
Paper VI (Practical)	Major and Minor Experiments, Identification relating to Environmental Geology & Geography, Environmental Pollution and Environmental Physiology, Field Study, Lab Records and Viva Voce	50

Part III

Paper	Topics	Full Marks
Paper VII (Theoretical)		80
	Unit I : Environmental Laws, Rules, Policies and Movements	30
	Unit II : Environmental Economics	25
	Unit III : Environmental Statistics and Mathematical Modeling	25
Paper VIII (Theoretical)		80
	Unit I : Environmental Microbiology and Environmental Biotechnology	30
	Unit II : Social Environmental Issues and Management	25
	Unit III : Environmental Technology for Pollution Control	25
Paper IX (Theoretical)		80
	Unit I : Energy Management	30
	Unit II : Instrumentation and Analytical Techniques	25
	Unit III : Resource Assessment and Conservation	25
Paper X (Practical)	Major and Minor Experiments relating to Remote Sensing study, Toxicology, Statistics and Viva Voce	80
Paper XI (Practical)	Major and Minor Experiments relating to Environmental Microbiology and Environmental Biotechnology	80
Total		800

(Theoretical - 540 Practical - 260)

B.Sc. Honours Course in Environmental Science

Part I

Paper I, Paper II & Paper III

Detailed Syllabus (Course Contents)

Part I

Paper I: (Theoretical): 75 Lectures

Total -75 marks

Unit I: Fundamentals of Environmental Science

(25 marks)

1. Understanding of Environment: Concept, ideas and components of environment; historical root, nature and scope of environmental science, man - environment interrelationships, moral and ethical issues in Environmental science, sustainability, carrying capacity.
2. Matter, Energy and Life: Elements - the material basis of life, origin and evolution of life on earth; Evolution theories (modern) and speciation mechanism; characteristics of living cells (prokaryotic and eukaryotic); responses of physical environment on living system: Energy in biosphere - sources, energy forms and energy acquisition mechanisms in living systems.
3. Environmental processes: Understanding of weather and climate changes with timescale; human response to climate change.
4. Environmental education and awareness: Goal, objectives and guiding principle, environmental literacy- formal and informal environmentalism, environmental awareness and role of NGOs, environmental movements, Green politics, National and International efforts on environmental protection and conservation.

Unit II: Environmental Biology

(25 marks)

1. Diversities of lifeforms: Concept of taxonomy, systematic and classification with respect to plant kingdom, animal kingdom and microbial world.
2. Basic understanding of Ecology: Concepts, rules in ecology, ecological factors and response of plants and animal life.
3. Community Ecology: Succession process, community analysis, ecological niche, ecotone, ecotype and biological indicators.
4. Biodiversity: Types, values, threats, conservation needs, monitoring and measurement techniques; Biodiversity status in India and its conservation practices; Bioprospecting, biopiracy, patents, TRIPS, CBD and bioethics.
5. Ecosystems: Concept, types, structure and functional aspects of major ecosystems, energy flow, ecological pyramids, productivity in ecosystems, stability and resilience in ecosystem, status of major ecosystems of India.

6. Forest and Wildlife: Values and major categories of forest and wildlife habitats, threats to forest ecosystem. Conservation of forest and wildlife.
7. Population Ecology: Structure, Natality, Mortality and growth, population dynamics - fluctuation, cycles and chaos.
8. Biogeography: Endemism, biomes of the world. Biogeographical regions of India.

Unit III: Environmental Chemistry

(25 marks)

1. Elements: Classification, properties, distribution and importance in biological system; bioinorganic complexes and their importance.
2. Fundamentals of chemical equilibrium and reaction kinetics, Order and Molecularity of a reaction, Stoichiometry, Laws of thermodynamics, enthalpy, free energy, chemical potential and entropy; acid base reaction, solubility product.
3. Fundamentals of aquatic chemistry: Composition and properties of water, water quality and quantity; water acidity and carbon dioxide in water, characteristics of water bodies, surface water, ground water, brackish water, marine water and their properties.
4. Chemistry of atmosphere: Composition of atmospheric layers, atmospheric processes and reactions of gases and particulates, atmospheric turbidity.
5. Principles of sedimentation, coagulation, filtration and adsorption processes.
6. Basic concept of colloid chemistry.

