

**AKS University, Satna**  
**Department of Environmental Science**

**Teaching & Examination Scheme**

M.Sc. (Environmental Science) Two Years (4 Semester)

Full time Degree Programme

The M. Sc. program will be divided into four semesters. It will carry 92 credits and this will be gained through 4 sections as under

- i) Classroom teaching
- ii) Laboratory and analytical works
- iii) Field Work and
- iv) Project work

**Total credits distribution pattern**

Total Credits	= 92 credits
I) Classroom teaching	= 56 credits
II) Laboratory, Field work and Project work	= 36 credits

**Teaching credit distribution (52 credits)**

- i) Core courses = 36 credits
- ii) Elective courses = 12 credits

Laboratory, Seminar Field work and Project work credit distribution **(36 credits)**

- a) Lab work = 18 credits
- b) Field work = 4 credits
- c) Seminars & presentation = 4 credits
- d) Project work = 12 credits

**II) Lab work, Field work and Dissertation (36 credits)****a) Laboratory and analytical (18 credits)**

The laboratory and analytical works will be done in I<sup>st</sup> and II<sup>nd</sup> semesters.

**b) Field work (2 credits)**

To strengthen the field work component and to have a wider exposure of the field conditions, students will undergo extensive field work during III<sup>rd</sup> semester which will help them in developing the understanding of different aspects of environmental sciences. Each student will submit his/her field work report for evaluation.

**c) Seminars & presentation (4 credits)**

To strengthen the personality, skill development and confidence level to present their work in different sectors and offices.

**d) Project work (12 credits)**

Each student will work for M. Sc. Project under the supervision of formally assigned supervisor in the department. Supervisor can also be from other university/research institute/industry.

Student shall work for his/her project work during entire period of IV<sup>th</sup> Semester. The work on research project will start in last week of 3<sup>rd</sup> semester under the supervision of concerned faculty member and will be completed by IV<sup>th</sup> semester with submission of project report. Project work will be evaluated by a 3 member expert committee (student advisory committees). Students will have to present their work in an open presentation. Students will be encouraged to publish the findings of their project work

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**M.Sc. Environmental Science- I Semester**

S. No.	Subject Code		Subject	Periods			Credit
				L	T	P	
1	79EV101	EVST	Fundamental of Environmental Science	3	1	-	4
2	79EV102	EVST	Natural Resources & Their Conservation	3	1	-	4
3	79EV103	EVST	Environmental Pollution	3	1	-	4
4	79EV104	EVST	Environmental Chemistry	3	1	-	4
5	79EV151	EVSP	Practical Lab-I	-	-	6	3
6	79EV152	EVSP	Practical Lab-II	-	-	6	3
7	79EV153	EVSS	Seminar/workshop				2
<b>Total</b>				<b>12</b>	<b>4</b>	<b>12</b>	<b>24</b>

**M.Sc. Environmental Science- II Semester**

S. No.	Subject Code	Paper Code	Subject	Periods			Credit
				L	T	P	
1	79EV201	EVST	Energy & Environment	3	1	-	4
2	79EV202	EVST	Waste Management	3	1	-	4
3	79EV203	EVST	Pollution Control Technology & Management	3	1	-	4
4	79EV204	EVST	Remote Sensing & Geoinformatics	3	1	-	4
5	79EV251	EVSP	Practical Lab-I	-	-	6	3
6	79EV252	EVSP	Practical Lab-II	-	-	6	3
7	79EV253	EVSS	Industrial visit/Field work/ Educational tour (max. 7days)				2
<b>Total</b>				<b>12</b>	<b>4</b>	<b>12</b>	<b>24</b>

**M.Sc. Environmental Science- III Semester**

S. No.	Subject Code		Subject	Periods			Credit
				L	T	P	
1	79EV301	EVST	Environmental Microbiology & Biotechnology	3	1	-	4
2	79EV302	EVST	Environmental Law, Policies & Ethics	3	1	-	4
3			<b>Elective paper Grp A Choose any one</b>	3	1	-	4
	79EV303A	EVST	i. National Issues & Disaster Management				
	79EV303B		ii. Basics of Physical Environments & Earth Sciences				
	79EV303C		iii. Environmental Toxicology				
4			<b>Elective paper Grp B Choose any one</b>	3	1	-	4
	79EV304A	EVST	i. Research Methods & Paper Writing				
	79EV304B		ii. Environmental Instruments & analytical techniques				
	79EV304C		iii. Environmental statistics and modeling				
5	79EV351	EVSP	Practical Lab-I	-	-	6	3
6	79EV352	EVSP	Practical Lab-II	-	-	6	3
7	79EV353	EVSF	Field work				2
<b>Total</b>				<b>12</b>	<b>4</b>	<b>12</b>	<b>24</b>

**M.Sc. Environmental Science- IV Semester**

S. No.	Subject Code		Subject	Periods			Credit
				L	T	P	
1	79 EV401	EVST	Industrial Safety & Hygiene	3	1	-	4
			<b>Elective paper Grp C Choose any one</b>	3	1	-	4
2	79EV402A	EVST	i. EIA & EMS				
	79EV402B		ii. Environmental Economics				
3	79EV451	EVSP	Major Project/Dissertation viva				12
<b>Total</b>							<b>20</b>

## I Semester

### EVST - 79EV101

#### Paper-1: Fundamental of Environmental Science

(3+1)

**Preamble:** This paper has been design to give basic concept about environment & its structures, components, function so as to make students to understand all the aspects & issues regarding nature as well as make them capable in understanding & decision making at their level.

#### Unit-1: Introduction to Environment & Environmental Science

Environment- Definition & Components. Definition, Scope and Multidisciplinary nature of Environmental Science, Goal of Environmental awareness and education. Environmentalists and Environmental movements in India. Brief introduction to environment regulatory organizations in India- MoEF, CBCB, SPCB.

#### Unit-2: Ecology

Definition, scope, branches of Ecology, application and significance, ecological landmark, ecological status in India, environmental factors: abiotic and biotic, limiting factors, Leibig's Law, Shelford's law, ecological indicators. Ecological Relationship: Intraspecific & Interspecific

#### Unit-3: Ecosystem

Concept and definition of ecosystem, types, components, structure & function of ecosystem. Factors affecting ecosystem. Energy flow in the ecosystem, food chain, food web & Ecological pyramids, biomes.

#### Unit-4: biodiversity and its conservation

Definition and types of biodiversity, Biodiversity hotspots, threats to biodiversity. Red data book, ERT and endemic species of India. Biodiversity conservation strategies, biogeographical classification of India.

#### Unit-5: Population & Community

Definition, population characteristics, population regulation– biotic potential and environmental resistances (r and k selections); Factors of population regulation – density dependent and density independent; and carrying capacity; genecology, Ecads, Ecotypes, Ecospecies, Niche, Keystone species, invasive species. Community – analytical and synthetic characters.

