



UNIVERSITY OF CALCUTTA

GURUPADA SAREN
SECRETARY

COUNCILS FOR UNDERGRADUATE STUDIES,
UNIVERSITY OF CALCUTTA.

Ref.No : CUS/ 21 /18
Dated the 16th February, 2018

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To
The Principals/T.I.C.
of all the Undergraduate Colleges
offering B.Sc. (Honours & General) in Environmental Science
affiliated to the University of Calcutta

Sir/Madam,

The undersigned is to inform you that the proposed **revised semesterised draft Syllabus for Environmental Science (General) Courses of Studies under CBCS has been uploaded in the Calcutta University website (www.caluniv.ac.in).**

The said syllabus has been prepared by the **U.G. Board of Studies in Environmental Science, C.U.**, suppose to be implemented from the academic session 2018-2019.

You are requested kindly to go through it and send your feedback within 28th February, 2018.

In this regard you may send your observation/ suggestion to the **Department of U.G. Councils, C.U.** or through email (u.g.councilsc.u@gmail.com), and you also may contact **Prof. Aniruddha Mukhopadhyay**, Department of Environmental Science through e-mail (amcu.envs24@gmail.com).

Your cooperation in this regard will be highly appreciated. Kindly treat the matter as urgent.

Thanking you,

Yours faithfully,


Secretary

**MODEL COURSE CURRICULUM FOR UNDERGRADUATE COURSES
UNDER CHOICE BASED CREDIT SYSTEM**

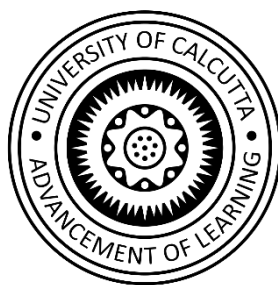
PROPOSED DRAFT SYLLABUS

FOR

BACHELOR IN

ENVIRONMENTAL SCIENCE

(GENERAL)



UNIVERSITY OF CALCUTTA

SEMESTER	COURSES	DETAILS OF THE COURSE	CREDIT
I	CORE COURSE CC 1 (T)	Fundamentals of Environmental Science	4
	CORE COURSE CC 1 (P)	Fundamentals of Environmental Science (Practical)	2
	ABILITY ENHANCEMENT COURSE AEC 1	English Communications	2
II	CORE COURSE CC 2 (T)	Ecology and Biodiversity	4
	CORE COURSE CC 2 (P)	Ecology and Biodiversity (Practical)	2
	ABILITY ENHANCEMENT COURSE AEC 2	Environmental Studies	2
III	CORE COURSE CC 3 (T)	Chemistry of Environment	4
	CORE COURSE CC 3 (P)	Chemistry of Environment (Practical)	2
	SKILL ENHANCEMENT COURSE SEC 1 (T)	Environmental Laws and policy, Environmental Audit and EIA	2
IV	CORE COURSE CC 4 (T)	Environmental Physics and Meteorology	4
	CORE COURSE CC 4 (P)	Environmental Physics and Meteorology (Practical)	2
	SKILL ENHANCEMENT COURSE SEC 2 (T)	Applications of Environmental Biotechnology	2
V	DISCIPLINE SPECIFIC ELECTIVES (DSE 1, 2) (T)	Energy and Environment/ Environmental Economics and Statistics (Any one Paper)	4
	DISCIPLINE SPECIFIC ELECTIVES (DSE 1, 2) (P)	Energy and Environment/ Environmental Economics and Statistics (Any one Paper) (Practical)	2
	SKILL ENHANCEMENT COURSE SEC 3 (T)	Environmental Pollution and Green Technologies	2
VI	DISCIPLINE SPECIFIC ELECTIVES (DSE 3, 4) (T)	Natural Hazard and Disaster Management/ Solid Waste Management (Any one Paper)	4
	DISCIPLINE SPECIFIC ELECTIVES (DSE 3, 4) (P)	Natural Hazard and Disaster Management/ Solid Waste Management (Any one Paper) (Practical)	2
	SKILL ENHANCEMENT COURSE SEC 4 (T)	Remote sensing, GIS and its applications	2

Semester Wise Environmental Science General Courses

Semester-I

CORE COURSE (CC) 1: Fundamentals of Environmental Science

Theory: 50 Lectures

Total credit: 4

Unit 1: Concept of Environment and Environmental Science: (15 Lectures)

Definition, Types and Components of Environment (Atmosphere, Hydrosphere, Lithosphere and Biosphere); Environmental Science: An overview; Scopes and Objective of Environmental and Ecological Science; Man – Environment relationships; Growth of Environmental and Ecological science in India.