Paper II: (Theoretical): 75 Lectures

Total -75 marks

Unit I: Environmental Physics

(25 marks)

1. Dynamic Meteorology: Atmospheric stability, Temperature inversion, heat transfer process, diffusion and transport of air pollutants.
2. Environmental Biophysics: Energy budget concept, radiation energy fluxes, energy flow model.
3. Radioactive Radiation: Source, characteristics and its biological effects, radiation in diagnosis and therapy of diseases. Use of radioisotopes in environment.
4. Atmospheric Physics: Basic knowledge of climatological parameters for environmental study, cloud formation and categories, artificial cloud seeding techniques.
5. Equipments: Dry and wet bulb, Hygrometer, Anemometer, Pyranometer, Wind vane, Radiosonde package. Basic principle of weather Radar.

Unit II: Environmental Geology**(25 marks)**

1. Fundamentals of Geology: Origin, evolution of earth, composition of earth, common rocks and minerals, major endogenic and exogenic processes, geological agents of changing environment viz. tectonics, magmatism, weathering, erosion and deposition; common geological structures - bedding, fold, faults, cleavages, schistosity, fractures.
2. Geomorphology: Forms and related processes; Different types of landforms, Pedogenesis, Coastal geomorphology: An overview.
3. Hydrogeology: Hydrological cycle: Aquifer, water balance, water flow hydraulics, artificial recharge and rain water harvesting, Watershed concept, water resource management.
4. Natural hazards and disaster management: Natural and Man made disasters - Types, causes, onset, impacts, forecasting and managements (viz. earthquake, flood, drought, cyclone, tsunami, volcanism, landslide). Environmental hazards related to mining processes.

Unit III: Environmental Geography**(25 marks)**

1. Concept of Environmental Geography: Man's modification of environmental systems.
2. Environmental Degradation: Concept, deforestation, agricultural activities, urbanization.
3. Meteorological Parameters: Temperature, humidity, rainfall, wind speed and direction, sunshine hour, atmospheric pressure, cloud cover, Numerical forecasting, Indian climate monitoring systems.
4. Tropical Monsoon: Causes and impacts; impacts of climate change on tropical monsoon.
5. Landuse: Concept, urban and rural land use policy, landuse planning- An overview. Changes in landuse - landcover through time.

Paper III: (Practical):**Total -50 marks****Distribution of Marks**

1. Major experiment (one)	20 marks
2. Minor experiment (one)	10 marks
3. Identification (two)	5 marks
4. Field study record (at least one field visit)	5 marks
5. Laboratory records	5 marks
6. Viva voce	5 marks

Major experiments:

1. Estimation of various water quality parameters - Alkalinity, hardness, dissolved oxygen, chloride, phosphate, nitrate, sulphate, iron.
2. Studies on plankton (phyto and zooplanktons of water samples).

Minor experiments:

1. Preparation of meteorological graphs, charts or windrose.
2. Measurement of pH and conductivity of soil and water samples.

Identifications:

Identification of common flora, fauna and microbes (microfungi) with characters.

Field Study:

Field study will be carried out to study forests, estuaries, coastal areas for understanding of climate and human impact on biodiversity.

B.Sc. Honours Course in Environmental Science

Part II

Paper IV, Paper V & Paper VI

Part II

Paper IV: (Theoretical):

Total -75 marks

Unit I: Environmental Pollution

(25 marks)

1. Environmental Pollution: Definition and major categories of environmental pollution, nature, fate and impact of pollutants, pollution in developed and developing nations.
2. Air Pollution: Sources of air pollution, chemical nature and transport of air pollutants, effects of air pollutants on plants, animals and human health, air pollution status in major Indian cities, air pollution monitoring and control strategies.
3. Water Pollution: Sources of water pollution, chemical nature and transport of water pollutants, effect of water pollutants on plants, animals and human health, water pollution status in India (major rivers, lakes, groundwater, coastal water), water quality monitoring and water pollution control strategies.
4. Noise Pollution: Sources of noise, distinction between sound and noise, Impact of noise on health, noise monitoring and control strategies.
5. Global environmental issues: Greenhouse effects, Depletion of ozone layer, acid rain, El-Niño effects and desertification - causes, consequences and management of each issue.

Unit II: Environmental Physiology

(25 marks)

1. Stress physiology of plants: Plant responses to water, salt and temperature stress; physiology of growth, reproduction and adaptation, Biological clock and Circadian rhythm.
2. Stress physiology of animals: Animal response to environmental stress; physiology of animal growth, reproduction and adaptation.
3. Behavioral Ecology: Social groups, co-operation and altruism, sex in ecology.
4. Environmental responses to health and diseases in plants, animals and human being.
5. UV-responses in plants, animals, and human health.

