

KANNUR UNIVERSITY
(Abstract)

Scheme & Syllabus for M.Sc Environmental Studies Programme under Choice based Credit Semester System – Implemented with effect from 2010 Admission – Orders issued.

ACADEMIC BRANCH

U.O.No.Acad/C2/13003/2010.

Dated, K.U.Campus.P.O,02-02-2011.

Read:1. U.O.No.Acad/C2/1973/2006 dated 07-03-2009.

2. Minutes of the meeting of the Curriculum Committee held on 16-08-2010.

3. U.O No Acad/C3/2049/2009 dated 11-10-2010.

4. Letter No.DES/93/2010-11 dated 13-12-2010 from the Course Director, Department of Environmental Studies, SAT Campus, Payyannur.

ORDER

1. The Scheme and Syllabus of M.Sc Environmental Studies Programme under Credit and Semester System were implemented in this University with effect from 2008 admission vide paper read (1) above.

2. The Curriculum Committee as per paper read (2) above, recommended to introduce Choice based Credit Semester System for PG Programmes in the University Departments in lieu of Credit Semester System and the revised regulations for the same were implemented with effect from 2010 admission as per paper read (3) above.

3. The Course Director, Department of Environmental Studies, vide paper read (4), has forwarded the revised scheme and syllabus of PG Programme in Environmental Studies in line with the revised regulations of Choice based Credit Semester System, for implementation with effect from 2010 admission.

4. The Vice Chancellor, after considering the matter in detail, and in exercise of the powers of the Academic council, conferred under section 11(1) of Kannur University Act 1996 and all other enabling provisions read together with, has accorded sanction ***to implement the revised scheme and syllabus for M.Sc Programme in Environmental Studies under Choice based Credit Semester System with effect from 2010 admission***, subject to report to the Academic Council.

5. The Regulation for Choice based Credit Semester System implemented in this University as per paper read (3) above and subsequent amendments will be applicable to this Programme also.

6. Orders are issued accordingly.

7. The revised scheme and syllabus for M.Sc Programme in Environmental Studies under Choice based Credit Semester System effective from 2010 admission are appended.

Sd/-

REGISTRAR

To

1. The Course Director, Dept. of Environmental Studies, SAT Campus, Payyannur.
2. The Examination Branch (through PA to CE).

Copy to:

1. PS to VC/PA to PVC/PA to Registrar.
2. DR/AR-I (Academic).
3. SF/DF/FC.

Forwarded/By Order

SECTION OFFICER

Appendix to U.O No.Acad/C2/13003/2010 dated 02-02-2011.



SCHEME & SYLLABUS

FOR

PG PROGRAMME

IN

ENVIRONMENTAL STUDIES

Under Choice based Credit Semester System

2010 admission onwards

**Dept. of Environmental Studies,
Swami Anandatheertha Campus,
Edat, Payyannur.**

The P.G. Programme in Environmental studies:

The M.Sc. Programme in Environmental Studies is a multidisciplinary post-graduate Programme in the frontier area of Environmental Sciences.

Duration : 2 Years (4 semesters)

Intake : 15 (12 merit + 3 payment/N.R.I quota)

The major objectives of the course are:

1. To provide an integrated knowledge of diverse disciplines and training various theoretical and applied aspects of environmental science and management leading to Masters Degree.
2. To establish advance facilities and promote research and technology development to solve environmental issues and problems.
3. To undertake consultancy project in environment, disaster management, environmental impact assessment (EIA), Remote Sensing (RS), Geographical Information System (GIS), Forest and Wild Life Management.
4. To establish good networking of academic collaboration with national and international organizations, institutions, industries and exchange of faculty and students.
5. To offer environmental information, education and communication services and offer extension activities like environmental awareness programmes for school college students and public.
6. The course contents will be abreast with the latest development in the area of study. The students have to do a full time institutional or industrial training/ project work for four to five months, enabling them to have valuable hands on experience. The theory, practical, project work and training activities of this programme prepare the student to acquire knowledge, skills and expertise on specified subjects along with the integrated knowledge of all relevant disciplines.

Eligibility:

B.Sc. Degree in any of the subjects {Botany/Zoology/Chemistry/Physics/Environmental Science/Environmental Management/Microbiology/Biotechnology/Biochemistry/Agriculture/Horticulture/Forestry/any branch of Life Science/ Geology/Geography) or an equivalent examination or an engineering degree in Civil/ Mechanical/ Chemical/ Environmental branch with an aggregate of 55% marks in the optional.

Admission:

The selection of the candidate is based on the marks secured at the admission/entrance test (50%) and at the qualifying examination (50%).The admission test will cover Environmental Science at the undergraduate level.

Note: *The regulations of Choice based Credit Semester System for PG Programmes implemented with effect from 2010 admission will be applicable to this Programme also and if there is any inconsistency between the regulations and its application to M.Sc Environmental Studies Programme, the former shall prevail.*

SCHEME**Semester I**

SI No	Course Code	Title of the Course	Contact Hrs/Week			Marks			Credits
			L	T/S	P	ESE	CE	Total	
1	ENS C 001	Fundamentals of Ecology	4	1	-	60	40	100	4
2	ENS C 002	Environmental Pollution	4	1	-	60	40	100	4
3	ENS C 003	Environmental Chemistry	4	1	-	60	40	100	4
4	ENS E 004	Environment of the Physical System	4	1	-	60	40	100	3
5	ENS C 005	Practicals in Ecology	-	-	5	60	40	100	3
6	ENS E 006 OR ENS E 007	Biodiversity and its Conservation OR Green Chemistry	4	1	-	60	40	100	3
Total						360	240	600	21

Note: The students can choose any two Elective Courses.

Semester II

SI No	Course Code	Title of the Course	Contact Hrs/Week			Marks			Credits
			L	T/S	P	ES	CE	Total	
7	ENS C 008	Environmental Engineering	4	1	-	60	40	100	4
8	ENS C 009	Environmental Microbiology and Biotechnology	4	1	-	60	40	100	3
9	ENS C 010	Fundamentals of Toxicology	4	1	-	60	40	100	4
10	ENS C 011	Statistics and Computer Application	4	1	-	60	40	100	4
11	ENS E 012	Natural Resource and their Conservation	4	1	-	60	40	100	3
12	ENS C 013	Practicals in Microbiology	-	-	5	60	40	100	3
13	ENS E 014 OR ENS E 015	Food Adulteration and Preservation OR Hydrology and Water Management	4	1	-	60	40	100	3
14	ENS C 016	Field Study based on ENS C 001 to ENS C 011	-	-	-	60	40	100	2
Total						480	320	800	26

Note: The students can choose any two Elective Courses.

Semester III

SI No	Course Code	Title of the Course	Contact Hrs/Week			Marks			Credits
			L	T/S	P	ESE	CE	Total	
15	ENS C 017	Environmental Economics & Laws	4	1	-	60	40	100	4
16	ENS C 018	Environmental Management	4	1	-	60	40	100	4
17	ENS C 019	Instrumentation and Analytical Technique	4	1	-	60	40	100	4
18	ENS C 020	Natural Hazards and Disaster Management	4	1	-	60	40	100	3
19	ENS C 021	Practicals in Environmental Chemistry	-	-	5	60	40	100	2
20	ENS C 022	Practicals in Environmental Geology	-	-	5	60	40	100	2
21	ENS E 023	Chemometrics and Good Laboratory Practices	4	1	-	60	40	100	3
	ENS E 024	Application of Remote Sensing and GIS							
		Total	-	-	-	420	280	700	22

Note: The students can choose any one Elective Courses.