Unit 2: Environmental Literacy: (5 Lectures)

Environmental literacy (formal and non-formal education)

Unit3: Environmental Problems and Global Environmental Issues: (15 Lectures)

Classifying environmental problems, Green House effect, Climate change, Acid deposition, Desertification, Ozone layer depletion.

Unit 4: Important atmospheric events: (8 Lectures)

Western disturbance, Tropical cyclones, Monsoon, El-nino phenomenon.

Unit 5: Climatic zone of the world: (7 Lectures)

Equatorial, Tropical, Sub-Tropical, Tundra.

CORE COURSE (CC) 1: Fundamentals of Environmental Science (Practical)

Total Hours: 50

Total credit: 2

1. Study of Laboratory safety rules.
2. To study the principle and applications of following instruments (autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter, conductivity meter, spectrophotometer)
3. Identification of rocks and minerals on the basis of physical characters.
4. Topological sheet interpretation.
5. Poster preparation on Environmental Education and global environmental issues.
6. Use of social media based-networking for raising environmental related emergent issues.
7. Viva Voce.

Suggested Readings:

1. Agarwal KM., Sikdar PK., Deb SC. A textbook of Environment. Mc millan India Ltd.
2. Anjaneyulu Y. Introduction to Environmental Science. B.S Publication.
3. Enger E, Smith B. Environmental Science. A Study of Interrelationships. McGraw-Hill Higher Education.

Semester-II

CORE COURSE (CC) 2: Ecology and Biodiversity

Theory: 50 Lectures

Total credit: 4

Unit 1: Ecological Concepts: (6 Lectures)

Subdivisions and development phases of ecology, Autecology – definition, distribution, phenological studies; Synecology – basic ideas, definition; food chains, food webs and trophic levels.

Unit 2. Population and Community Ecology: (7 Lectures)

Definition; Population characteristics, growth mortality, survivorship and dynamics; Community structures and characters; Predation; Competition; Symbiosis; Defensive Mechanism; Resilience and stability; Basic concept of ecological succession.

Unit 3: Ecosystem ecology: (10 Lectures)

Basic concept of ecosystem, structural and functional aspects of ecosystems; Raymond Lindeman – Trophic level dynamics, Ecological pyramids; Productivity concept of ecosystem; Concept of limiting factors – Liebig's law of minimum, Shelford's law of tolerance; Cycling of nutrients.

Unit 4: Concept and Importance of Biodiversity: (4 Lectures)

Definition; Types; India as megadiverse country; Values (Direct and indirect) and Services of Biodiversity.

Unit 5: Threats to Biodiversity: (5Lectures)

Natural and Anthropogenic disturbances; Habitat loss, Habitat degradation, and Habitat fragmentation; Climate change; pollution; hunting; over-exploitation; deforestation; invasive species; land use changes; overgrazing etc.

Unit 6: Measurement of Biodiversity: (6 Lectures)

Different types of biodiversity measurement indices viz. Shannon Wiener biodiversity index, Simpson index, Evenness index, frequency, abundance, density, relative density.

Unit 7: Conservation of Biodiversity: (12 Lectures)

Importance of biodiversity patterns in conservation; In-situ conservation (Biosphere Reserves, National Parks, Wildlife Sanctuaries); Ex-situ conservation (botanical gardens, zoological gardens, gene banks, seed and seedling banks, pollen culture, tissue culture and DNA banks),role of local communities and traditional knowledge in conservation; Biodiversity Hotspots; IUCN Red List categorization - guidelines, practice and application; Red Data book; Joint forest management, Sanctuary and Biosphere reserve – difference and location in India. People's biodiversity register (PBR); Importance of Wetland, its conservation, Ramsar Convention.