Unit III: Environmental Toxicology and Environmental Health (25 marks)

1. Principle to toxicology: Dose response relationship, concept of LC₅₀ and ED₅₀.
2. Chemical and biological factors influencing toxicity.
3. Bioaccumulation and bio-magnification of toxicants in ecosystem.
4. Bioassay methods using plants and animal model.
5. Environmental health: Basic concept, physiological responses of man to relevant stresses in the environment, industrial toxicology and its relationship with occupation and hygiene and also diseases.
6. Epidemiological study: Concept, monitoring techniques with respect to Arsenicosis and Fluorosis, vector borne diseases.

Paper V: (Theoretical): Total -75 marks**Unit I: Environmental Management (25 marks)**

1. Principles of Environmental management: Concept and objectives of environmental management; environmental quality- measurement and indexing, environmental management system with respect to pollution control (air, water, soil and noise).
2. Basic functions of management: Forecasting, planning, organizational structure, motivation and coordination, control and communication, leadership in direction and decision making.
3. Environmental Impact Assessment: Concept and scope of environmental impact assessment, principle and salient features, EIA process, methodology, MoEF guidelines, baseline data generation, impact evaluation (checklist, matrix, network and evaluation system), preparation of Environment Management Plan, Environment clearance procedure.
4. Environmental Audit: Concept, scope, process, benefit, procedure, Certification audit system - ISO14000, EMS preparation.
5. Strategies for sustainable development and management of natural resources.
6. Management of urban environment: An overview.

Unit II: Remote sensing and GIS techniques - Application (25 marks)

1. Principle and concept of remote sensing: History of remote sensing development, kind of remote sensing and satellite system in remote sensing.
2. Remote sensing data acquisition, processing and analysis methods.
3. Application of remote sensing techniques in natural resource monitoring, landuse and landcover management and planning.
4. GIS technique: Concept, techniques and applications with case studies.
5. Air photo and Satellite imageries: Interpretation and analysis.

Unit III: Soil Science**(25 marks)**

1. Origin, nature and classification of parent materials, soil formation and soil profile.
2. Composition and properties of soil components: Soil minerals, soil water, soil air, soil temperature, soil reaction, soil organisms.
3. Soil fertility- soil organic matter, nitrogen, phosphorus and sulphur economy in soil.
4. Soil erosion: Accelerated soil erosion, causes, consequences and control strategies.
5. Soil pollution: Sources and soil pollution management.

Paper VI: (Practical):**Total -50 marks****Distribution of Marks**

1. Major experiment (one)	25 marks
2. Minor experiment (one)	10 marks
3. Identification (two)	5 marks
4. Laboratory records	5 marks
5. Viva voce	5 marks

Major experiments:

1. Toposheet interpretation and landuse mapping.
2. Thematic mapping (slope measurement, drainage pattern identification), landuse and landcover analysis and interpretation of SOI Toposheet.
3. Determination of BOD, COD of water samples.
4. Determination of phosphate, nitrate and organic carbon of soil samples.

Minor experiments:

1. Handling of meteorological data recording equipment (Rain gauge, Anemometer, Dry and wet bulb thermometer, Barometer) and their uses.
2. Recording and interpretation of noise and noise Leq determination.

Identifications:

1. Identification of common rocks, minerals and ores.
2. Morphological and anatomical examination of xerophytic features of plants.
3. Studies on features of salinity tolerance in plants.

B.Sc. Honours Course in Environmental Science

Part III

Paper VII, Paper VIII, Paper IX,
Paper X and Paper XI

Part III

Paper VII: (Theoretical):

Total -80 marks

Unit I: Environmental laws, rules, policies, treaties and movements (30 marks)

1. National policy statement: Environment and development, National Environment Policy 2006: An overview.
2. Legislative framework of environmental protection, historical perspectives and Indian constitutional provisions.
3. Environmental Acts and rules: Water (Prevention and control of Pollution Act, 1981); Environment (protection) Act, 1986; Wildlife (Protection) Act, 1972; Forest (conservation) Act, 1980; Biodiversity Act, 2002 and related rules: An overview.
4. International treaties on Environmental protection - Ramsar Convention, Montreal Protocol, Kyoto Protocol, Convention on Biological Diversity (CBD), Convention on International Trade of Endangered Species (CITES).
5. Sanction and enforcement bodies of environmental laws: Role of The High Court (Green Bench), The Supreme Court, National Green Tribunal, State and Central Pollution Control Boards.
6. National Environmental Movement: Silent Valley movement, Chipko movement, Narmada movement, Appiko movement, Almatti dispute and Tehri dam movement.