Semester IV

SI No	Course Code	Title of the Course	Contact Hrs/Week			Marks			Credits
			L	T/S	P	ESE	CE	Total	
22	ENS C 025	Project Work and Viva Voce	-	-	30	60	40	100	15
		Total				60	40	100	15

Note : - ENS - Environmental Science, C - Core, E - Elective, L - Lecture, T -Tutorial. F-Field

OPEN COURSE

Course Code	Title of the Course	Contact Hrs/Week			Marks			Credits
		L	T/S	P	ESE	CE	Total	
ENS O 026	Fundamentals of Environmental Science	3	1	-	60	40	100	3

Note: Semester IV consists of a major Project and the students have to complete the Project within six months in collaboration with any of the Research Institutions located within or outside the State.

SEMESTER - I

ENS C 001 -FUNDAMENTALS OF ECOLOGY

Unit-1. Fundamentals of Environmental Science

Definition, Scope and Importance of Environmental Science, Definition; Multidisciplinary nature of the environmental Science; Scope and importance; Need of Environmental awareness, Ecology, Inter relationship of ecology with other disciplines. Introduction to global environmental problems.

Unit II. Components of the Environment

a).The atmosphere or the air: Layers of Atmosphere , Composition of air; importance of atmosphere, meteorological conditions and air circulation.

b).The hydrosphere or water: Importance of water, distribution of fresh water at global, national and state level. Hydrological Cycle.

c).Lithosphere or the rock and the soil: Elementary composition of rocks in the earth crust. Types of rocks; Process of soil formation: Physical weathering, Chemical weathering of rocks; Role of soil in shaping the biosphere.

Unit III. Environmental Factors

a) Climatic Factors - Light, Temperature of Air (atmospheric temperature), Rainfall (precipitation), Humidity of air, atmosphere (gases and wind), fire.

b) Topographic Factors: height of mountains, direction of mountains and valleys, steepness of slope and exposure of slope.

c) Edaphic factors: Soil-soil formation, soil profile, soil erosion, soil conservation.

d) Biotic factors: Intra specific interactions; Inter specific interactions: Neutralism, Commensalism, Mutualism, Parasitism, Predation.

Unit: IV : Ecological adaptations -Ecological adaptations of plants (Hydrophytes, mesophytes, xerophytes, and halophytes) animals (aquatic conditions-hydrocoles; amphibious conditions or sec. hydrocoles), Terrestrial(mesocoles and xerocoles)

Unit V Ecosystem Definition; Components of ecosystem; Abiotic components: Light, Temperature, Pressure, Water, Wind, Soil; Biotic components: Energy flow in an ecosystem: Primary production, Secondary production; Food chain: Grazing food chain, Detritus food chain; Ecological pyramids: Pyramid of number, Pyramid of biomass, Pyramid of energy; Food web; Ecological indicators. Biogeochemical cycles : a) Gaseous cycles: Oxygen cycle, Carbon cycle and Nitrogen cycle. b) Sedimentary cycles: Phosphorus cycle, Sulphur cycle.

Unit VI: Population Ecology and Community Ecology: Population characteristics- Population growth and its dynamics; natality, mortality, growth patterns; Age distribution, Malthus theory; Community structure, Species diversity, Ecological dominance, Ecotone, Edge effect, Ecological equivalent, Succession and Climax.

Unit VII. Major Ecosystems. Terrestrial Ecosystem-Forest, grass land, arid, Crop land, Wet land- Ponds, Lakes, Rivers, Oceans, Estuaries.

Unit VIII : Applied Ecology-Vegetation Analysis – Quadrat, Transect and Point quadrat method of saplings-Determination, of quadrat size and quadrat number(Wiegerts's and Hendricks Methods).

Species diversity measures – Species richness – Species heterogeneity (Simpson's Indices, Shannon – Wiener Indices).

Girth class and Height class measurement.

Museology –Plants and Animals –Collection and Preservation.

Major Herbaria's and Museums.

Taxonomy and Biosystematics.

Biomass and Productivity estimation techniques.

References

01. Fundamentals of Ecology Eugene P. Odum, (Natraj Publishers, Dehradun.)
02. Principles of Ecology P. S. Verma, V. K. Agarwal (S. Chand and Co. New Delhi)
03. Environmental Biology P. D. sharma (Rastogi Publications, Meerut)
04. Ecology and Environment P. D. sharma (Rastogi Publications, Meerut)
05. Principles of Environmental Biology P. K. G. Nair(Himalaya Publishing House, New Delhi)
06. Environmental Biology M. P. Arora (Himalaya Publishing House, New Delhi)
07. Environmental Science Enger Smith, Smith, W. M. C.Brown (Company Publishing)
08. Principles of Soil Science Watt K. E. F. (1973), (McGraw Hill Book Company, New Delhi)
09. Introduction to Environmental Studies Turk & Turk
10. Ecology and Field Biology Robert Leo Smith (Harper Collins college publication)
11. General Ecology H. D. Kumar (Vikas Publishing house, New Delhi)
12. Elements of Ecology Brijgopal, N. Bharadwaj (Vikas Publishing house, New Delhi)
13. Fundamentals of Environmental Science G. S.Dahliwal,G S.Sangha P.K.ralhan(Kalyani Publishers,N
14. Environmental Ecology Bill Freedman (Academic Press, New York)
15. Concepts of Ecology N. Arumugam (Saras Publication, Kottar, Dist. Kanyakumari)
16. Plant Ecology P. L. Kochhar
17. A text book of Environmental Studies.D.K.Asthana,Meera Asthana (S.Chand&Co.)
- 18.Essential Environmental Studies.S.P.Misra,S.N.Pandey,(Ane Books Pvt.Ltd,Chennai)
- 19.Environmental Education – A Conceptual Analysis. P.Kelu,university of Calicut publication
- 20.Environmental Science. V.K.Ahluwalia,Sunita Malhotra (Ane Books Pvt.Ltd,Chennai)

ENS C 002 -ENVIRONMENTAL POLLUTION

Unit – I Introduction to Environment - Environmental factors - Segment of Environment Man-Environment relationship, anthropogenic effects on the natural environment, Environmental degradation.

Environmental pollution – Definition, causes of environmental pollution – population, urbanization, industrialization, resource consumption, deforestation, agriculture and transportation.

Unit –II Air pollution - Sources, effects and control measures.

Definition - Air pollutants - Sources of air pollutants - Types of air pollutants - primary and secondary air pollutant- Gaseous, solid and biopollutants. Movements and reactions of pollutants in the atmosphere. Reactions of pollutants in the air to form smog and PAN.

Acid rain, ozone depletion, green house effect and global warming.

Factors affecting air pollutants and their mode of actions: climate, temperature, humidity and wind currents.

Impacts of air pollution on Human being - Animals - Plants - Materials, buildings and climate
Control measures of Air pollution.

Unit III - Water pollution - Sources, effects and control measures

Definition and significance.

Types of water pollution - Point and non point source of water pollution- surface and ground water pollution.

Sources of water pollution - Domestic, Industrial , Agricultural and Natural sources.