#### Text Books

1. Introduction to Environmental Science, Anjaneyulu, Y. (2009) BSP Books Pvt. Ltd., Hyderabad.
2. Ecology, Arora.M.P, Himalaya Publication
3. Ecology & Environment, Sharma.P.D., Rastogi Publication, Meerut
4. Ecological methods for field and laboratory investigation – Michael
5. An Introduction to Ecology and Environmental Science – Prabu
6. Ecology and Environmental Biology-Saha

**Reference Books**

1. Begon, M., Townsend, C. R., and Harper, J. L.. *Ecology from Individuals to Ecosystems*. Wiley-Blackwell, USA. 2005.
2. Botkin, Daniel B. and Keller, Edward A. *Environmental Science: Earth as a Living Planet*. 6<sup>th</sup> ed. John Wiley & Sons, USA, 2007.
3. Chapman, J. L. and Reiss, M. J. *Ecology: Principles and Applications*. Cambridge University Press, UK., 1998.
4. Odum, E.P. *Fundamentals of Ecology*. W.B. Saunders, USA. Indian Reprint 1996,

**EVST - 79EV102****Paper-2: Natural Resources & Conservation****(3+1)**

**Preamble:** This paper takes an objective view of the nature of Earth's resources, particularly the nonrenewable resources, how and where they are generated, how they are extracted and used, and how these activities impact Earth's environment. It also addresses sustainability by looking into different ways of conservation of the natural resources and their management.

**Unit-1: Introduction**

Definition and types of resources, resources of India, carbon credit & carbon footprint. Sustainable development- concept and issues. Role of an individual in conservation of natural resources.

**Unit-2: Forest Resources**

Forest Products and Environmental importance of forests. Forest covers in India. Afforestation and Deforestation, Joint Forest Management. Forest Fire and its Control. Forest conservation.

**Unit-3: Water Resources**

Forms and types of water. Earth's water distribution. Global water balance. Origin and composition of sea water. Resources of ocean. Factors influencing the surface water. Ground water provinces of India. Water demand, Desalination, Impact of Dam & Mining on Water resources. Water Conservation Strategies in India–Rain Water Harvesting and watershed management.

**Unit-4: Land & Food Resources**

Land as a resource, land degradation, soil erosion and desertification, wetland management, Soil Conservation Strategies.

Types of food resources, World food problems, Impacts of climate change on food production. Impact of modern agriculture and pesticides on agriculture.

**Unit-5: Mineral Resources**

Types, mineral resources in India. Oceans as new areas for exploration of minerals resources, Ocean ore and recycling of resources. Environmental impact of exploitation, processing and smelting of minerals. Conservation of Mineral resources.

**Text Books**

1. Environmental Ecology: Gurudeep Raj, P.R.Trivedi, Akashdeep Publishing House, New Delhi.
2. Forests in India: V. P. Agrawal, Oxford & IBH Publishing Co. Pvt.Ltd. New Delhi, (1968)
3. An Introduction to Environmental Management: Dr. Anand S. Bal, Himalaya Publishing House (2005)
4. A Textbook of Environmental Studies: Dr. Satyanaraya, Dr. S.R. Sitre, Dr. S.B. Zade, Dr. P.U. Meshram, Allied Publisher.
5. A Text Book of environmental Sciences: Purohit, Shammi, Agarwal, Student edition, Jodhpur, 2012

**Reference Books**

1. Botkin, Daniel B. and Keller, Edward A. *Environmental Science: Earth as a Living Planet*. 6th ed. John Wiley & Sons, USA. 2007.
2. Enger, E.D. and Smith, B. F. *Environmental Science: A Study of Interrelationships*. 11<sup>th</sup> ed. McGraw Hill Inc., USA. 2006.
3. An Introduction to Environmental Management: *Dr. Anand S. Bal, Himalaya Publishing House (2005)*.



**EVST - 79EV103****Paper-3: Environmental Pollution****(3+1)**

**Preamble:** Various pollutions cause adverse health effects. A large number of diseases are caused and spread by contaminated soil, water and air. This paper focused on the source, pathways & impacts of environmental pollutants on health & property.

**Unit-1: Air Pollution**

Definition, Primary and secondary air pollutants, sources of pollution. Transport & diffusion of pollutants. Effects of pollutants on human beings, plants, animals, materials and on climate.

**Unit-2: Water & Marine Pollution**

Definition, Types of pollutants- Physical, Chemical & Biological, Sources and effects of water & marine pollution.

**Unit-3: Soil Pollution**

Definition, Sources and effects soil pollution, Physico-chemical and bacteriological sampling and analysis of soil; Industrial waste, heavy metals and their interaction with soil components; Soil micro-organisms and their functions.

**Unit-4: Noise Pollution**

Definition, Sources & effects of noise pollution, measurement of noise and indices, effect of meteorological parameters on noise propagation, noise exposure levels and standards.

**Unit-5: Nuclear & Thermal pollution**

Definition & sources & biological effects of radiation; Thermal Pollution – causes & consequences

**Text books**

1. Environmental Problems and Solution: D.K. Asthana, S.Chand and Company, New Delhi.
2. Air Pollution : B. K. sharma, H. Kaur ( Krishna prakashan media, Meerut )
3. Water Pollution: V. P. Kudesia, Pragati Prakashan, Meerut.
4. Soil pollution & Soil organisms : P. C. Mishra
5. Noise Pollution: B. K. Sharma, H. Kaur, Goel Publishing House, Meerut, 1994

**Reference Books**

1. A text book of Environmental Chemistry and Pollution Control: S.S. Dara.
2. Environmental Pollution Analysis: Khopkar.
3. Environment Chemistry: A. K. de, New Age Publication
4. Water Pollution – Causes, Effects, and Control – P.K.Goel, New age International

**EVST - 79EV104****Paper-4: Environmental Chemistry****(3+1)**

**Preamble:** The course introduces the students to some basic chemistry relevant to the course, and to the general chemistry of the lithosphere, hydrosphere and atmosphere. Emphasis is also placed on understanding the chemistry of various anthropogenic pollutants and basic analytical techniques.

**Unit-1: Fundamental**

Concept & Scope of environmental chemistry, stoichiometry, Gibb's energy, chemical potential, chemical equilibria, acid base reactions, solubility product, solubility of gases in water, the carbonate system, unsaturated & saturated hydrocarbons, radionuclides.

**Unit-2: Atmospheric Chemistry**

Classification of elements, chemical speciation, particles, ions and radicals in the atmosphere, chemical processes for formation of inorganic & organic particulate matter, thermochemical & photochemical reactions in the atmosphere, oxygen & ozone chemistry, chemistry of air pollutants, photochemical smog. Acid rain- Fundamental, Effects.

**Unit-3: Water Chemistry**

Properties of water, chemistry of water, concept of DO, BOD, COD, sedimentation, coagulation, filtration, redox potential.

**Unit-4: Soil Chemistry**

Formation, constituents and properties of soils; adsorption of contaminants; Inorganic & organic components of soil; nitrogen pathways & NPK in soils.