Unit II: Environmental Economics

(25 marks)

1. Concept of environmental economics, the economy and the environment, cost effectiveness analysis, cost-benefit analysis.
2. National resource economics- analytical tools, supply and demand, accountings of natural assets.
3. Pollution economics- Environmental policy analysis, command control strategies and incentive based strategies.
4. Economic valuation techniques of environmental benefits - various methods.
5. Importance of cost-benefit analysis in project design and appraisal.
6. Carbon tax, Carbon trading, Clean development mechanism, and ecomark-concept only.

Unit III: Environmental Statistics and Mathematical modeling (25 marks)

1. Primary and secondary data collection, measure of mean, mode, median, standard deviation and standard errors.
2. Measure of skewness.
3. Normal distribution hypothesis testing.
4. Correlation and regression analysis.
5. Analysis of variance (ANOVA).
6. Exponential growth, Logistic growth model.
7. Introduction to simple computer programme.

Paper VIII: (Theoretical):**Total -80 marks****Unit I: Environmental Microbiology and Environmental Biotechnology (30 marks)**

1. Microbial world: An overview of distribution, diversities, environmental relevance viz. biogeochemical cycles of elements.
2. Microbe in application: Pollution abatement, agricultural practices, industrial production, medical and pharmaceutical uses.
3. Microbes and major diseases of crop plants and human being: Brown spot of rice stem, rot of jute, Late blight of potato, cholera, typhoid and dysentery in man.
4. Environmental Biotechnology: Concept and application in industry, agriculture and energy sector.
5. Bioremediation and Phytoremediation: Definition, principle, types and application.
6. Principles of various biotechnological methods: Plasmid isolation, restriction digestion, PCR, RADP, RFLP.
7. GM crops in agriculture: Prospects in India and its environmental implications.

Unit II: Socio-environmental Issues and Management (25 marks)

1. Man, society and environment – interdependence.
2. Green movement and its response to main stream and ecological crisis.
3. Impact of major human activities: Transportation, urbanization, industrialization, tourism on environment.
4. Social behavior of modern society and environmental values in life style, environmental refugee problem.
5. Ecological footprint analysis: An overview.
6. Environmental planning: Concept, legal and administrative framework, urban ecological planning and management.

Unit III: Environmental Technology for Pollution Control (25 marks)

1. Basis and necessary for standards. Standards of various environmental parameters and industrial discharges. Principles of pollution abatement.
2. Air pollution abatement strategies.
3. Water pollution abatement strategies. Waste water treatment technologies – cleaning rivers like Thames, Ganges.
4. Management of solid and hazardous wastes.
5. Concept of clean environment.
Modern technological approaches towards pollution prevention and control (viz. zero discharge, waste minimization, process modification etc.). Concept of green technology - some case studies.

Paper IX: (Theoretical):**Total -80 marks****Unit I: Energy Management****(30 marks)**

1. Conventional energy: Sources and categories, current status of exploitation viz. coal, petroleum, natural gas, nuclear fuel with reference to India and their consequences on environment.
2. Non-Conventional energy: Sources and categories, current status of exploitation viz. solar, wind, biofuel, tidal, geothermal, hydal energy etc. with respect to India and their consequences on environment.
3. Energy production and its consequence on environment. Conventional and non-conventional energy use.
4. Energy Audit: Concept, purpose and methodology. Energy conservation in industry and energy planning: An overview.

Unit II: Instrumentation and Analytical Techniques in Environmental Science**(25 marks)**

1. Water and soil sampling techniques, preservation, storage and processing techniques.
2. Principle and application: Titrimetry, Gravimetry, Potentiometry, Spectrophotometry, Flamephotometry, Atomic absorption spectrometry, Inductively coupled plasma mass spectrometry, Chromatographic techniques, Gel electrophoresis.
3. Air quality sampling and analysis: Techniques and application
4. Radioactivity detection techniques and application: An overview.

Unit III: Resource Assessment and Conservation**(25 marks)**

1. Concept of resources, resource classification, Resource exploration techniques and sustainable management.
2. Principles of natural resource conservation with respect to Forest, Wildlife, Ocean.
3. Eco- development and eco- restoration of habitats: An overview.
4. Waste land management: An overview.
5. Role of woman in natural resource conservation: An overview.
6. Importance of Tribal community in natural resource protection and conservation: An overview.