Impact of water pollution on human being, animals, plants and environment.

Control measures of water pollution.

Unit IV - Soil / Land pollution - Sources, effects and control measures

Sources of soil pollution -Natural sources - Natural calamities.

Anthropogenic sources - Agricultural practices, Industrial and Municipal discharges – Municipal solid waste dumping - Land fill leachates - Plastics - Radioactive leakage - Mining activities and Electronic wastes. Impact of soil / land pollution - Soil fertility - Soil micro organisms – Effects on plants and animals.

Control measures.

Unit V - Noise pollution

Definition and concept of Noise pollution.

Sources of noise pollution - Indoor and outdoor noise pollution

Natural and Anthropogenic sources.

Impact of noise pollution - Impacts on plants and animals.

Unit VI - Radioactive Pollution

Definition - Scope of the study-Types and sources of Radioactivity Natural and man made

Radioactivity- Radioactive pollution episodes- Precautions and control measures.

Unit VII - Thermal and Marine Pollution

Thermal and nuclear power plants as source of thermal pollution. Impacts of thermal pollution on aquatic fauna and flora. Controlling measures of Thermal pollution.

Marine pollution - Definition Sources of Marine pollution - Natural and Anthropogenic sources

Control measures of marine pollution. Pollution status of coastal and ocean waters.

Oil pollution - Sources - effects and control measures.

References

1. B.K Sharma – Environmental chemistry –Goel publication.
2. A.K. De - Environmental Chemistry
3. Tyagi and Mehra - Environmental Chemistry
4. Trivedi P.R & Raj Gurdeo-Environmental water and soil Analysis, Akasdeep Pub.House,N Delhi.
5. V.K.Alhuwalia, Environmental Chemistry Ahe books, India
6. S.P. Misra and S.N. Pandey – Essential Environmental studies-Ane books Pvt. Ltd.

ENS C 003 - ENVIRONMENTAL CHEMISTRY

Unit 1.Fundamentals of Chemistry

- 1.01 Concepts and scope of environmental chemistry
- 1.02 Principles of Bio-geochemical cycle N,C, P,S, Water
- 1.03 Stoichiometry
- 1.04 Chemical Kinetics- Control of reactions, First, second and zero order reactions
- 1.05 Chemical Equilibria
- 1.06 Thermodynamics -Energy, Entropy, Enthalpy, Gibb's energy and Chemical potential
- 1.07 Acid-Base reactions
- 1.08 Solubility Products
- 1.09 Unsaturated and Saturated- Hydrocarbons
- 1.10 Radio nuclides.

Unit II. Transformation of Refractory Organic Compounds in the Environment

- 2.01 Synthetic detergent (Surfactant) -cationic, anionic and non- ionic detergents, Modified detergents
- 2.02 Pesticides and Fertilizers -Classification, Degradation and Analysis of pesticides, Pollution due to pesticides , DDT, Endosulphan and its molecules, Types of synthetic fertilizers.
- 2.03 Synthetic polymers
- 2.04 Petroleum products.

Unit III. Chemistry of Atmosphere

- 3.01 History and evolution of the earth's atmosphere.
- 3.02 Structure and composition of atmosphere.
- 3.03 Chemical composition of atmosphere.
- 3.3a Classification of elements in the atmosphere.
- 3.3b Water, CO₂, NO_x, SO_x, O₂, Ozone, Chemical speciation, Particles, ions, and radicles in the atmosphere,Chemical processes for the formation of Inorganic and Organic Particulate matter, Thermochemical and photo chemical reactions in the atmosphere. Temperature inversion, Atmospheric lapse rate, Adiabatic lapse rate, wet and dry adiabatic lapse rate.Photochemical smog. Origin and occurrence.Oxidising and Reducing smog.Ecological effects.Oxygen and Ozone chemistry. Ozone layer.Chemistry of Ozone layer.Ozone depletion. Mitigation of ozone

depletion. Eco friendly coolants. Chemistry of atmospheric pollutants. Acid rain and its ecological effects.

Unit IV. Chemistry of Lithosphere

Structure and composition of lithosphere, Chemical properties of important rocks and minerals. Chemical characteristics of soil, Organic and inorganic components of soil, Soil horizon, Formation of soil, Soil forming processes, Weathering and pedogenesis, Soil pollution, Fate of chemicals in soil, Soil erosion.

Unit V. Chemistry of Hydrosphere

Hydrological cycles, Composition and structure of pure water, Physico chemical properties of water and aqueous solution, Solubility of solids, liquids, and gases in water, Chemical reaction and equilibrium in water, Carbonate equilibrium, Metal ion equilibrium, Redox equilibrium. Natural organic components in water.

References:-

1. B.K Sharma – Environmental chemistry – Goel publication.
2. A.K. De - Environmental Chemistry
3. Tyagi and Mehra - Environmental Chemistry
4. S.P. Misra and S.N. Pandey – Essential Environmental studies – Ane books Pvt. Ltd.

ENS E 004 - ENVIRONMENT OF THE PHYSICAL SYSTEM

Unit I : Constituents of the Nucleus

Nuclear charge – Mass and binding energy – Radioactivity – Alpha, Beta and gamma emission successive disintegration – Radioactive series – nuclear reactions – Energy released in fission and fusion.

Unit II : Origin of Earth

Origin of Earth – Theories pertaining Earth's origin, internal structure of Earth's crust, mantle and core – composition, continental drift, plate tectonics.

Minerals – Rock forming and ore forming minerals. Minerals-concept of major, trace and Rare Earth Elements(REE). Classification of trace elements, Trace elements and health.

Rock and rock cycle, Structure of rocks - Rocks – Brief classification and characteristic – megascopic features of different types of rocks.

Geomorphology: Introduction-Soil-Weathering and pedogenesis, Factors of soil formation, soil profile, Classification of types of soil(Reference to India and Kerala), Structure of soil, Soil quality parameters and assessment.

Coastal sedimentation and land forms, coastal erosion.

Unit III. Structure and Composition of Atmosphere

Atmosphere: Structure, Composition, Stratification, Pressure gradient, Humidity, Thermodynamics of atmosphere, Lapse rate- Dry and wet adiabatic lapse, Temperature inversion and air pollution. Velocity, Acceleration. Vertical motion of air parcel in the atmosphere, Vertical stability of atmosphere. Horizontal motion in the atmosphere – Ferrel's Law & Coriolis's effect, Winds-formation & classification, local, winds. Clouds- formation &

classification, cloud seeding, Aerosols, Artificial rain, Acid rain, Global warming, Green house effect .Ozone layer formation & depletion, Global environmental problems.

Unit IV. Weather & Climate

Weather & Climate: Definition & scope, classification. Climate of India, oceanic & continent influence (air-sea interaction), El nino & La nino effects.

Climate change-causes, effects. Regional scenario of climate change. Climate of India; Indian monsoon, (Onset of monsoon), Rain bearing systems, Break in change in the ecosystems. Weather & climate monitoring equipments, Meteorological data collection & analysis (Rainfall, Evaporation, Temperature, Relative humidity, Wind speed, Wind direction, Wind rose)

Unit V. Physical Parameters of Atmosphere

Temperature, Heat, Heat transfer, specific heat, Energy of the atmosphere – solar energy. Absorption by the atmosphere scattering reflection, refraction, rarefraction. Absorption by earth, Terrestrial radiation – Earth's heat balance. Nature of sound – Physiological and physical properties – speed of sound – interference of sound waves, Resonance, Doppler effect, Acoustics of auditorium, Thunder and lightning, Noise pollution and its measurement and control.