CORE COURSE (CC) 2: Ecology and Biodiversity (Practical)

Total Hours: 50

Total credit: 2

1. Determination of requisite size of the quadrat for vegetation analysis.
2. Analysis of frequency, density, abundance of plants in a piece of vegetation by quadrat and transect method. (Part of Field report)
3. Ecological comments on charts/material/fresh plant material
4. To determine basal cover, GBH of trees
5. Identification of common flora and fauna of various ecological habitats with characteristics features. (Herbarium/ specimens)
6. Field study on ecology and biodiversity of flora and fauna of a local area and field report submission.
7. Visit to Botanical garden/ Zoological garden and report submission.
8. Viva Voce.

Suggested Readings:

1. Chapman, Reiss. Ecology: Principles and Applications. Cambridge University Press.
2. Kormondy EJ. Concept of Ecology. Prentice hall of India.
3. Kumar HD. Modern concepts in Ecology
4. Odum EP. Fundamentals of Ecology
5. Sharma PD. Ecology and Environment. Rastogi Publication.
6. Das MC. Fundamental of Ecology. Tata Mcgraw Hill Publication.
7. Gaston, KJ. & Spicer, J.I. 1998. *Biodiversity: An Introduction*. Blackwell Science, London, UK. Krishnamurthy, K.V. 2004. *An Advanced Text Book of Biodiversity - Principles and Practices*. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi
8. Maiti, Maiti. Biodiversity: Perception, Peril and Preservation. PHI Learning Pvt. Ltd.

Semester-III

CORE COURSE (CC) 3: Chemistry of the Environment

Theory: 50 Lectures

Total credit: 4

Unit 1: Basics of General Chemistry: (8 Lectures)

Molecular weight, Equivalent Weight, Molarity, Normality, Oxidation and Reduction Reactions; Brief idea of Metals and Nonmetals; Aromatic & Aliphatic compounds, Saturated and unsaturated hydrocarbons.

Unit 2: Basics of Chemical Equilibrium and Kinetics: (4 Lectures)

Stoichiometry; Chemical equilibrium; Acid-base reactions (acidity, alkalinity, buffer and buffer capacity).

Unit 3: Water Chemistry: (10 Lectures)

Fundamentals of water quality; Concept of DO, BOD, COD, Hardness; Principles of sedimentation, coagulation, filtration.

Unit 4: Air Chemistry: (12 Lectures)

Classification of elements, particles, ions and radicals in the atmosphere; Chemical process for formation of inorganic and organic particulate matters in air; PM-10, PM-2.5, Sulphur Oxides Chemistry, Nitrogen Oxides Chemistry, Carbon Oxides Chemistry, VOCs (Volatile Organic Compounds), PAHs (Polycyclic Aromatic Hydrocarbons), Peroxyacetyl nitrate (PAN) and Photochemical smog; Ozone chemistry.

Unit 5: Soil Chemistry: (8 Lectures)

Soil composition; relation between organic carbon and organic matter; inorganic and organic components in soil; soil humus; cation and anion exchange reactions in soil; nitrogen, phosphorus and potassium pathways in soil.

Unit 6: Chemistry of Heavy metals: (8 Lectures)

Pb, Hg, Cd and As - Physical and chemical properties; Behavior of heavy metals and their compounds in environment.

CORE COURSE (CC) 3: Chemistry of the Environment (Practical)

Total Hours: 50

Total credit: 2

1. Estimation of water quality parameters – pH, conductivity, TSS, free CO₂, hardness, alkalinity, chloride, Dissolved oxygen. Determination of Turbidity in water by Secchi disc (Field practical).
2. Estimation of Soil quality parameters - pH, conductivity, water holding capacity, moisture, organic carbon.
3. Viva Voce.

Suggested Readings:

1. Banerjee SK. Environmental Chemistry.
2. Dara SS. A text book of Environmental Chemistry and Pollution Control.
3. De AK. Environmental Chemistry. New Age (P) Ltd.
4. Gupta PK. 2004. Methods in Environmental analysis – water, soil and air. Agrobios (India), Jodhpur
5. Jadhav HV. Elements of Environmental Chemistry
6. Moore JW, Moore EA. Environmental Chemistry
7. Peavy HS, Rowe DR. Environmental Engineering. McGraw Hill.