**Unit-5: Green Chemistry for Sustainable Future**

Reagents, Media, Special Importance of Solvents, Water the Greenest Solvents, Synthetic and Processing Pathways, Role of Catalyst, Biological Alternatives, Biopolymers, Principles and Application of Green Chemistry, Zero waste technology.

**Text Book**

1. Environmental Chemistry: B.K. Sharma, and H. Kaur. *Goel Publishing House*,
2. Environmental Chemistry, Manahan. Stanely Lewis Publishers.
3. Elements of Environmental Chemistry: *H. V. Jadhav ( Himalaya, Publishing House)1992.*
4. Environmental Chemistry with Green Chemistry, Asim K. Das, Books and Allied (P) LTD. Kolkata.

**Reference Books**

1. Environmental Chemistry : *A.K.Dey, (Wiley Eastern Ltd),1987.*
2. Environmental Chemistry –a modular approach, Williams Ian, Willey John & Sons

**EVSP- 79EV151****Practical Lab-1**

1. Determination of minimum size of quadrat for community study.
2. Determination of density, frequency, abundance and dominance of plant species using quadrat method.
3. Calculation of the Importance Value Index (IVI) of species
4. Determination of diversity by Simpson index
5. Calculation of richness, evenness and dominance of species
6. To study the biotic components of a pond eco system.
7. To study a biotic components of a grassland ecosystem.
8. Calculation of similarity index between two adjoining communities.
9. Estimation of moisture, pH and conductivity of soils under different land uses.
10. Determination of tree height, trunk height & canopy cover & Its importance
11. Identification of tree species at AKSU campus

**EVSP- 79EV151****Practical Lab-2**

1. Laboratory concepts: Rules and regulation, preparation of standard solutions.
2. Handling of digital instruments of laboratory.
3. Sampling methods & storage techniques of water & soil
4. Estimation of temperature, pH, conductivity and turbidity of water samples.
5. Measurement of noise of Industrial, Residential & Silent zone
6. Determination of alkalinity of water samples.
7. Measurement of Acidity, TDS of a water sample
8. Physical properties of soil: Determination of textured and particle size distribution
9. Determination of wind velocity and direction by anemometers
10. Determination of relative humidity by psychomotor

## II Semester

EVST- 79EV201

### Paper-1: Energy & Environment

(3+1)

**Preamble:** This paper helps the students to understand different energy sources, requirements & its environmental issues that have become serious national as well as global matter. It will also provide an understanding of the links between energy use & environmental quality.

#### Unit-1: Introduction

Human energy requirement, Energy use pattern in different parts of the world and its impact on the environment; Energy use pattern in India; Sources of energy and their classification; Energy forms and transformation, Global energy balance. Problems related to various energy uses.

#### Unit-2:

Current energy scenario: India and World, Principles of Energy management, Energy policy, Energy action planning, Energy security and reliability, Energy and environment, Need of Renewable and energy efficiency.

#### Unit-3: Non-renewable Sources of Energy

Non-renewable energy sources: Fossil fuels – Composition and Classification of coal, crude oil and natural gas – Consumption and demands of coal, crude oil and natural gas – Environmental impacts of fossil fuel consumption

#### Unit-4: Renewable Sources of Energy

Principles of generation of - hydroelectric power, tidal power, Ocean Thermal Energy Conversion (OTEC), Wind energy and geothermal energy. Solar collectors, Photovoltaics, Solar pond, Environmental implication of energy use. Impacts of large scale exploitation of Solar, Wind, Hydro and ocean energy.

#### Unit-5: Energy conservation

Energy efficiency: introduction, definition, importance and benefits of energy efficiency.

Energy audits: report & its format, energy conservations, Primary identification of energy conservation opportunities, energy actions plan.

**Text Books**

1. An Introduction to Energy Sources: Viswanathan B (2006).
2. Solar Energy: Tiwari, G.N. Narosa Publishing, New Delhi, (2005)
3. Renewable Energy and Environment - A Policy Analysis for India: Ravindranath, N. H., Usha Rao, K., Natarajan, B. and Monga, P., Tata-McGraw Hill, New Delhi
4. Non-conventional Energy Sources: Rai, G.D. Khanna Publishers, (2011)
5. Handbook on Energy Audit and Environment management, Abbi Y. A., Jain Shashank, TERI, New Delhi, 2006

**Reference Books**

1. Ecology, Environment and Resource Conservation: Singh, J.S., Singh S.P. and Gupta S.R., Anamaya Publishers, New Delhi, 2006.
2. Energy and the Environment: Fowler, J. M., McGraw Hill, (1984)
3. Energy Science- Principle, Technologies, and Impacts: John Andrews and Nick Jelly, Oxford University Press, UK. (2007)
4. Energy System and Sustainability: Boyle, G., Bob Everett and J. Ramage, Oxford Univ. Press, New York. (2003)
5. General Aspects of Energy Management and Energy Audit, Bureau of Energy Efficiency, Govt of India

**EVST- 79EV202****Paper-2: Waste Management****(3+1)**

**Preamble:** This paper provides an overview of the basic concepts of waste & the needs for its management. It covers various treatment technologies and their application to different solid wastes, and shows the pathways of their management.

**Unit-1: Fundamental**

Definition, sources & types of different solid wastes, composition & types of various wastes Municipal waste, hazardous waste, biomedical waste & e-waste; environmental & health impacts of various waste.

**Unit-2: Municipal Solid Waste Management**

Integrated Solid waste Management; Waste reduction at source, Collection techniques/Methods and Transport of solid waste, the 4R strategies for waste management. Landfill method & landfill gas; composting, vermi-composting, biofertilizers, Energy from Waste- Incineration, Pyrolysis, Gasification, Refuse derived fuels, Biogas. Specification of landfill sites as per rule.

**Unit-3: Hazardous Solid Waste Management**

Physico-Chemical, Biological and Thermal Destruction of Hazardous Wastes, Incineration, Pyrolysis, Wet Air Oxidation, Secured Landfill, Land Farming; guidelines for identification of landfill for Hazardous Waste Disposal.

**Unit-4: Biomedical Waste Management**

Guidelines for collection, storage & transportation of biomedical wastes; different containers & labeling, incineration of biohazard wastes, biohazard & cytotoxic hazard symbol

**Unit-5: E-waste Management**

Collection, storage & segregation of e-waste, amount of e-waste worldwide, global trade issue; management.

**Text Books**

1. Environmental engineering: G.N.Pandey, G.C. Carney, Tata McGraw Hill Education Pvt Ltd, New Delhi
2. Environmental engineering: Howard S. Peavy, Donal R. Rowe, George Tchobanoglous, McGraw Hill Education Pvt Ltd, New Delhi.
3. Solid waste pollution: Dr.Aradhana Salpekar, Jnanada Prakashan, New Delhi, 2008
4. Environmental Pollution Control Engineering: C. S. Rao, New age International, Mumbai, 2003
5. Environmental Science Principles and Practices: R. C. Das, D. K. Behra, Printice, Hall, New Delhi, 2008

### Reference Books

1. Hospital Waste Management: Acharya, D.B. and Singh, M. Minerva Press, Delhi. 2003.
2. Industrial Waste: Alleman, J. E. and Karanagh, J. T. Ann Arbor Science.1982.
3. Solid and Hazardous Waste Management: Bhatia, S.C. Atlantic Publishers, 2007.
4. Bio-waste and Biological Waste Treatment: Evans, G. James and James (Science Publishers) Ltd, U.K. 2005.