Reference

1. Arther Beiser, Applied physics, Schaum's outline series; Mc Grace Hills Book Co. New York.
2. Albert Miller, Jack C Thompson, Richard E Peterson and Donald R Haragan; Elements of Meteorology; Charles E Merril publishing Co. Columbus.
3. Frederick K Lutgens and Edward J Tarbuck; The atmosphere; prentice Hall publications, New Jersey
4. Floyd F Sabins; Remote sensing – Principles and Interpretation; W.H freeman and Co. San Francisco.
5. Erwin Schande, Springes – Verlag; Remote sensing for environmental sciences; Berling Heidelberg, New York.
6. E.C Barrett and L.F Curtis; Introduction to Environmental Remote Sensing; Chapman and Hall, London.
7. Lutgens and Tarbuck; The Atmosphere, Prentice Hall publication, New jersey.
8. Barry and Charley; Atmosphere, Weather and Climate; The English Language Book Society, 1976.
9. A.A Ramasastry; Weather and Weather forecasting' Publication division, Ministry of Information and Broadcasting, Ministry of India, 1984.
10. Billings; Structural Geology; Tata Mc Grace Hill publication Co. New Delhi.
11. Holmes A; Principles of physical geology, Ronald, New York, 1965.
12. Berry, LG & Brian Mason; Mineralogy; Freeman publication, 1959.
13. A.V Strahles and A.H Strahles; Environmental Geo-Science; Wiley International, 1973.
14. Tyrell G.W; Principles of petrology; Methven publication, 1959.
15. Validia K.S; Environmental Geology; Tata Mc Grace Hill publishing Co. Pvt. Ltd- New Delhi, 1987.
16. R.H.green, Sampling Design and statistical methods for Environmental Biologists, 1979.

17. A.C Wardlove; Practical statistics for Experimental Biologist.
18. D.C Sancheti 7 V.K Kapoor; Statistics; Sulthan Chand & Sons, New Delhi, 1991.
19. B.Ram; Computer fundamentals; New Age International (P) Limited, New Delhi.
20. Ron Mansfield; Concise guide to MS Office; BPB publications.

ENS C 005 - PRACTICALS IN ECOLOGY

1. Quantitative and Qualitative analysis of Phytoplankton and Zooplanktons
2. Primary Productivity-Light and Dark bottle method
3. Primary productivity – Chlorophyll method
4. Terrestrial-Biomass
5. Screening Test-(Demonstration Only)
 - a. Using fish –LC 50
 - b. Macrophytes-Germination
6. Study of vegetation of local area/college campus
7. Study of fauna of local area/campus
8. To find out minimum size of the quadrat for vegetation study
9. Study of vegetation density by quadrat method
10. Study of vegetation frequency by quadrat method.
11. Study of Phytoplankton.
12. Estimation of biomass.
13. Study of Zooplankton
14. Determination of water transparency by Secchi disc
15. Determination of pH and temperature of water.
16. Determination of carbon dioxide in water.
17. Field visit to terrestrial/aquatic environments.
18. Study tour (one day)
19. Study of ecological adaptations

ENS E 006 - BIODIVERSITY AND ITS CONSERVATION

Unit-I - Biodiversity and its Conservation:

1. Introduction-Definition, Types of biodiversity such as genetic, species and ecosystem, biodiversity; Biodiversity at Global, National and local levels ; The mega-diversity countries of the world Biogeographical classification of India.

Importance and value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values.

2. Measurement of Biodiversity-Species richness, species diversity, Simpson Index, Shannon Wiener Index, Alpha, Beta and Gamma Diversity.

3. Threats to biodiversity-Habitat loss and degradation, poaching of wild life, introduction of exotic species, genetic pollution, climate change, man wildlife conflict; Endangered and endemic species of India; extinction of species, key stone species.

4. Hot spots of biodiversity.

Unit II- Biodiversity conservation

In situ conservation–protected areas-National parks, Wildlife sanctuaries, Biosphere reserves, Definition, concept and short description of and importance of major reserves; Nilgiri Biosphere Reserve, Agasthyamalai Biosphere Reserve, Sunderban, Andaman and Nicobar, Gulf of Mannar. Project Tiger, Project Elephant, sacred groves with special reference to Kerala, Documenting traditional knowledge. Ex situ conservation-Botanical gardens, zoos, aquaria, National Bureau of Plant Genetic Resources(NBPGR), National Bureau of Animal Genetic Resources(NBAGR), Documenting traditional knowledge.

Unit III - Global strategy for conservation

Stockholm conference 1972, Nairobi Conference 1982, Montreal Protocol 1987, London, 1989, Rio Declaration 1992, Berlin Mandate 1995, Geneva Convention, 1996, Kyoto Protocol 1996, Johannesburg Conference 2002.

Unit IV - People's movement for environmental conservation in India

Bishnoi Movement, Chipko Movement, Narmada Bachao Andolan, Apikko movement, Silent Valley Movement, Baliyapal.

Recommended Books

1. A Text Book of Environmental Sciences, S. S. Purohit, Q. J. Shammi and A. K. Agarwal, Student Edition (Agrobios), Jodhpur.
2. A Text Book of Environmental Studies, D. K. Asthana and Meera Asthana, S. Chand & Co., New Delhi.
3. Air Pollution, M.N. Rao and H.V.N. Rao, Tata McGraw Hill, New Delhi.
4. An Introduction to Air Pollution, R. K. Trivedy and P. K. Goel, B. S. Publications, Hyderabad.
5. Aerial Photography and Image Interpretation for Resource Management, Paine, D.P., John Wiley and Sons.
6. Chemical & Biological Methods for Water Pollution Studies, R.K. Trivedy and P. K. Goel, Environmental Publications, Karad.
7. Disaster Management in Hills, Dr. Satendra, Concept Publishing Co., New Delhi.
8. Ecology and Environment, P.D. Sharma, Rastogi Pub., New Delhi.
9. Environmental Science, S.C. Santara, New Central Book Agency (P) Ltd., Kolkata.
10. Ecology: Principles and Applications, J. L. Chapman & M.J. Reiss, Cambridge University Press, U.K.
11. Environment: Problems and Solutions, D.K. Asthana and Meera Asthana, S. Chand & Co., New Delhi
12. Environmental Biotechnology, M. H. Fulekar, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
13. Environmental Chemistry, A.K. Dey, New Age International Publishers, New Delhi.
14. Environmental Concerns and Strategies, T. N. Khoshoo, Ashish Publishing House, New Delhi
15. Environmental Geography, Savindra Singh, Prayag Pustak Bhavan, Allahabad.