SKILL ENHANCEMENT COURSE (SEC) 1: Environmental Laws and policy, Environmental Audit and EIA

Theory: 30 Lectures

Total credit: 2

Unit 1: Fundamental rights and duties in Indian Constitution; Policies related to Environment (8 Lectures)

National Forest Policy 1952, National Forest Policy 1988; National Environment Policy, 2006

Unit 2: Environmental legislation (10 Lectures)

Legal definitions (environmental pollution, natural resource, biodiversity, forest, sustainable development); Article 48A (The protection and improvement of environment and safeguarding of forests and wildlife); Article 51 A (Fundamental duties).

The Indian Forest Act 1927; The Wildlife (Protection) Act 1972; The Water (Prevention and Control of Pollution) Act 1974; The Water (Prevention and Control of Pollution) Cess Act 1977; The Forests (Conservation) Act 1980; The Air (Prevention and Control of Pollution) Act 1981; The Environment (Protection) Act 1986; Motor Vehicle Act 1988; The Public Liability Insurance Act 1991; Noise Pollution (Regulation and Control) Rules 2000; The Biological Diversity Act 2002.

Unit 3: Environmental Audit (6 Lectures)

Overview of Environmental Audit, Basic steps of Environmental Audit, Benefits of Environmental Audit.

Unit 4: Environmental Impact Assessment (6 Lectures)

Definitions, introduction concepts and types; scope and methodologies of EIA, EIA regulations in India.

Suggested Readings:

1. Glasson, J., Therivel, R., Chadwick, A. 1994. Introduction to Environmental Impact Assessment. London, Research Press, UK.
2. Judith, P. 1999. Handbook of Environmental Impact Assessment. Blackwell Science.
3. Marriott, B. 1997. Environmental Impact Assessment: A Practical Guide. McGraw-Hill, New York, USA.
4. Naseem, M. 2011. Environmental Law in India Mohammad. Kluwer Law International.
5. Venkat, A. 2011. Environmental Law and Policy. PHI Learning Private Ltd.
6. Rosencranz A, Divan S, Noble ML. 2001. Environmental law and policy in India. Tripathi.

Semester-IV

CORE COURSE (CC) 4: Environmental Physics and Meteorology

Theory 50 Lectures

Total credit: 4

Unit 1: Thermodynamics:

(12 Lectures)

Concept of System; First and second law of thermodynamics; Entropy; Enthalpy, Free energy; Chemical potential; Heat transfer process; Mass and energy transfer across the various interfaces; Material balance.

Unit 2: Energy Interactions:

(8 Lectures)

Energy budget concept: Radiation fluxes, metabolism of latent heat exchange; Energy equilibrium between biotic and abiotic environmental component.

Unit 3: Concept of Radiation Physics:

(8 Lectures)

Types of Electromagnetic radioactivity and its units, characterizations of various rays, application of radio isotopes; Biological effects of radiation.

Unit 4: Techniques related to environmental physics:

(10 Lectures)

Acoustic radar; Application of LASER radiations; Electrical detection of airborne particles using surface ionization techniques; Biosensor: Concept and application.

Unit 5: Concept of Meteorology:

(12 Lectures)

Basic knowledge of climatological parameters for environmental study; Weather and climate; Classification of Climate; Fundamentals of temperature, pressure, relative humidity, rainfall and wind speed; Concept of atmospheric stability; Mixing height, temperature inversion.

CORE COURSE (CC) 4: Environmental Physics and Meteorology (Practical)

Total Hours: 50

Total credit: 2

1. Recording of wind speed, relative humidity, atmospheric pressure, rainfall, insolation and light intensity.
2. Preparation of windrose (data supplied)
3. Visit to a Weather Station (one day)
4. Viva Voce.