**EVST- 79EV203****Paper-3: Pollution Control Technology & Management****(3+1)**

**Preamble:** Pollution control technologies enable students to solve various environmental pollutions in environmental sound way. This paper also includes various guidelines of Government of India regarding the standards of different pollutants in different domains, making students more aware about recent techniques & finding solutions.

**Unit-1: Air pollution control**

Methods of air pollution monitoring and analysis, stack sampling & monitoring, Role of green belt in air pollution control. Engineering methods of air pollution control- Gravity settling chamber, Cyclonic precipitators, Electrostatic Precipitators (ESP), Fabric filters, Scrubbers- Wet & Dry. Catalytic converter & Vehicular emission control. Personal Protective equipments for Dust & Gaseous pollutants, NAAQS by CPCB

**Unit-2: Water pollution control**

Water Quality Standards, Physico-chemical & bacteriological sampling and analysis of water, Sewage and waste water treatment and recycling, Bioreactors for waste water treatment, Design aspects of major units in treatment plant & their function, Thermal pollution & Marine pollution control, CPCB standards for waste water & drinking water.

**Unit-3: Soil Pollution Control**

Degradation of different insecticides, fungicides and weedicides in soil, Control of soil pollution.

**Unit-4: Noise Pollution control**

Noise control and abatement measures, Ear plug, ear muffs, noise barriers, plants that control noise pollution, Noise pollution standards by CPCB

**Unit-5: Radiation & thermal pollution control**

Models of radioactive decay, Detection of nuclear radiations, Control of thermal pollution.



**Text books**

1. Basic Water Treatment: George Smethurst, Scientific Publishers, Jodhpur.
2. Air Pollution : V. P. Kudesia ( Pragati Prakashan, Meerut )
3. Noise Pollution and Control Strategy: S.P. Singal, Narosa Publishing House, New Delhi.
4. Environmental Pollution Control Engineering: C. S. Rao, New age International, Mumbai, 2003

**Reference Books**

1. Manual on sewerage & sewage treatment: Ministry of works & housing, New Delhi.
2. Physico-chemical; Process of water quality control: W. J. Webber, Wiley inter-science.
3. Indian standard for drinking water, sewage, noise & Air, CPCB, New Delhi.
4. Solid and Hazardous Waste Management: Rao, M. N. and Sultana, R., BPS Books Pvt. Ltd, Hyderabad. (2011)
5. Municipal Solid Waste management- Processing, Energy Recovery Global Examples: Reddy, Jayarama P., BSP Books Pvt. Ltd, Hyderabad. (2011)
6. Handbook of Environmental Health and Safety – principle and practices (Vol. II): H. Koren; Lewis Publishers

**EVST- 79EV204****Paper-4: Remote Sensing and Geoinformatics****(3+1)**

**Preamble:** This paper introduces various methods used in the collection of data and analysis for environmental studies. Remote sensing is increasingly being used in investigating resources, disasters and many more various factors. The students will be benefited in learning & applying various techniques of remote sensing and GIS in different aspects of environmental studies.

**Unit 1 Fundamentals**

Fundamentals of Remote sensing & GIS, Principles of aerial photography and satellite remote sensing, electromagnetic spectrum (EMS), RS Platforms and Sensors, Spectra of Environmental Components, ground truth data collection; GPS Technology and Navigation.

**Unit 2**

**Date acquisition:** aerial photography, cameras and satellite data: Orbits (sunsynchronous, geosynchronous, Polar), Multispectral scanners, CCD cameras, Imager analysis: elements of aerial photographic interpretation, stereoscopic data analysis and series of satellites. Future prospects of remote sensing in India.

**Unit 3 Satellite Image Analysis & Photogrammetry:**

Image characteristics, pre-processing, image classification (supervised and unsupervised), change detections, Principles of GIS, raster and vector GIS, Data input, database creation, data storage, database standards, processing and manipulation.

**Unit- 4: GIS & GPS**

Basic concepts & technology of GIS, Raster and vector data, Map projection, Topology creation, overlay analysis.

**Global Positioning System (GPS):** Basic principles, Applications to environmental studies

**Unit- 5: Remote Sensing & GIS Applications**

Remote sensing & GIS application in Forestry, Environmental degradation, Agriculture, Soil survey and soil mapping, Decision Support System for Disaster Management, water quality mapping.

**Text Books**

1. Fundamentals of Remote Sensing: George Joseph, Universities Press Hyderabad, 2005
2. Remote Sensing and GIS: M. Anji Reddy, BS Publications, Hyderabad, 2008
3. GIS Basics: Shahab Fazal, New Age International Publishers, New Delhi, 2008
4. Geographical Information Systems: Anil K. Jamwal, Jnanda Prakashan, New Delhi, 2008

**Reference Books**

1. Remote Sensing of the Environment – An earth resource perspective: J. R. Jensen; Pearson Education
2. An Introduction to GIS: Heywood, Pearson
3. Essentials of GPS: N. K. Agarwal; Spatial Networks Pvt. Ltd., Hyderabad. (2004)
4. Principles of Geographical Information System for Land Resource Assessment: Burrough, P.A. Oxford Univ. Press, (1986).
5. Remote Sensing & Image Interpretation: Lillesand T.M. & Kiefer R.W. (1987). 2<sup>nd</sup> Ed.

**EVSP- 79EV251****Lab-1**

1. Visit to cogeneration or waste heat recovery plant and submit a report.
2. Study the electrical tariff calculations.
3. Working principle of photovoltaic cell.
4. Perform energy audit of a AKS University and submit report with recommendation.
5. Study of composition of Municipal Solid Waste
6. To determine the moisture content in given solid waste sample.
7. To determine the pH of a given sample of hazardous waste by universal indicator method and pH meter method.
8. To determine NPK in solid waste material.
9. To determine C/N ratio in solid waste.
10. A visit to normal and secured landfill site, biological composting/vermicomposting

**EVSP- 79EV252****Lab-2**

1. Field visit to river/lake and water and wastewater treatment plants.
2. Determination of Biological Oxygen Demand of water sample.
3. Determination of Chemical Oxygen Demand (COD) of water sample.
4. Estimation of dissolved oxygen (DO) of water samples.
5. Determination of PM10 and PM 2.5 in ambient air by Dust Sampler.
6. Monitoring and analysis of Gaseous pollutants.
7. Stack monitoring and sampling of pollutants in industry.
8. Study of air pollutant control devices in an industry.
9. MAP Reading & Identification of signs & Symbols used in MAPS.
10. Preparation of Base map from Survey of India Topo sheets.
11. Latitude & longitude measurement of 10 spots at AKSU campus by GPS device.