16. Fundamentals of Ecology, E.P. Odum, W.B. Saunders Co., Philadelphia.
17. Handbook of Environmental Laws, Acts, Rules, Guidelines, Compliances and Standards, Vol. I and II, BS Publications, Hyderabad.
18. Handbook of Methods in Environmental Studies, Vol. 1 & 2, S. K. Maiti, ABD Publishers, Jaipur.
19. Law on Protection of Environment and Prevention of Pollution (Central and States), R. G. Chaturvedy and M.M. Chaturvedy, The Law Book Co. (Pvt.) Ltd., Allahabad.
20. Natural Disasters, Lee Davis, Checkmark Books, New York.
21. Practical Methods in Ecology and Environmental Science, R. K. Trivedy and P.K. Goel, EnviroMedia, Karad.
22. Standard Methods for the Examination of Water and Wastewaters, American Public Health Association, Washington, DC.
23. State of India's Environment: A Citizen's Report, Arvind Agarwal, Centre for Science and Environment, New Delhi.
24. Water Pollution: Causes, Effects and Control, P. K. Goel, New Age International Publishers, N D.
25. Environmental Biology, P.S. Verma and V.K. Agarwal, S.Chand & Co., New Delhi.
28. Environmental Chemistry, A.K. Department of Environmental Science, New Age International Publishers, New Delhi.
29. Essentials of Ecology & Environmental Science, S.V.S. Rana, Prentice Hall of India Pvt. Ltd., N D.
30. Introduction to Environmental Legislation, B.L.Chavan, A.R.Shahane and C.S. Rawandale, Asian Inst. Env. Law., Karmala.
31. Environmental Chemistry, B.K. Sharma, Goel Publishing Housing, Meerut.

ENS E 007 - GREEN CHEMISTRY

Unit I. Soaps, detergents and detergent builders-preparation. Difference between soap and detergents. Cleansing action of soaps and detergents. Soaps and detergents as pollutants. Shampoo and toilet-soap preparation.

Unit II. Food poisoning-food poisoning caused by chemicals, poisonous plants and microorganisms, Food hygiene in the prevention of food poisoning.

Unit III. Green Chemistry-Principles of Green Chemistry, Design of Green Synthesis, prevention of waste and byproducts, Atom Economy, prevention of chemical accidents, microwave assisted green synthesis, Diels Alder reaction.

Unit IV. Water Analysis-Water quality monitoring-sampling-analysis of water-physico-chemical and biological parameters of water-water quality standards-WHO, BIS-Eutrophication (9 Hours).

Unit V. Solid wastes management-Solid wastes-Types, disposal methods-sanitary land filling, incineration, recycling, composting-composting methods-indoor and Bangalore method, Windros method. Vermi composting.

Unit VI. Environmental Issues-

a. Global warming and Green House Effect-Acid Rain-Bhopal Tragedy

b. Environmental movements-Plachimada movement-Silent Valley-Narmada Bachao Andolan-Chipko movement

Reference:

1. Ahluwalia, V.K. Green Chemistry
2. Ahluwalia, V.K. and M.Kidwai. New trends in Green Chemistry
3. Misra, S.P. and S.N. Pandey, 2009. Essential Environmental Studies, Ane Books Pvt. Ltd
4. Bhatia, S.C. Environmental Chemistry, CBS publications
5. De, A.K. Environmental Chemistry,
6. Bharucha, E. Text Book of Environmental Chemistry, Oxford & IBH
7. Ahluwalia, V.K. and Sunita Malhotra Environmental Science, Ane Books Pvt. Ltd

ENS C 008 - ENVIRONMENTAL ENGINEERING**Unit 1 - Introduction to Environmental Engineering**

Introduction to Environmental Engineering. Principles and scope of Environmental Engineering. Modern trends in Environmental Engineering.

Unit II- Water Pollution and Water Quality Standards

- 1) Type, Sources And Impact
 - Surface Water, Ground Water
 - Domestic, Industrial, Agriculture And Natural Water
 - Impact On Human Being, Animals, Plants And Environment
- 2) Water Quality Parameters
 - Physical, Chemical And Biological Parameters
- 3) Water Sampling Type, Selection Of Sampling Point, Equipment Used, Sample Preservation And Maintenance
- 4) Water Quality Standards - Industrial, Drinking Water

Unit III - Water Treatment Process

Water Treatment, Mixing And Flocculation, Coagulation, Jar Test, Softening Lime Soda And Ion Exchange Process, Filtration, Slow, Rapid and Pressure Filter, Disinfection, Chlorination, Ozonisation -An UV Application.

Unit IV - Waste Water Treatment

Municipal, Sewage And Industrial Treatment, Basic Treatment Process And Flow Sheet Water Flow Rates And Their Assessment. Unit Operation Of Pre-Treatment And Primary Treatment, Bar Rocks, Grit Chambers, Communitors, Equalization And Sedimentation, Design Concept, Secondary Treatment, Biological Unit Process, Nature And Kinetics Of Biological Growth, Aerobic Process, Activated Sludge Process And Its Modification, Oxidation Ponds, Attached Growth System, Trickling Filters, Rotating Biological Conductors, High Rate Anaerobic Reactor-Cstr, Upflow Anaerobic Filters -Uafs, Uasb, Expanded, Fluidised Bed Reactors, Chemical Unit Processes, Precipitants, Coagulation, Disinfection, Tertiary/Advanced Treatment System, Filtration, Absorption, Nitrogen And Phosphorous Removal, Biological Nutrient Removal (Bnr) Systems, Sewage Disposal Methods.

Unit V - Air Pollution and Air Quality Standards

Air Pollutants : Type, Source And Nature, Primary And Secondary Pollutants, Natural and Anthropogenic Sources, Gaseous ,Solid ,Particulate And Bio Pollutants, Air Pollution Meteorology, Turbulence,Stability Lapse Rate ,Plume Behavior, Terrain Effects, Factors Affecting Dispersion of Air Pollutants, Dispersion Modeling, Gaussian Dispersion Model, Transport ,Diffusion And Reactions of Pollutants In The Atmosphere, Gas Laws Governing The Behavior of Pollutants In Atmosphere, Reactions of Pollutants In The Air Smog Pan, Acid Rain ,Ozone Depletion and Global Warming, Animals, Plants, Materials, Factors Affecting Air Pollution. Temperature And Their Mode of Action(Climate, Temperature, Humidity, Wind, Sunlight), Impact of Air Pollutants on, Human Beings, Animals ,Plants, Materials, Building And Climates, Method of Monitoring And Standards of Air Pollutants, Air Quality Monitoring, Wind Roses, Air Sampling ,Analysis of NO_x, SO_x, CO And Particulate Matter. Air Quality Standards.

Unit VI - Air Pollution Control

Control of Particulate Matter, Gravitational Settling Chamber, Centrifugal Collector, Electrostatic, Fabric And Wet Collector, Scrubber, Control of Gaseous Contaminants, Adsorption, Absorption, Combustion, Automobile Emission Control.

Unit VII - Solid Waste Management

Municipal,Solid Waste, Types, Sources, Characteristic, Water Collection And Transport, Techniques/ Processing of Solid Waste Recovery, Reclamation, Recycle And Re Use of Resources, Disposal Methods, Incineration, Pyrolysis, Composting ,Vermi composting, Sanitary Land Fills And Anaerobic Digestion.