Paper X: (Practical):**Total -80 marks****Distribution of Marks**

- | | |
|---------------------------|----------|
| 1. Major experiment (one) | 35 marks |
| 2. Minor experiment (one) | 20 marks |
| 3. Identification (two) | 10 marks |
| 4. Laboratory records | 5 marks |
| 5. Viva voce | 10 marks |

Major experiments:

1. Estimation of NO_x and SO_x from air samples.
2. Cytological preparation of root tips, flower bud or salivary gland chromosomes.

Minor experiments:

1. Landuse and landcover analysis using imageries (FCC).

Identification/ Interpretation:

1. Interpretation of Air photo.
2. Interpretation of Imageries.

Paper XI: (Practical):**Total -80 marks****Distribution of Marks**

1. Major experiment (one)	30 marks
2. Minor experiment (one)	15 marks
3. Identification (two)	10 marks
4. Field study record (at least one field visit)	10 marks
5. Laboratory records	5 marks
6. Viva voce	10 marks

Major experiments:

1. Determination of total coliform load of water sample.
2. Determination of chlorophylls, enzymes viz. catalase, peroxidase and ascorbic acid of plant samples.
3. Bioassay of toxic compounds by enzyme assay or seed germination test.

Minor experiments:

1. Gram staining, spore staining techniques.

Identification of biological samples:

1. Herbarium of diseased plant species as prescribed in syllabus.
2. Identification of slides of pathogenic organisms (fungi, bacteria, parasites).

Field Study: Field study will be carried out.

Suggested Reading:

1. Basic Ecology - E. P. Odum.
2. Ecology & Environment - P. D. Sharma.
3. A Textbook of Environment - K. M. Agarwal, P. K. Sikdar, S. C. Deb. Mcmillan India Ltd.
4. Environmental Science - Cunningham and Saigo, Mc Graw Hill.
5. Environmental Science - S. C. Santra, New Central Book Agency Calcutta.
6. Introduction to Environmental Engineering and Science - G. M. Masters, Prentice Hall.
7. Handbook of Analytical Instruments - R. S. Khandpur, Tata McGraw Hill.
8. Environmental Chemistry - Stanley E. Manahan, 9th edition, CRC Press.
9. Environmental Chemistry - A. K. De. New Age (P) Ltd.
10. Textbook of Air Pollution and its Control - S. C. Bhatia.
11. Textbook of Noise Pollution and its Control - S. C. Bhatia.
12. Wastewater Engineering: Treatment and Reuse, Metcalf and Eddy Inc, McGraw-Hill Publication, 4th Edition, 2003.
13. Solid and Hazardous Waste Management - S. C. Bhatia.
14. Standard Methods for the Examination of Water and Wastewater, APHA, Washington, D. C.
15. Industrial Water Pollution Control - W. W. Eckenfelder, McGraw-Hill. 1999.
16. Environmental Toxicology - Cambridge University Press, D. A. Wright, P. Welbourn.
17. Introduction to Physical Geography - A. N. Strahler & Strahler, 1996. London, John Wiley & Sons.
18. Landscape Ecology - R. T. T. Forman, M. Godron, Academic Press.
19. Atmosphere, Weather and Climate – R. G. Barry & R. J. Chorley, 1999, Routledge (London).
20. Climatology - D. S. Lal.
21. Environmental Geography - S. Singh, 1991, Pragag Pustak Bhawan, Allahabad.
22. Environmental Geology - E. A. Keller.
23. Principles of Geomorphology - W. D. Thornbury, Wiley Eastern.
24. The Nature and Properties of Soils - N. C. Brady.
25. Remote Sensing - Lillesand and Keifer.
26. Environmental Economics - D. W. Pearce, 1977, London, Longman Group Ltd.
27. Environmental Biotechnology - Alan Scragg. Oxford University Press.
28. Environmental Management - H. M. Saxena; Rawat Publication.
29. Pollution Control Act, Rules and Notifications - CPCB, 2006.
30. Handbook of Environmental Laws, Acts, Guidelines, Compliance & Standards; Vol I & II; BS Publication.
31. Environmental Economics- R. N. Bhattacharyya.
32. Structural Geology- M. P. Billings.