### III semester

EVST: 79EV301

#### **Paper: Environmental Microbiology & Biotechnology**

**(3+1)**

**Preamble:** The paper emphasized to provide comprehensive knowledge about various toxic materials, microbes, their importance & culture methods and to develop remedial measures for environmental damage using microbial green technologies.

#### **Unit-1: Introduction to Environmental Microbiology**

Introduction, scope, importance of environmental microbiology, structure of microorganisms- fungi, bacteria, virus, classification of microorganisms, microbial diversity. role of microorganisms in air, water and soil for microbial qualities, environmental aspects of infectious diseases (Water Born Diseases),

#### **Unit-2: Microbial Diversity**

Fundamental concept of bacteria, fungi, actinomycetes; microbial diversity in man-made ecosystems and natural ecosystems; importance of microbes in nutrient cycling

#### **Unit-3: Microbial Methods**

Types of culture, sterilization and disinfection, techniques used of enrichment of culture, method of pure culture, preparation, maintenance and preservation of microbial culture (Pour plate, Streak plate and Spread plate).

#### **Unit-4: Environmental Biotechnology**

Introduction, basic of environmental biotechnology, definition and Scope of biotechnology, biotechnological approach of environmental pollution control, energy management and abatement, bioremediation, reclamation and restoration.

#### **Unit-5: Biotechnology for Environmental Protection**

Scope of biotechnology in pollution control, bioremediation, microbes used in pollution mitigation, bioleaching, biomining, waste water treatment, bio-control agents- bio-pesticides, bio-insecticide, mushroom cultivation and vermiculture, bioethics and biosafety.

**Text Books**

1. Hand book of Microbiology: Yu. S. Krivashein (Mir Publishers Moscow)
2. Microbiology for Environmental Engineering: M. C. Kinnery (Tata McGraw-Hill Publishing Company Limited, New Delhi),
3. Environmental Biotechnology: S. N. Jogdand, Himalaya Publishing House, Mumbai (2006).
4. A Textbook of Biotechnology: R. C. Dubey, S. Chand & Company, New Delhi (2002).
5. Biotechnology: B.D. Singh, Kalyani Publishers

**Reference Books**

1. Microbiology: P. D. Sharma, (Rastogi publication Meerut)
2. Environmental Biotechnology-Theory and Application: Evans, G.M. and Furlong J.C. John Wiley and Sons. 2003
3. Biotechnology for Waste and Wastewater Treatment: Cheremisinoff, N. P., William Andrew Publishing, New York. (1996)
4. Biotechnological methods of Pollution control: Abbasi, S. A. and E. Ramasami, University Press, Hyderabad. (1999)
5. Basic Environmental Microbiology: Srivastava, M. L., Manohar Books, New Delhi. (2003)

**EVST: 79EV302****Paper-2: Environmental Laws, Policies and Ethics****(3+1)**

**Preamble:** Environmental law is that branch of law for planetary housekeeping, protecting the planet and its people. This paper aims to understand and apply a range of regulatory instruments to preserve and protect the environment. It also emphasizes on identifying the strengths and weaknesses in law and its enforcement and develop strategies to overcome the same.

**Unit-1: Introduction**

National & international efforts for environmental protection, environmental policy resolution, public policy strategies in pollution control, scheme of labeling of environmentally friendly products (ecomark), Biosafety- issues & protocol. IPR- basic concept

**Unit-2: Environmental Laws**

Environment (Protection) Act 1986, Forest Conservation Act 1980, Wildlife (Protection) Act 1972, Water (Prevention and Control of Pollution) Act 1974; Air (Prevention and Control of Pollution) Act 1981; Bio-Medical Waste (Management & Handling) Rules, 1998; Hazardous Waste (Management, Handling Rules, 1989); Plastics manufacture, Sale and Usage Rules, 1999. Public Liability Insurance Act, 1991; Municipal Solid Waste (Management & Handling) Rule, 2000.

**Unit-3: Environmental Policy in India**

National Environmental Policy: National Policy, Regulatory Framework: Rule & regulations of central & state Government and Central & State pollution control boards for Safeguard for Environmental Protection

**Unit-4: Environmental Treaties and Conventions**

Evolution and development of International Environmental laws with reference to Stockholm Conference on Human Environment, 1972, Ramsar Convention on Wetlands, 1971, Montreal Protocol, 1987, Basel Convention (1989, 1992), Earth Summit at Rio de Janeiro, 1992, UNEP, GEF, UNFCCC and IPCC, Kyoto Protocol, 16 1997; Earth Summit at Johannesburg, 2002. UN Summit on Millennium Development Goals 2000, Copenhagen Summit 2009.

**Unit-5: Environmental Ethics**

Basic concepts of ethics, value education, corporate social responsibility, Movements related to Environment – Chipko movement, Narmada bachhao aandolan, Silent Valley, Role of NGOs in environmental protection, Environmentally Significant Days. Sustainable Development: Definition and concepts of sustainable development,

**Text Books**

1. Environmental Law and Policy: Diwan Shyam and Rosencranz Armin, 2002
2. Environment and Pollution Law: Mohanty. S. K., Universal Law Publishing Co. Pvt. Ltd. 2004
3. Environmental law in India: Shastri, S.C. Eastern Book Co, Lucknow. 2008
4. Environmental Ethics- An invitation to Environmental philosophy: Des Jardius, J.R., (3<sup>rd</sup> Ed.), Wadsworth Publication, Belmont, California. 2001

**Reference Books**

1. Constitution of India [Referred articles from Part-III, Part-IV and Part-IV-A].
2. CPCB, 2010, [Revised], Pollution Control Acts, Rules and Notifications Issued there under.
3. Declaration of: The Stockholm Conference, Rio, Rio+5 and Rio+10.
4. Jaswal, P.S. and Jaswal, N. Environmental Law. Pioneer Publications, Delhi. 2003.
5. Leelakrishnan, P. Environmental Law in India. LexisNexis Butterworths Wadhwa, Nagpur. 2005.
6. Tiwari, R. K. Global Environmental Policies. A B D Publishers.2007.



**EVST: 79EV303A****Elective Paper Group A (CHOOSE ANY ONE PAPER )****Paper-A1: National Issues & Disaster Management****(3+1)**

**Preamble:** This paper enlightened two different aspects one is society & its issues and another is disaster issues and its control. It is very essential to know about the society & relevant issues simultaneously with environmental problems that enables learners in decision & policy making in a holistic approach.

**Unit-1: Environmental Issues**

Delhi case study, solid waste problem, population growth & environment, water crisis in India, GHG<sub>s</sub> emission & low carbon lifestyles.

**Unit-2: Social Issues**

Illiteracy, poverty, child marriage, child labour, sanitation issues & diseases. Poor education, less opportunity for youth, food wastage, health issues

**Unit-3: Fundamental of Disaster**

Disasters- definition & types, chemical disaster, BLEVE, natural disasters & artificial disaster-causes & effects, case studies in India, disaster management authorities in India, NDMA & NIDM, Hazchem code- a basic concept.