Industrial and Hazardous Waste Management

Unit VIII- Noise Pollution

8.1 Sources And Impact of Noise

8.1.1 Anthropogenic, Natural sources

8.1.2 Impacts of Noise Pollution

8.2 Monitoring And Abatement Measures

8.2.1 measures of Noise-Decibel And Noise Level

8.2.2 noise Exposure Levels and Standards

8.2.3 Remedial Measures

Unit IX - Radioactive Pollution

9.1 Types and Sources of Radioactivity

9.1.1 Radioactivity-Natural and Man Made

9.1.2 measurement of Radiation

9.1.3 Interaction of Radiation With Matter

9.1.4 Precaution and Control Measures

9.1.5 Peaceful Application of Nuclear Radiation

-Energy Production-Agriculture-Medicine-Tracer Applications

ENS C 009 - ENVIRONMENTAL MICROBIOLOGY AND BIOTECHNOLOGY

Unit I : Scope and history of Environmental Microbiology

Scope and history of Environmental Microbiology – characteristics, classification, identification and morphology of microorganism.

Microbial world – Bacteria, Archaea, Fungai., Algae, Virus, Protozoa.

Identification of microorganisms – Direct microscopic examination, cultural characteristics, biochemical and physiological and physiological properties, Antibiotic sensitivity testing, serological methods, Phage typing, protein analysis, comparison of nucleotide sequences.

References

1. Microbiology - Prescott, Harley and Klein (Ed) 7th edition.
2. Manual of Microbiology - Tools and Techniques. Second edition. Kanika Sharma,
3. Microbiology- Michael J Pelzar, JR.E.C.S Chan and Noel.R.Krieg. 8th edition.

Unit II : Genetic engineering

Genetic engineering and tissue culture- Principles and scope of Genetic engineering. Application of genetic engineering, benefits and hazards- the ethical and social implications of genetic engineering, Tissue culture Techniques and its applications.

References

1. Microbiology. Prescott Harley and Klein (Ed) 7th edition.
2. Microbiology- Michael J Pelzar, JR.E.C.S Chan and Noel.R.Krieg. 8th edition.
3. Biological Science. R.Soper. Cambridge University. 3rd Edition.

Unit III : Environmental Microbiology

Microbiology and segments of Environment. Microbial diversity in soil, biogeochemical role of soil microorganisms. Biodegradation of herbicides and pesticides. The aquatic micro organisms. The role and importance of microbial ecosystems, biogeochemical transformation.

References

1. Modern soil Microbiology, Elsar, Jansson and Tervors. 2nd Edition.
2. Microbiology - Michael J Pelzar, JR.E.C.S Chan and Noel.R.Krieg. 8th edition.
3. Microbiology. Prescott Harley and Klein (Ed) 7th edition.

Unit IV: Environmental Biotechnology

Environment Biotechnology–Principles and scope, Role of biotechnology in Environmental Protection, biotechnology in industrial pollution control–Paper industries, Textile Industries, Petrochemical Industries, Leather Industries and Mining Industries.

References

1. Handbook of Environment Biotechnology vol 1. S.C Bhatia. Atlantic publication
2. Advances Environment Biotechnology by S.K Agarwal
3. Environment Biotechnology, theory and application. Gareth.M.Evans and Indith C.Fuslong

Unit V : Emerging trends in Environment Biotechnology

Emerging trends in Environment Biotechnology- Bioremediation and Biosensors. Principles of Bioremediation, Techniques used in Bioremediation, Advantages and disadvantages of Bioremediation. Principles and applications of Biosensors. Concept of Bioremediation in waste water management. Waste water treatment Practices, solid waste management.

References

1. Essentials of Biotechnology. R.C Sobti and Suparna S Pachauri.
2. Handbook of Environment Biotechnology. Vol 1 .S.C Bhatia, Atlantic publisher and distributions
3. Biotechnology in Environment management. Vol 2
4. Essentials of Biotechnology by Sobti.
5. Methods in Biotechnology by Hanspeter

ENS C 010 - FUNDAMENTALS OF TOXICOLOGY**Unit I: Basics of Toxicology**

Definition of toxicology, Branches of toxicology, scope and importance of toxicology, Environmental toxicology, Principles of toxicology, Toxicants and their classification. Categories of toxic effects. Factors influencing toxicity. Toxic effects due to combination of chemicals. Dose effect and dose response relationships.

Unit II Toxic Chemicals In The Environment

Toxic chemicals in the environment – Inorganic and organic toxicants- entry in to the environment, cycles and residence time. Translocation of xenobiotics.

Toxicity of pesticides, organo chlorine, organo phosphates and carbamides, insecticides, heavy metals , radioactive substance, fluorides, chemicals, fertilizers.

Unit III Toxicity

Metabolism of toxic substance by plants and animals. Mode of action of toxicants, biotransformation of toxicants, Bioaccumulation of xenobiotics, Bioconcentration and Biomagnification. Toxicity test, In vitro and In vivo toxicity test.

Pollution by industries- types and characteristics – dispersion and circulation . Mechanism of pollutants degradable and non degradable toxic substances.

Ecosystem influence on the fate and transport of toxicants.

Unit IV Occupational Health Hazards.

Occupational health – physical, chemical, biological and physiological hazards. Control of toxic materials and protection measures. Toxicity of air, water and soil. Health and hygiene epidemiology, epidemiological diseases (air & water) due to pollution problems with special reference to Kerala and India.

Unit V Ecological Risk Assessment

Ecological risk assessment. Sanitary engineering- sewage systems, sewage treatment and disposal. Sanitary regulation.

References

1. P.D.Sharma, Environmental biology and toxicology, 1997-98.
2. P.K.gupta and D.K.Shinlee, Modern toxicology g.C. Butler, Principles of Eco toxicology
3. G.C.Butler,Principle s of Eco toxicology
4. Duffus, John H, Environmental toxicology
5. Shukla J.P and Pandey, Elements of Toxicology, Radha publishers, New Delhi.
6. Rand G.M and Perocelli S.R, Fundamental of Aquatic Toxicology, Hemisphere publishing Corporation, Washington.
7. Cockerham L.G and Shane B.S, Basic Environmental Toxicology, CRC press, Bocaraton, USA.
8. Jacob, Thankamma, Food Adulteration, MC Millan publishers Pvt. Ltd., 1976.
9. Kalia M & Sood. Food preservation and processing, Kalyani pub. Ludhiana, New Delhi.
10. Hobbs B.C & Roberts D. Food poisoning and Food Hygeine 6th Edition. Edward Arnold pub. London, 1993
11. Kamleshwar Pandey, Shukla, J.P, Trivedi (ed)2009, fundamentals of toxicology, New central book agency (p) Ltd.

ENS C 011 BIostatISTICS AND COMPUTER APPLICATION

Biostatistics

Unit-I –Fundamentals of Statistics

- 1.1. Introduction
- 1.2. Classification of Statistical Methods
- 1.3. Sampling Methods
- 1.4. Units and Errors
 - 1.4 A Units-Definition, Significance and Application
 - Measurement Scales
 - Physical Quantities
 - SI Units
 - 1.4 B Errors of measurements
 - Absolute, Relative, Biased and Unbiased errors
- 1.5 Collection of Data
- 1.6 Classification and Tabulation of Data
- 1.7 Representation of Data-Graphical representation of data-construction of frequency curve, bar diagram, histogram and pie diagram(use suitable classified data/tables)
- 1.8 Measure of central tendency and dispersion
 - Mean-Median-Mode-Range-Deviation-Standard Deviation and Coefficient of variation
 - Moments-skewness and Kurtosis
- 1.9 Correlation and Regression-Linear and curvilinear regressions

Unit II Statistical Methods

- 2.1 Probability
 - Frequency approach-addition and multiplication theorems
 - Binomial-Poisson and normal distribution
- 2.2 Testing of Hypothesis
 - Hypothesis-Null and Alternative Hypothesis

Test of Hypothesis based on Z,t,F and χ^2 Tests.