UNIVERSITY OF KALYANI

Syllabus and Regulations for B.Sc. (General) 3 Years
Degree Course in Environmental Science

According to the New Examination Pattern

Part – I, Part – II & Part – III

University of Kalyani
Syllabus for B.Sc. (General) 3-years Degree
Course in Environmental Science
Contents
General Course

Papers	Topics	Page No
	Detailed Marks Divisions	i
	Course Structure (Summary)	ii
	Part I	
Paper I (Theo)	Group-A	
	Unit I: Fundamental of Environmental Science	G-1
	Unit II: Ecology and Ecosystem	G-1
	Group B	
	Unit III: Biodiversity and Conservation Biology	G-1
	Unit IV: Environmental Chemistry	G-1
	Part II	
Paper II (Theo)	Group-A	
	Unit I: Environmental Geoscience	G-2
	Unit II: Environmental Physics and Application of Statistics	G-2
	Group B	
	Unit III: Environmental Pollution	G-2 & G3
	Unit IV: Environmental Management	G-3
Paper III (Practical)	Major and Minor Experiments, identification, Field study, Lab records and Viva Voce	G-3&G4
	Part III	
Paper IV (Theo)	Group A	
	Unit I: Environmental Toxicology and Environmental Health	G-5
	Group B	
	Unit II: Environmental Microbiology and Environmental Biotechnology	G-5
Paper IV (Practical)	Major and Minor experiments, Field study, Lab Record, Viva Voce	G-5& G6
	Suggested Reading	G-6

University of Kalyani
Syllabus for B.Sc. (General) 3-Years Degree Course
in Environmental Science

Total Marks - 400

Theoretical 260 (Part I- 100, Part II- 100 and Part III- 60)
and
Practical 140 (Part II- 100, Part III- 40)

Detailed Marks Divisions

Part-I

Paper I: Group A (Theo)- 50 marks (Unit I- 25 marks, Unit II- 25 marks)
Group B (Theo)- 50 marks (Unit III- 25 marks, Unit IV- 25 marks)

Part-II

Paper II: Group A (Theo)- 50 marks (Unit I- 25 marks, Unit II- 25 marks)
Group B (Theo)- 50 marks (Unit III- 25 marks, Unit IV- 25 marks)

Paper III: (Practical)-100 marks

Part-III

Paper IV: Group A (Theo)- 60 marks (Unit I- 30 marks, Unit II- 30 marks)
Group B (Practical)- 40 marks

Total (Theoretical – 260 + Practical 140) = 400

[Each Theoretical Papers (100 marks or 60 marks) will be of 3 hours duration and
each Practical paper 40 marks will be of 4 hours duration in examination]

Course Structure (Summary)

Part I

Papers	Topics	Full Marks
Paper I (Theo)	Group-A	50
	Unit I: Fundamental of Environmental Science	25
	Unit II: Ecology and Ecosystem	25
	Group B	50
	Unit III: Biodiversity and Conservation Biology	25
	Unit IV: Environmental Chemistry	25

Part II

Papers	Topics	Full Marks
Paper II (Theo)	Group-A	50
	Unit I: Environmental Geoscience	25
	Unit II: Environmental Physics and Application of Statistics	25
	Group B	50
	Unit III: Environmental Pollution	25
	Unit IV: Environmental Management	25
Paper III (Practical)	Major and Minor Experiments, Identification, Field study, Lab records and Viva Voce	100

Part III

Papers	Topics	Full Marks
Paper IV (Theo)	Group A	60
	Unit I: Environmental Toxicology and Environmental Health	30
	Group B	
	Unit II: Environmental Microbiology and Environmental Biotechnology	30
Paper IV (Practical)	Major and Minor experiments, Field study, Lab Record, Viva Voce	40
Total: 400		

(Theoretical-260 Practical -140)

**B.Sc. (General) 3-years Degree Course
in Environmental Science**

Part I

Paper I

Detailed Syllabus (Course Contents)

Part I

Paper I: (Theoretical): 100 Lectures

Total -100 marks

Group A:

50 marks

Unit I: Fundamentals of Environmental Science

(25 marks)

1. Environmental Science – An overview.
2. Physical law of nature- conservation of matter, Laws of Thermodynamics.
3. Components of environment and characteristics of environmental processes.
4. Global and National environmental Issues.
5. Weather and Climate of the World.
6. Earth's Carrying capacity and environmental issues.

Unit II: Ecology and Ecosystem

(25 marks)

1. Concept of Ecology and Ecological principles.
2. Categories of Ecological Studies.
3. Concept of Community, Succession, biological interaction and productivity.
4. Basic concept of ecosystem, Component types, Structure and function of ecosystems, Energy flow in ecosystem.
5. Ecosystems of India - its problem and management.
6. Population growth, mortality and survivorship.