**Unit-4: Risk Assessment**

Risk analysis - definition of risk, Environmental risk analysis, risk assessment and risk management, Basic steps in risk assessment - hazard identification, dose- response assessment, exposure assessment, Risk characterization.

**Unit-5: Disaster management**

Pre & post disaster management, planning, prevention, mitigation, preparedness, response, recovery; guidelines for disaster management.

**Text Books**

1. Population, Environment and Society: Borrie, W.D., O.U.P., U.K. 1988.
2. Geology, Environment and Society: Valdiya, K.S., Universities Press. 2004
3. Technology and Global Environmental issues: Makofske, W.J. and Karlin, E.F., Addison Wesley, Toronto. 1995
4. Geological Hazards-Their Assessment, Avoidance and Mitigation: Bell. F.G, E & FN Spon, e- Books der ULB Darmstadt. 1999

### Reference Books

1. Environmental Risks & Hazards: Cutter, Susan, L., Prentice Hall of India Pvt. Ltd. N. Delhi. (1999)
2. Disaster Management: Gupta, H., University Press, Hyderabad. (2003)
3. Encyclopaedia of Disaster Management series: Sinha, P.C., Anmol Publication., New Delhi. (1998)
4. Environmental Hazards-Assessing Risk and Reducing Disaster: Smith Keith, Routledge. 2001

**EVST: 79EV303B****Paper-A2: Basics of Physical Environments & Earth Sciences****(3+1)**

**Preamble:** This paper helps to understand ground level of the earth & its various components where we are living and that enable students to value the Mother Nature. This paper will let the students aware about the function & structure of the biosphere & the importance of them.

**Unit-1: Fundamental**

Definition, Principles and scope of Environmental Science, Human's relationship with the environment, physico-chemical and biological factor in environment, earth as a whole ecosystem, mass and energy transfer across the various interface, environmental challenges before humans & need to study the environmental sciences

**Unit-2: Atmosphere**

Origin and evolution of atmosphere, structure and composition of atmosphere; evolution of atmosphere; composition of air; atmospheric temperature; atmospheric pressure; earth's radiation balance

**Unit-3: Hydrosphere**

Hydrology and hydrogeology, global distribution of water, Water balance, water flow hydraulics, types of water, hydrological cycle, factors affecting the surface water, artificial recharge and rain water harvesting, water resource management, aquifers

**Unit-4: Lithosphere**

Primary differentiation and formation of core, mantle, crust, rocks and minerals, concept of minerals and rocks, weathering, erosion, transportation and deposition of earth's materials by running water, wind and glaciers.

**Unit-5: Fundamentals of Geology**

Major endogenic and exogenic processes, geological agents of changing environment viz. tectonics, magnetism, weathering, erosion and deposition, common geological structures- bedding, fold, faults, cleavages, fractures, deposits

**Text Books**

1. Environmental Geology: Validia.K.S, Tata Mc Grace Hills Publishing Co. Ltd. New Delhi.
2. Atmosphere, Weather and Climate: Barry and Choslay, The English Language Book Society.
3. A Text Book of Environmental Studies: D. K. Asthana and Meera Asthana, S. Chand & Co., New Delhi.
4. Essentials of Ecology & Environmental Science: S.V.S. Rana, Prentice Hall of India Pvt. Ltd., New Delhi.

**Reference Books**

1. Environmental Science: Enger, Smith and Smith W.M.C. Brown company publication
2. Environmental Science: Botkin and Kelter, John Wiley and Sons, New York.
3. Environmental Science: S.C. Santara, New Central Book Agency (P) Ltd.,Kolkota.

**EVST: 79EV303C****Paper-A3: Environmental Toxicology****(3+1)**

**Preamble:** This paper deals with various toxic elements in the environment, how they enter in the system & in body and their negative impacts so as the students can identify the exact problem & their sources in problem solving. This paper also makes the students strong in practical field & research towards environmental sound problem solving.

**Unit-1: Fundamental**

Concept of toxins, toxicity and toxicology, Classification of toxic compounds, Dose effect and Dose response relationship, levels of toxicity – acute, sub acute and chronic, Types of toxicants, classification of toxicants – factors that affect environmental concentration of toxicants, Chemical and biological factors influencing toxicity.

**Unit-2: Toxicity Assessment**

Concept of LC 50, LD 50 and ED 50. Biotransformation, bio magnification, bio concentration, bio accumulation, bioactivation toxicants in ecosystem. Bioassay methods using plants and animal model.

**Unit-3: Epidemiological study**

Concept, monitoring techniques with respect to Arsenicosis and Fluorosis, vector borne disease. Environmental risk evaluation and evaluation and management: an overview.

**Unit-4: 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.

**Unit-5: Occupational health**

Basic principles of occupational health, the occupation- hygiene relationship, safety and diseases, Health maintenance: Survey, analysis and recommendations regarding health and safety problems in the working and living environment.

### **Text Books**

1. Environmental biology and toxicology: P.D.Sharma, 1997-98.
2. Modern toxicology: P.K.gupta and D.K.Shinlee,
3. Elements of Toxicology: Shukla J.P and Pandey, Radha publ., New Delhi.
4. Fundamentals of Ecotoxicology: Newman, M.C, Lawrence, C.A., and Unger. M.A., 2002, 2nd Ed., CRC Press, Boca Raton, Florida.

### **Reference Books**

1. Basic Environmental Toxicology: Cockerham L.G and Shane B.S, CRC press, Bocaraton, USA.
2. Principles of Ecotoxicology: Walker, C.H., Hopkin, S.P., Sibly, R.M., and Peakall, D.B. 2001, 2nd Ed. Taylor & Francis, London. 36
3. Living with the Earth: concepts in Environmental Health Science (2nd Ed.): Moore, G.S., 2002, Lewis publishers, Michigan.
4. Encyclopaedia of Environmental Pollution and Control: Trivedy, R. K (1994), Enviromedia publications, Karad.

**Elective Paper Group B (CHOICE ANY ONE PAPER)****EVST: 79EV304A****Paper-B1: Research Methods and Paper Writing****(3+1)**

**Preamble:** Research methodologies are the most important part to develop ideas & guidelines in problem solving in various aspects technically & scientifically. This paper enables students to make their ideas come true in higher study & paper writing in a proper channel those would have a great contribution towards nature, society & mankind.

**Unit-1: Fundamental**

Concept & methods of research, classification of research, planning research projects, measurement of research problems, use of sampling, & questionnaires construction for research, processing of research data & preparation of research report.

**Unit-2: Statistical Analysis**

Sampling, data collection and recording, central tendency – concept; arithmetic mean, mode, median for ungrouped and grouped data, measures of dispersion: absolute and relative measures; range, standard deviation (grouped and ungrouped data), variance, quartile deviation, coefficient of variability, probability - normal, poisson and binomial, tests of hypothesis and significance.