2.3 Analysis of variance-single and two way analysis

Unit III Fundamentals of Computer

3.1 Introduction to Computer-

History and Evolution-Parts of Computer Hardware, software and operating systems

Classification of Computers

Operating Systems-Fundamentals of DOS,Excel,Spreadsheet,Word,PageMaker,Photoshop and Power point-Computer and Communication-Internet,World Wide Web and E mail

Unit IV Application of Computer in Environmental Science and their Management

4.1 Computer modelling

4.1 a Population growth and interaction(Lotka-Volterra model)

4.1 b Leslie's matrix model

4.1 c Point source stream pollution model

4.1 d Box model

4.1 e Gaussian plume model

4.1 f models for EIA

4.2 Data analysis using packages

4.2 a Editing, data tabulation and graph plotting

4.3 Computer Programming Languages

4.3 a FORTRAN,C AND C+

References

1. A.C.Wardlove;Practical Statistics for Experimental Biologists
2. D.C.Sancheti & V.K.Kapoor:Statistics:Sultan Chand & Sons,New Delhi,1991
3. B.Ram;Computer Fundamentals;New Age International (P) Ltd,New Delhi
4. Ron Mansfield:Concise guide to MS Office:BPB Publications
5. Fundamental of Biostatistics-Khan,I.A.Khayyum.1994.Ukaaz's Pub.,Hyderabad
6. Pillai and Sinha,H.C.1968.Statistical Methods of Biological Workers,Rama Prasad & Sons,Agra.
7. Ramakrishnan.P.1995 Biostatistics.Saras Pub.Nagerkovil
8. R.H.Green:Sampling Design and Statistical Methods for Environmental Biologists,1979.

ENS E 012 NATURAL RESOURCE AND THEIR CONSERVATION

Unit I Natural resource conservation:

Natural resource – Definition – Concept, classification of natural resources (Renewable and non renewable resources)

Renewable resources –Land / Soil resources – Land as a resource, land degradation, conservation measures. Soils of India, Soil or land degradation, Causes of soil and land degradation, waste lands,desertification.

Water resources – sources of water, hydrological cycle, Use and exploitation of surface and ground water, conflict over water, water conservation strategies.

Forest resources – Importance of Forest - Ecological and Economic significance – Classification of Forest resources - Use and over exploitation, deforestation, Timber extraction, afforestation, basic causes of deforestation, management of forest resources.

Plants and animal resources – over exploitation, species extinction, control measures.

Unit II Non renewable resources

Energy resources:-

Non renewable energy resources-Fossil fuels (Coal, Petroleum and natural gas),nuclear fuel.

Renewable energy resources (Biomass, Bio fuel, Hydropower, Tidal energy, wave energy, wind energy,geothermal energy, solar energy, magneto hydrodynamic power, Hydrogen energy).

Energy crisis, management of energy resources.

Unit III Mineral resources

Classification of Minerals, Minerals of India. Uses of economic importance of minerals.

Management of Mineral resource, Mineral wealth of our planet, non renewable nature of mineral deposits, the inexhaustible nature of mineral elements, use and exploitation of mineral resources, environmental effects of extracting and using mineral resources. Remedial measures.

Food resources – World food problems, changes caused by agriculture and over grazing, effects of modern agriculture, merits of conventional agricultural system. World food supply, food security, Sustainable agriculture.

Unit IV Role of an Individual in conservation of natural resources

Definition and meaning of conservation, equitable use of resources for sustainable development.

References:

1. Anil Tyagi, Environmental Science, Danika publishing company, New Delhi, 2007.
2. Barrington EJW, Environmental Biology. Resource and Environmental Science series, Edward Arnold (pub) Ltd. London.
3. Purohit, S.S, Shammi, Q. Land Agarwal, A.K; A text book of Environmental science, student edition publishers, Jodhpur, 2004.
4. R.K khitoliya and K. Venkatachalam)(1997), Urban settlements and Natural hazards. Proceedings of seminar on Natural hazards in the Urban habitat. November, New Delhi.
5. Arya,A.S (1997) key note Address, Seminar on “Built Environment & Natural hazards”. Indian buildings congress. February, New Delhi

ENS C 013 - PRACTICALS IN MICROBIOLOGY

1. General Laboratory equipments and its familiarization
2. Gram staining
3. Spore staining

4. Oxidation - Fermentation test
5. Determination of Motility
6. Catalase test
7. THB load of soil and water
8. THB load in different Environmental conditions.
9. Most Probable Number (MPN) Test.

ENS E 014- FOOD ADULTERATION AND PRESERVATION

Unit I Food and its spoilage

Food – Types of food – Food spoilage and poisoning – Spoilage caused by molds, yeasts bacteria enzymes, insects and food constituents.

Unit II Food poisoning

Food poisoning caused by chemicals, poisonous plants and micro organisms, Food hygiene in the prevention of food poisoning, factors contributing to outbreak of food poisoning.

Unit III Methods and Principles of food preservation

Preservation by salting, using sugar, antibiotics, chemicals, by drying, Fermentation, cooling, concentration and heating. Preservation of milk products. Preservation of beverages.

Unit IV Food Adulteration

Common adulterants, intentional and incidental adulteration, Methods for detection of food adulterant. Safety of food additives and preservatives. Food additive regulations, Food grades, Food standards, food laws and food regulations.

Unit V Safety of Foods

Safety of food additives and preservatives, Food additive regulations, Food grades, Food standards, Food laws and Food regulations.

References

1. Jacob, Thankamma. Food Adulteration.1976. Mc Millan Pub.
2. Kalia M and Sood.1996. Food preservation and processing. Kalyani Pub. Ludhiana- New Delhi
3. Hobbs B.C. and Roberts D.1993. Food poisoning and Food Hygiene. 6th Edn. Edward Arnold Pub. Ltd

ENS E 015 - HYDROLOGY AND WATER MANAGEMENT

Unit I- Hydrology – Definition, History of hydrology, Branches of hydrology – Chemical hydrology, Eco hydrology, Hydrogeology, hydro informatics, hydrometeorology, isotope hydrology, surface hydrology.

Unit II-Hydrologic cycle – Different process of hydrologic cycle – precipitation, Canopy interception, snow melt, remelt, sub surface flow, infiltration, evaporation, transpiration, sublimation, advection, condensation.

Unit III-Surface water hydrology – rainfall and surface runoff relationship, runoff, runoff characteristics, open channel flow, Statistical analysis in hydrology –Probable maximum precipitation – hydrograph, flow duration curve –Flood frequency analysis and estimation – Water balance.

Unit IV -Ground water hydrology – Ground water table, stream – aquifer interactions, base flow recession, porosity and permeability, hydraulic head and fluid potential, Darcy's Law and hydro conductivity, Heterogeneity and anisotropy, storage properties of aquifers, Equations of ground water flow, well hydraulics, solute transport.