Suggested Readings:

1. Barry, R. G. 2003. Atmosphere, Weather and Climate. Routledge Press, UK.
2. Boeker, E. & Grondelle, R. 2011. Environmental Physics: Sustainable Energy and Climate Change. Wiley.
3. Forinash, K. 2010. Foundation of Environmental Physics. Island Press.
4. Singh, Savindra Climatology, Prayag Pustak Publication.

SKILL ENHANCEMENT COURSE (SEC) 2: Applications of Environmental Biotechnology

Theory: 30 Lectures

Total credit: 2

Unit 1: Principles of different biotechnological methods: (10 Lectures)

Plasmid preparation, restriction digestion, DNA ligation, PCR, RAPD and RFLP.

Unit 2: Biotechnological applications: (3 Lectures)

Biotechnological applications in medicine and industry.

Unit 3: Application of Biotechnology in waste treatment: (7 Lectures)

Wastewater treatment; solid waste treatment: sources and management (composting, vermiculture and methane production); Bioremediation; Phytoremediation.

Unit 4: Ecologically safe products and processes: (7 Lectures)

PGPR bacteria: biofertilizers, microbial insecticides and pesticides; Integrated pest management.

Unit 5: GMs and GMOs: (3 Lectures)

Concept of GM and GMOs; Biosafety protocol.

Suggested Readings:

1. Rittman, B.E. & McCarty, P.L. 2001. Environmental Biotechnology. Principles and Applications. McGraw-Hill, New York.
2. Scagg, A.H. 2005. Environmental Biotechnology. Oxford University Press.

Semester-V

[Elective Course (Any One from DSE-1 and DSE-2)]

DISCIPLINE SPECIFIC ELECTIVES (DSE) 1: Energy and Environment

Theory: 50 Lectures

Total credit: 4

Unit 1: Energy resources:

(10 Lectures)

Defining energy; forms and importance; Global energy resources; renewable and non-renewable resources: distribution and availability.

Unit 2: Energy demand:

(10 Lectures)

Global energy demand: historical and current perspective; energy demand and use in domestic, industrial, agriculture and transportation sector.

Unit 3: Energy Resource Management:

(20 Lectures)

Conventional and non-conventional energy resources; Brief idea of energy production and environmental consequences involved (*viz.* Thermal, Hydel, Solar, Wind, Geothermal, Energy from oceans and Bio-energy); Need for energy efficiency; Energy conservation and sustainability; Action strategies for sustainable energy management from a future perspective.

Unit 4: Energy Audit:

(10 Lectures)

Concept, purpose and methodology.

DISCIPLINE SPECIFIC ELECTIVES (DSE) 1: Energy and Environment (Practical)

Total Hours: 50

Total credit: 2

1. To prepare energy budget of a cropping system aquaculture.
2. To determine energy efficiencies from the given data.
3. Preparation of Energy audit of a domestic unit/office.
4. Demonstration of water conservation techniques.
5. Demonstration of use of solar devices, photo-cells, wind-mills.
6. Demonstration of Biogas plant
7. Preparation of report on Energy Plantation /Visit to a water shed management project and field report preparation.

Suggested Readings:

1. World Commission on Environment and Development. Our Common Future. Oxford University Press.

2. Elliott, D. 1997. Sustainable Technology. Energy, Society and Environment (Chapter 3). New York, Routledge Press
3. Shastri M.N.1995, Energy Options : Himalaya Publishing House, New Delhi.

DISCIPLINE SPECIFIC ELECTIVES (DSE) 2: Environmental Economics and Statistics

Theory: 50 Lectures

Total credit: 4

Unit 1: Concept of environmental economics:

(4 Lectures)

Economy and the environment.

Unit 2: National resource economics:

(10 Lectures)

Economics of non-renewable resources; economics of fuels and minerals; Introduction to natural resource accounting.

Unit 3: Tools for environmental economic policy:

(12 Lectures)

Growth and environment; environmental accounting, Kuznets curve, assessing benefits and cost for environmental decision making; cost benefit analysis; Economic valuation techniques of environmental benefits - various methods; Policies for controlling air and water pollution; polluter pay principles.

Unit 4: Carbon trading:

(9 Lectures)

Carbon tax, carbon trading; clean development mechanism; clean production and technology and ecomark - concept only.