**Unit-3: Statistical Methods**

Hypothesis testing, significance and correlation, correlation, linear models and regressions, pearson and other correlation coefficients, multiple Regressions, distribution- normal, t and chi square test, difference among means, F-test.

**Unit-4: Computer**

Fundamental of computer, MS Office- word, excel, power point, statistical software for data analysis (SPSS), data presentation.

**Unit-5: Scientific Paper Writing**

Basic principles of research design, execution and reporting; concept of research articles, research papers, reviews, scientific popular articles; components of a research article (title, author-line, address, abstract, summary, hypothesis, keywords, introduction, methodology, observations, discussion, conclusion, citing relevant work of others; Reference protocols; copyright Act (in brief), plagiarism, Cheating / academic frauds; process of reviewing; Concept of Impact factor; H-Index.

**Text Books**

1. An introduction to Statistical Methods, 23<sup>rd</sup> revised edition: C.B. Gupta & Vijay Gupta, Vikas Publishing House Pvt Ltd, Noida. 2015
2. Statistical Methods: S. C. Gupta, Sultan Chand & Sons Publishers, New Delhi, 1997
3. Fundamentals of Computer: V. Rajaraman, Prentice Hall of India, New Delhi, 2008
4. Computer: Malhar V. Lathkar, Sadhusudha Prakashan, Nanded. 1995

**Reference Books**

1. Introduction to statistics – C.Leach (J.Wiley New York, USA)
2. Mathematical Analysis for modelling J. Rosenblatt and S. Bell (CRC Press London, UK)
3. General statistics W. Chase and F. Bown (J.Wiley Newyork., USA)



**EVST: 79EV304B****Paper-B2: Instrumentation and Analytical Techniques****(3+1)**

**Preamble:** This paper is very helpful for the students & an essential tool for research works as it comprises detail working principle of various instruments those are the base of practical work, analysis of various samples & finding results.

**Unit-1: Fundamental**

Soil sampling techniques, preservation, storage and processing techniques. Basic principle of autoclave hot air oven, Microbial isolation techniques, Principles and application of titrimetry, gravimetry, potentiometry, spectrophotometry analysis and their application.

**Unit-2: Sampling and analysis**

Techniques of air & water quality sampling, storage, processing and analysis, Principles of chromatography analysis and their application, Principles of gel electrophoresis techniques and their application, Radioactivity detection techniques and application: an overview.

**Unit-3: Instrumental Techniques**

Application of Spectrophotometry (UV-Visible spectrophotometry), Titrimetry, Gravimetry, Colourimetry, NMR, ESR, Microscopy-phase, light and fluorescence microscopes, Scanning and Transmission electron microscopes.

**Unit-4: Chromatographic Techniques**

Paper chromatography, thin layer chromatography, ion exchange chromatography, Column chromatography, Atomic Absorption Spectrophotometry.

**Unit-5: Advanced Technology**

Electrophoresis, solid and liquid scintillation, X-ray fluorescence, X-ray diffraction. Flame photometry, Gas-liquid chromatography, High pressure liquid chromatography - auto radiography, Ultracentrifugation.

### **Text Books**

1. Chemical & Biological Methods for Water Pollution Studies: R.K. Trivedy and P. K. Goel, Environmental Publications, Karad.
2. Handbook of Methods in Environmental Studies: Vol. 1 & 2, S. K. Maiti, ABD Publishers, Jaipur
3. Practical Methods in Ecology and Environmental Science: R. K. Trivedy and P.K. Goel, EnviroMedia, Karad.
4. guidelines for the Examination of Water and Wastewaters: CPCB, Delhi, India

### **Reference Books**

1. Physicochemical examination of water sewage and industrial effluents: Manivasakam, N. Pragatiprakashan, Meerut
2. Environment, water and soil analysis: Trivedi, P.R. and Raj Gurdeep. Akashdeep Pub, New Delhi
3. Manual of Microbiology-Tools and Techniques: Kanika Sharma,2008, Ane Books India
4. Microbiology A Laboratory Hand Book3: Cappucino,J.G. and Sherman.N.

**EVST: 79EV304C****Paper-B3: Environmental Statistics and Modeling**

**Preamble:** This paper is very helpful for research works. This paper deals with advanced research techniques & methodologies that build the students more expert & scientific to carry a research work.

**Unit-1: Fundamental Statistics**

Population and samples, tabulation of data, frequency tables and frequency curves, mean, mode and median; variance and standard deviation, coefficient to variation, data presentation techniques, probability

**Unit-2: Sampling**

Concept of sampling; types of sampling, simple random, random sampling and stratified random sampling; Correlation and regression, concept of testing of hypothesis; tests for single mean and difference of means; Chi-square test, students t-test, and F-test. ANOVA,

**Unit-3: ESA**

Introduction to Environmental System analysis, approaches to development of models, linear, simple and multiple regression model, validation and forecasting, weather forecasting

**Unit-4: Statistical Models**

Models of population growth and interactions –Lotka – Volterra model, Leslie's matrix model, point source stream pollution model, box model, Gaussian plume model, prey-predator model.

**Unit-5: Computers & Software**

computer applications: Structure, function, capabilities and limitations of computer, computer packages, applications of computer in environmental science; Ecological modeling using computer softwares, Software for statistical analysis like MS-Excel, SPSS, MiniTab, Sigmaplot, Statistica.

**Text Books**

1. Fundamental of applied statistics – S.C. Gupta and V.K. Kappor.
2. Elements of statistics – Donald R. Byrkit.
3. Multivariate analysis- Hunt and Shelly
4. Computer fundamentals

**Reference Books**

1. Computerized environmental modeling: J. Hardstay, D.M. Taylor & S.E. Metcalf
2. Computerized aided environmental management: S.A. Abbassi and F.I. Khan.
3. Biostatistics: M.P. Arora & P K Malhan Himalya publication
4. Principle of biostatistics: Satguru Prasad

**EVSP: 79EV351****Practical Lab-**

1. Study the working principle of different instruments of Microbiology and Biotechnology lab.
2. Study of general techniques of microbiology media preparation, Sterilization
3. Inoculation, cultivation, isolation and enumeration of microorganisms.
4. Gram staining of bacteria.
5. Isolation and Enumeration of soil bacteria.
6. Isolation and Enumeration of Fungi.
7. DNA isolation through PCR.
8. Calculation of mean, mode, median of given data.
9. Calculation of standard error & standard deviation.
10. Calculation of Coefficient of Correlation.
11. Use of statistical software and their usage in environmental science data analysis.
12. Paper Writing- Format, Requirements & Process.