Group B:

50 marks

Unit III: Biodiversity and Conservation Biology

(25 marks)

1. Origin and Evolution of life and Speciation.
2. Concept and Categories of Biodiversity.
3. Values and Threats of Biodiversity.
4. Monitoring and Measurement of Biodiversity.
5. Conservation of Biodiversity: In-situ and ex-situ methods, hotspot, protected area networks, role of IUCN, Biodiversity Acts and Treaties.
6. Commercialization of Biodiversity.
 - Bioprospecting, Patents, TRIPS, Biopiracy and Bioethics issues.

Unit IV: Environmental Chemistry

(25 marks)

1. Elements- Types and its distribution, properties and behavior.
2. Reaction Processes- oxidation and reduction reactions, acid-base reactions.
3. Water Chemistry- Composition, properties and functions.
4. Atmospheric Chemistry- Composition, properties and functions.
5. Chemical Equilibrium in environmental components.

**B.Sc. (General) 3-years Degree Course
in Environmental Science**

Part II

Paper II & Paper III

Part II

Paper II: (Theoretical): 100 Lectures

Total -100 marks

Group A:

50 marks

Unit I: Environmental Geoscience

(25 marks)

1. Earth's Crust and its composition.
2. Different kinds of rocks and minerals.
3. Soil genesis and its classification.
4. Major landforms and landform related processes.
5. Weather elements- Temperature, humidity, precipitation, Wind, Sunshine exposure, Storms and Cyclones, Climate of India (Specially tropical monsoon and western disturbances).

Unit II: Environmental Physics and Applications of Statistics

1. Energy and Environment- source and kinds of energy, energy management.
2. Heat transfer Process, mass and energy transfer across various interfaces, material balance, atmosphere stability.
3. Radiation Physics: Concept and types of electromagnetic radiation, radioactivity and biological effects of radiation, radioisotopes.
4. Climatic Variation and Climatic change impact of environment.
5. Statistical application – Concept of mean, mode, median, standard error and deviation, probability, correlation and regression and analysis, data presentation.
6. Sampling procedure, sampling design, estimate of sample size, testing of hypothesis, Chi square and student 't' test.

Group B:

50 marks

Unit III: Environmental Pollution

(25 marks)

1. Environmental pollution: Concept, types - physical, chemical and biological, pollutants nature and fate.
2. Water pollution: Source of water pollution, nature of pollutants, effect of water pollutants, pollutants monitoring, control of water pollution, Case studies - Ground water pollution in West Bengal; river, lake and coastal water pollution in India.
3. Air pollution: Source of air pollution, nature of air pollutants, nature of air pollutants, effects of air pollutants, air pollution monitoring, control of air pollution, Case Studies: Urban air pollution in India, Vehicular pollution, indoor air pollution.

4. Soil Pollution: Source of soil pollution, nature of soil pollutants, effects of soil pollutants, soil pollution monitoring, control of soil pollution, Case Studies: Soil pollution and crop productivity.
5. Noise pollution: Sources of noise pollution, monitoring of noise pollution, effects of noise pollution, control of noise pollution, Case studies: Noise pollution studies in Indian Cities.
6. Radiation Hazards, Photochemical Smog, Environmental Carcinogenesis.
7. Biopollutants, Bioindicators, Biomarkers, Biosensors - concept only.

Unit IV: Environmental Mangement

(25 marks)

1. Environmental quality monitoring and management – basic concept.
2. Environmental Impact Assessment- purpose, process, evaluation methodology, Environmental clearance procedure.
3. Environmental Audit - concept, procedure, certification audit - ISO14000
4. Environmental laws; policies & rules: Water (Prevention and Control of Pollution) Act 1974, Air (Prevention and Control of Pollution) Act, 1981, Environmental (Protection) Act 1986, Wildlife (Protection) Act 1972, Biodiversity Act 2002 and related rules; National Environmental Policy 2006.
5. Role of NGO's, Judiciary and Pollution Control Board in Environmental Protection.
7. Environmental Education and environmental movements in India with reference to Silent valley movement, Chipko movement, Narmada Bachao movement.
8. Water resource management- Rainwater harvesting, Wastewater treatment & re-use.