Unit 5: Basic Statistics:

(15 Lectures)

Statistical Sampling, sampling units, estimation of sample size; Mean, mode, median, standard error and deviation, probability, correlation and regression; Testing of hypothesis: Null and alternative, chi-square and student's 't' test.

DISCIPLINE SPECIFIC ELECTIVES (DSE) 2: Environmental Economics and Statistics (Practical)

Total Hours: 50

Total credit: 2

1. Numerical problems on biostatistics Chi-Square test and Student's t test).
2. Calculation of NPV (Net Present Value) of Projects from data supplied.
3. Viva -voce.

Suggested Readings:

1. Das. NG. Statistical Methods.

2. Hanley N, Jason FS, White B. Environmental Economics in Theory and Practice. 1997. New Delhi. Macmillan – India.
3. Sankar U. (ed.) Environmental Economics. New Delhi. Oxford University Press, 2001.
4. Wayne RO Environmental Statistics and Data Analysis. 1995. CRC Press.

SKILL ENHANCEMENT COURSE (SEC) 3: Environmental Pollution and Green Technologies

Theory: 30 Lectures

Total credit: 2

Unit 1: Introduction:

(2 Lectures)

Definition of pollution; pollutants; classification of pollutants (Physical, chemical and biological).

Unit 2: Air and Noise Pollution:

(8 Lectures)

Air borne particles and particulate matters, Temperature inversion, SO_x, NO_x, Hydrocarbons, Lead & other pollutants; Temperature inversion; photochemical Smog; Health effects of Air pollution; Adverse health effects of tobacco.

Measurement of Noise, Health effects of Noise pollution, Control of noise pollution.

Unit 3: Water pollution:

(6 Lectures)

Sources of surface and ground water pollution; Water quality parameters: COD, BOD, DO, hardness, alkalinity; Biological aspects of water pollution: MPN, Eutrophication; Biological indicator; Arsenic pollution of drinking water and its consequence: An overview.

Unit 4: Pesticide pollution:

(2 Lectures)

Classification of pesticide, Biological magnification of persistent organic pollutants.

Unit 5: Pollution control:

(2 Lectures)

Activated Sludge Process (ASP) - Trickling Filters - oxidation ponds, fluidized bed reactors, concept and working of effluent treatment plants (ETPs).

Unit 6: Green technologies and its applications:

(10 Lectures)

Definition and concepts: green technology, Green House Gas (GHG) emissions reduction: carbon capture and storage (CCS) technologies, fuel efficient vehicles, and mass transit, methane emissions reduction and/or reuse; Pollution reduction and removal (Flue Gas Desulfurization (FGD) methods; Rainwater Harvesting; Successful green technologies: wind turbines, solar panels; 3R's of green technology: recycle, renew and reduce.

Suggested Readings:

1. Arceivala. Waste water treatment for pollution control. Tata Mc Graw Hil
2. Chatwal, Anand. Instrumental Methods of Analysis.

3. Khopkar. Environmental Pollution Analysis
4. Mastters GM. Introduction to Environmental Engineering & Science. Prentice Hall of India

Semester-VI

[Elective Course (Any One from DSE-3 and DSE-4)]

DISCIPLINE SPECIFIC ELECTIVES (DSE) 3: Natural Hazard and Disaster Management

Theory: 50 Lectures

Total credit: 4

Unit 1: Introduction:

(12 Lectures)

Definition of hazard and disaster; Natural, technological and context hazards; Concept of risk and vulnerability.

Unit 2: Natural hazards:

(16 Lectures)

Natural hazards – earthquake; volcanoes - cause and effects; floods: types and nature, effects; landslides: causes and types of landslides, effects; drought: types of drought - meteorological, agricultural, hydrological and effects; tornadoes, cyclone & hurricanes; tsunamis: causes and location of tsunamis, effects.

Unit 3: Anthropogenic hazards:

(16 Lectures)

Impacts of anthropogenic activities such as rapid urbanization, injudicious ground water extraction, deforestation; large scale developmental projects, like dams and nuclear reactors in hazard prone zones; Nature and impact of accidents; Case studies of Bhopal, Minamata and Chernobyl disaster.