**EVSP: 79EV352****Practical Lab**

1. Calculation of the carbon footprint of some anthropogenic activities.
2. Study of Women Health & Child Labor in India
3. Study of Environmental issues in India- Delhi case study
4. Suicides of Farmers- Case study of a serious social issue
5. Resettlement & Rehabilitation issues & R&R Policy in India
6. Risk identification, assessment & management of Earthquakes & Flood
7. Preparation of different models for rain water harvesting
8. Study of environmental management system (ISO 14000) in industries
9. Visit to Disaster Management Cell in urban area for the following disaster
10. Study of socio-economy of an area with the help of Census data
11. S.C Mehta (Goldman Environmental Prize winner) & His Fights against Pollution
12. Enlist various green buildings in India and world.
13. Survey of market for environmental sound products (eco-labelling)
14. Study of environmental management practices in industries
15. PPEs & Safety Protocols in various Industries in India.
16. First Aid preparation- Importance & requirements.

## IV semester

EVST: 79EV401

### Paper: Industrial Safety & Hygiene

(3+1)

**Preamble:** This paper contains various aspects regarding safety & health issues at work places that will be the most helpful knowledge for students in their work life. The contents demonstrated guidelines about safety & health for the workers in broader way that will surely make the students work efficient in a safe way.

#### Unit-1: Fundamental

Need for safety; safety legislation: acts and rules; safety standards and codes; safety policy: safety organization and responsibilities; responsibilities of employers & employees; requirements of record-keeping & reporting; importance of industrial safety & safety organizations; responsibilities of safety officer, supervisors & safety committees.

#### Unit-2: Acts & Rules

Central acts; Construction Safety Regulations, Petroleum Rules 2002, Electrical Act & Rules; History & Provisions under the factories Act and rules made there under with amendments; Functions of National Safety Council.

#### Unit-3: Industrial Accidents

Causes & effects of industrial accidents; accident prevention and control techniques; cost of accidents; impacts of accidents on employees; role & responsibilities of union, management & society in preventing accidents; first aid-a basic concept.

#### Unit-4: Safety & Health Hazards

Identification of potential safety and health hazards in industrial and development projects; risk reduction strategies; occupational safety, Process Safety Management (PSM) as per OSHA; PSM principles; OHSAS – 18001; EPA Standards; performance measurements to determine effectiveness of PSM.

#### Unit-5: Industrial Best Practices (IBP<sub>s</sub>)

IBP<sub>s</sub> in electrical, mechanical, fire & machine guarding; Personal Protective Equipments (respiratory and non-respiratory); occupational health; ergonomics of ambulance; management of contractors.

#### Text Books

1. Industrial Safety, Health and Environment Management Systems: R.K.Jain and Sunil S.Rao, Khanna publishers, New Delhi (2006)

2. Handbook of Occupational Safety and Health: Slote.L, John Willey and Sons, NewYork.
3. Industrial Safety, Health and Environment Management Systems: R. K. Jain and Sunil S. Rao, Khanna publishers, New Delhi (2006)
4. The Factories Act with amendments 1987, Govt. of India Publications DGFASLI, Mumbai.

**Reference Books**

1. Safety Management: Grimaldi and Simonds, AITBS Publishers, New Delhi. (2001)
2. Industrial Safety –National Safety Council of India
3. Handbook of Environmental Health and Safety – principle and practices (Vol. II): H. Koren; Lewis Publishers

**Elective Paper Group C (CHOOSE ANY ONE PAPER)****79EV402A****Paper-C1: EIA & EMS****(3+1)**

**Preamble:** This paper introduced EIA, a systematic process that assesses & analyze the environmental consequences of development projects in advance. EIA process describes the agenda of all environmental agencies & their legislations regarding various developmental activities.

**Unit-1: Introduction**

Concept & scope of EIA, principle, salient features & legislative framework for EIA, guidelines & notification of MoEF, basic concept of Central & State appraisal committees.

**Unit-2: EIS & EA**

Process for preparing Environmental Impact Statement (EIS) & public participation, environmental Audit (EA)- introduction, objectives, benefits, procedure & guidelines of EA. Baseline information and prediction ( land, water, atmosphere, energy), Restoration and rehabilitation technologies.

**Unit-3: Methods of EIA**

Impact assessment methodologies, Generalized approach to impact analysis, resource analysis & baseline information. Case studies of cement industry, thermal power, and mining area.

**Unit-4: Operational Aspects of EIA**

Introduction, environmental site clearance, classification of industries, site selection, environmental clearance & guidelines for industries, Screening, Scoping, public consultation, appraisal, decision making, post-clearance monitoring protocol.

**Unit-5: EMP & Quality Management**

Fundamentals of EMP, strategies & objectives, 12 steps to heaven, Environmental management in industries; Industrial estate planning; Urbanization & municipal environmental issues; Rural environmental problems & solutions, Introduction to ISO 9000, ISO 14000, Introduction to ecoplanning

**Text Books**

1. Environmental Impact Assessment: Principles and Procedures, John Wiley and Sons, New York.
2. Environmental Impact Assessment: S.A.Abbasi, D.S.Arya, Discovery Publishing House, New Delhi.
3. An Introduction to Environmental Management: Dr.Anand S.Bal, Himalaya Publishing House, New Delhi.
4. Environmental Impact Analysis Handbook: John G.R. and David C.Wooten, McGraw Hill Publications. (1987)

**Reference Books**

1. Charles, H. Eccleston (2011) Environmental Impact Assessment, CRC Press, New York.
2. Anjaneyulu, Y. and Manickam W. (2010) Environmental Impact Assessment Methodologies, BSP Books Pvt. Ltd., Hederabad
3. Lawrence, D. P. (2003) Environmental Impact Assessment: Practical Solutions to Recurrent Problems, John Wiley and Sons, New Delhi.
4. Morris, P. and R. Therivel (2001), Methods of Environmental Impact Assessment, Spoon Press.



**Paper Code: 79EV402B****Paper-C2: Environmental Economics****(3+1)**

**Preamble:** The paper deals with the human dimension of development and environment. It aims to provide adequate knowledge about resources & economical balances, & also shows pathways of management of natural resources in regarding economical aspects.

**Unit-1: Fundamental**

Concept of environmental economics, the economy and the environmental, cost effectiveness analysis, cost-benefit analysis.

**Unit-2: Tools of Economics**

National resource economics- analytical tools, supply and demand, accountings of natural assets.

**Unit-3: Pollution economics**

Environmental policy analysis, command control strategies and incentive based strategies, economic valuation techniques of environmental benefits assets.

**Unit-4: Terminology**

Carbon tax, carbon foot print assessment, carbon trading, clean development mechanism, clean production and technology and ecomark.

**Unit-5: Natural resources accounting**

concepts, methods and empirical evidences. Environment and trade, Prey-Predator and supply-demand cycles.

**Text Books**

1. Economics of Environment and Development: Kumar Pushpam, 2005, Arc Books New Delhi.
2. Environmental and Natural Resource Economics: Tietenberg. T, 2003, Pearson Education, New York.
3. The Theory of Environmental Policy: Baumol, W.J. and Oates, W.E., 1988, Cambridge University Press.

**Reference Books**

1. Measures of value and Resources- Resources for the future: Freeman A.M., 2001, Washington DC.
2. Introduction to Environmental Economics: Shogren, White and Hanley, 2001, Oxford University Press, New York.