Paper III: (Practical):

100 marks

Distribution of marks

- | | |
|--|------------------|
| 1. One major Experiment | -25 marks |
| 2. One minor experiment | -15 marks |
| 3. Identification with reasons (five) | -15 marks |
| 4. Microbial preparation (one) | -15 marks |
| 5. Field Study report and Laboratory records | -15 (5+10) marks |
| 6. Viva-Voce | -15 marks |

Major Experiments:

1. Estimation of water quality parameters - Dissolved oxygen, hardness, alkalinity, sulphate and chloride.
2. Estimation of Soil quality parameters - organic carbon and hardness.

Minor Experiments:

1. Determination of pH, Conductivity, Total suspended solid of water, pH and conductivity of soil.
2. Subculturing techniques.

Identifications:

1. Common Plants/ Animals (Herbarium/ specimens).
2. Planktons/ Fungi-slides.
3. Anatomical preparation of ecologically adapted plants viz, xerophytes, hydrophytes, epiphytes.
4. Toposheet interpretation and landuse map preparation.

Microbial Preparations

1. Bacterial stains-Gram staining and Spore staining.
2. Isolation of bacteria/ fungi from soil or air (exposure plate technique).

Field study

1. One local field study for observation of flora and fauna of the area (both terrestrial and aquatic habitat).
2. Visit to Botanical garden/ Zoological garden/ Metrological station and record their activities.

**B.Sc. (General) 3-years Degree Course
in Environmental Science**

Part III

Paper IV

Part III

Paper IV: (Theoretical): **60 marks**

Group A: **30 marks**

Unit I: Environmental Toxicology and Environmental Health **(30 marks)**

1. Environmental toxicology – concept, acute and chronic toxicity, dose-response of toxic chemicals.
2. Biochemical and metabolic responses of toxic chemicals.
3. Environmental health- concept of health and disease, relationship of environment and health, relationship of nutrition and health.
4. Occupational health- concept, monitoring and management.
5. Epidemiological studies of various diseases - chronic arsenicosis, fluorosis.
6. Communicable diseases and health management.
7. Global environmental issues and human health.

Group B: **30 marks**

Unit II: Environmental Microbiology and Environmental Biotechnology **(30 marks)**

1. Microbial diversity, distribution of microbes and their role in environment.
2. Microbes and crop diseases : overview.
3. Microbes and public health: overview.
4. Microbes in Industrial use: overview.
5. Microbes in waste water treatment and pollution control: Case studies.
6. Microbes in energy management : Case studies.
7. Organic farming and Vermicomposting.
8. GM Crops and food safety.
9. Understanding of biotechnological techniques: Plasmid preparation, restriction digestion, PCR, RAPD, RFLP.

Paper IV: (Practical): **40 marks**

Distribution of marks:

- | | |
|----------------------------|-----------|
| 1. Major experiments (one) | -25 marks |
| 2. Minor experiments (one) | -10marks |
| 3. Laboratory records | -05 marks |
| 4. Viva voce | -10 marks |

Major experiments:

1. Determination of SO_x and NO_x.
2. Determination of primary productivity.
3. Measurements of Leq of noise level.
4. Preparation of windrose (data supplied).
5. Determination of nitrate and phosphate of water sample.
6. Coliform load determination of water sample.

Minor Experiments:

1. Detection of Carbohydrate, protein and fats by qualitative tests using food samples.
2. Determination of Chlorophylls.
3. Demonstrations pour plate techniques.

Suggested Reading:**Text Books:**

1. A textbook of Environment- K. M. Agarwal, P.K. Sikdar and S.C. Deb. Mc millan India Ltd.
2. Introduction to Environmental Science - Y. Anjaneyulu , B.S Publication.
3. Concept of Ecology- Edward J. Kormondy, Prenticehall of India.
4. Environmental Science – S. Roy Publishing Syndicate.
5. A Textbook of Environmental Studies - G.R. Chatwal and Harish Sharma, Himalaya Publishing Home.
6. Ecology and Environment – P.D. Sharma, Rastogi Publication.
7. Fundamental principles of Ecology- E. P. Odum ,W.B. Sander's Company.
8. Environmental Chemistry- A.K.De , New Age (P) Ltd.
9. Environmental Science- S.C.Santra, New Central Book Agency.
10. Environmental Biotechnology-Scragg.
11. Introduction to Environmental Engineering & Science - G.M. Masters, Prentice Hall of India.
12. Statistical Methods- N.G.Das.
13. Fundamental of Ecology- M.C. Das, Tata Mcgraw Hill Publication.
14. Park's textbook of Preventive and Social medicine - K. Park Banarasidas Bhanot.