Unit 5: Disaster management:

(6 Lectures)

Disaster management cycle; Disaster management plan.

DISCIPLINE SPECIFIC ELECTIVES (DSE) 3: Natural Hazard and Disaster Management (Practical)

Total Hours: 50

Total credit: 2

1. Project Report based on any two field-based case studies among following disasters and one disaster preparedness plan of respective college or locality: -Flood and waterlogging, Cyclone, Earthquake, Human Induced Disasters: Fire Hazards, Chemical, Industrial accidents.
2. Poster preparation and presentation on topic related to national and international disaster and disaster management.
3. Viva -voce.

Suggested Readings:

1. Schneid, T.D. & Collins, L. 2001. Disaster Management and Preparedness. Lewis Publishers, New York, NY.
2. Smith, K. 2001. Environmental Hazards: Assessing Risk and Reducing Disaster. Routledge Press.
3. Singh Savindra and Jeetendra, Disaster Management, Pravalika publication, Allahabad

DISCIPLINE SPECIFIC ELECTIVES (DSE) 4: Solid Waste Management

Theory: 50 Lectures

Total credit: 4

Unit 1: Solid Waste:

(8 Lectures)

Sources and generation of solid waste; their classification and chemical composition; characterization of municipal solid waste; hazardous waste and biomedical waste.

Unit 2: Effect of solid waste disposal on environment:

(8 Lectures)

Impact of solid waste on environment, human and plant health; water quality and aquatic life; mining waste and land degradation; effect of land fill leachate on soil characteristics and ground water pollution.

Unit 3: Solid waste Management:

(12 Lectures)

Different techniques used in collection, storage, transportation and disposal of solid waste (municipal, hazardous and biomedical waste); landfill (traditional and sanitary landfill design); thermal treatment (pyrolysis and incineration) of waste material; drawbacks in waste management techniques; Concept of Integrated waste management.

Unit 5: Resource Recovery:

(10 Lectures)

4R - reduce, reuse, recycle and recover; biological processing - composting, anaerobic digestion, aerobic treatment; reductive dehalogenation; mechanical biological treatment; green techniques for waste treatment.

Unit 5: Policies for solid waste management:

(12 Lectures)

Municipal Solid Wastes (Management and Handling) Rules 2000; Hazardous Wastes Management and Handling Rules 1989; Bio-Medical Waste (Management and Handling) Rules 1998; Plastic Waste (Management and Handling) Rules, 2011; E-Waste (Management) Rules, 2016.

DISCIPLINE SPECIFIC ELECTIVES (DSE) 4: Solid Waste Management (Practical)

Total Hours: 50

Total credit: 2

1. Demonstration of composting techniques including vermicomposting
2. Study of soil microbial activity- Soil respiration (for stability and maturity of compost)

3. Visit to sewage treatment plants/ Visit to waste water treatment plants/ Solid waste management site with field report preparation.
4. Viva-Voce.

Suggested Readings:

1. Hossetti, B.B Prospects and perspective of solid waste management., New age International.
2. Singh, J and Ramanathan, AL 2009. Solid Waste Management: Present and Future Challenges

SKILL ENHANCEMENT COURSE SEC 4: Remote sensing, GIS and its applications

Theory: 30 Lectures

Total credit: 2

Unit 1: Remote Sensing:

(8 Lectures)

Definitions and principles; electromagnetic (EME) spectrum; spectral signature; satellites and sensors; aerial photography and image interpretation.

Unit 2: Geographical Information Systems:

(12 Lectures)

Definitions and components; spatial and non-spatial data; raster and vector data; database generation; database management system; land use/ land cover mapping; GPS survey, data import, processing, and mapping.

Unit 3: Applications of remote sensing and GIS:

(8 Lectures)

Water resource management, land use planning, forest and wildlife resources, agriculture, and atmospheric studies.

Suggested Readings:

1. Remote sensing and GIS (2nd Edition) Basudev Bhatta, Oxford University Press
2. Sabins, F.F. 1996. Remote Sensing: Principles an Interpretation. W.H. Freeman.