Unit V -Hydrologic measurements-

- a) Quantifying surface water flow – Stage – discharge measurement.
- b) Quantifying ground water flow - Ground water pressure (Piezometer), ground water depth (aquifer test), conductivity, infiltration (infiltrometer), soil moisture (soil moisture meter, gravimetric method, capacitance probe, Time domain reflectometer, Tensiometer). Geophysical investigation – resistivity and seismic method – application of remote sensing.
- c) Quantifying hydrologic exchange at the land – atmospheric boundary.

Precipitation:

1. Precipitation characteristics (disdrometer)
2. Cloud properties, rain rate estimation, hail and snow detection (radar)
3. Rain and snow fall (Rain gauge)
4. Humidity (Sling psychrometer, thermo hydrograph)
5. Evaporation (Evaporation pan)
6. Transpiration

Unit VI - Water management practices

- 1) Water shed management
- 2) Wetland conservation
- 3) Rainfall pits and rain water harvesting
- 4) Contour bunding
- 5) Drip irrigation
- 6) Channel irrigation

Reference

- 1) Chone, V.T. Hand book of Applied Hydrology, Mc Grace Hill publication, New Delhi.
- 2) Charlu, TGK and Datta, D.K. Grand water development in India, Rural electric corporation, New Delhi, 1982.
- 3) Jayaram Reddy, A Text Book of hydrology, Lakshmi publishers, New Delhi.
- 4) Rangunath, H.M, Hydrology, Wiley tastem publication, New Delhi, 1985.
- 5) CWRDM Publications, CWRDM, Kamamangalam.
- 6) Linsev, Kohies Panthus; Applied Hydrology, Mc Grace Hills Publication, New Delhi.
- 7) Subramanya.K, Hydrology for Engineers, Tata Mc Grace Hills Publications, New Delhi, 1984.
- 8) IS L986 91983) Measurement of Rainfall.
- 9) IS 5973 (1976) Pan evaporimeter.

- 10) Varshney, R.S; Engineering hydrology, New chand & Bros. Publications Rorkee.
- 11) Todd.D.K. Green water hydrology; John Wileys & Sons Publications, New York.
- 12) Validia.K.S, Environmental Geology, Tata Mc Grace Hills Publishing Co. Ltd. New Delhi.
- 13) Barry and Choslay, Atmosphere, Weather and Climate, The English Language Book Society.

ENS C 016 – FIELD STUDY

All students shall undertake field visits (continuous or with break) to a minimum of seven days to various stations and locations that are important for understanding of the subject. The stations chosen shall include natural sites, research institutions/ Industries/ factories. Soon after their visit student shall submit their reports.

ENS C 017 - ENVIRONMENTAL ECONOMICS & LAWS

Unit I : Environmental economics

Introduction, World environmental history and economic development. Nature and scope, Principles of environmental economics. Interrelationship between economics, environment and ecology. Foundation of environmental economics.

Unit II : Environmental Economics Basics and trends

Environmental Economics Basics and trends. Environmental and economy, environmental and economic growth, environmental and development.

Basic concept of sustainable development. Measures for sustainable development.

Main characteristics of environmental goods- Pure public goods, Mixed collective goods, public bads, externalities, consumption and demand, production and supply, Marginal analysis. Market and market failure. Externalities – marginal social cost, marginal private cost, marginal external growth, cost and solution to externality.

Principles of maximum social welfare - Pareto Criterion.

Unit III : Resource economics

Resource economics. Economics of natural resources. Population growth and its impact on environment.

The concept of common property resource and issues in global environmental resource sharing.

World trade and the environment – International trade, Intellectual Property rights.

Social CBA. Economic CBA, Environmental pollution- control, private cost and social cost. Application of CBA.

Unit IV : Environmental Laws / Policies and agencies.

- i) History of environmental law, environmental legislation in India, Central and state boards for the prevention and control of environmental pollution, powers and functions of pollution control boards, penalties and procedure, duties and responsibilities of citizens for environment protection
- ii) Wildlife Act 1972, Air and Water act, Water cess Act, Forest Act, Environmental protection Act 1986, Hazardous waste (Management and Handling) rules 1989, Bio medical waste (

Management and Handling) rules 1988. Ministry of Environment and forests – notification relating to hazardous microorganisms and genetically modified organism 1989. Public liability insurance Act 1995. Noise pollution 2000. Natural environment tribunal Act 1995.

iii) International cooperative movements. Global Environment monitoring systems (GEMS) .Antarica convention, stockholm summit, UNCED and its four conventions- climate change, biodiversity, desertification , tropical forest, Ramsar convention.

iv) National and international agencies - Earth watch, UN organization, WCN, UNEP and others, Co operation on ozone layer, migratory species, wetlands, mangroves, oceans.

Unit V : Information, Education and Communication

Environmental education /awareness - formal and informal education , lifestyle changes and consumerism, values and ethics.

Information networks.

ENVIS centres - INFOTERA

Role of NGO's in the implementation of environmental policies, communication and management.

Major environmental issues in India and Kerala with case studies. Green movement and Eco feminism - Chipko movement, Naarmada Bachao movement, Baliapal movement, Silent valley movement.

Referencenes:

1. World commission on Environment and Development ; “Our common future”. Oxford University Press publications.
2. Leela Krishnan, Law and Environment.
3. Adiseshiah M.S (1987) Economics of Environment.
4. Victor P.A (1972) The Economics of Pollution, Mathau, London Publication.
5. Rogene and Buchoiz (1993) Principles of Environmental management, Prentice Hall publications.
6. Indian Institute of Ecology and Environment, New Delhi.
 1. Occasional monographs – 11,22,41,42,51,70,77,87
 2. Environment International – 42,51,71,72,75,76,84,85,86.
7. Roscheraz, Environment law and policy in India.
8. Lohithakshan(2002),‘Paristhithi Niyamangal”,Kerala State Institute of Languages (Malayalam).
9. Khitolia R.K.(Ed) 2009. Environmental protection and the Law. APH publishing corporation.
10. Karpakam, M. 1991. Environmental Economics. Stuling Pub. New Delhi.

ENS C 018- ENVIRONMENTAL MANAGEMENT

Unit I - EIA

- i) Introduction : Definition, aim, principles and concept, scope. Origin and development of EIA. Relationship of EIA to sustainable development EIA in project planning and implementation.
- ii) Method and steps
 - a) Adhoc Method, b) Overlay Method, c) Checklist Method, d) Network Method
 - e) Matrix Method f) Ecosystem Modeling

Unit II - EIA PROCESS

- i) Methods for preparing EIA
 - a) Socio-economic aspects, b) Making inventories, c) Sampling and data process
 - e) Baseline study
- ii) Impact prediction
 - a) Positive and negative impact, b) Primary and secondary impact
 - c) Impact on Physical Social and biotic environment
- iii) Evaluation of proposed action
 - a) Risk assessment and risk management, b) Mitigation Measures
 - c) Comparison of alternatives, EIS and EMP, d) Review and decision making
 - d) Practices and guidelines in India

Unit III - EIA for Different Environmental Programmes.

- i) Industries
- ii) Urban development
- iii) landuse
- iv) Energy projects
 - a) Hydel b) Thermal c) Nuclear d) Oil gas e) solar f) wind
- v) Resource management
 - a) Agriculture b) Irrigation c) Water d) Biodiversity e) Costal Zone
- vi) EIA case studies

Unit IV: Environmental Planning and Management

- i) Principles of EPM
 - a) Principle, concepts and scope of environmental Planning
 - b) Ecological aspects of EPM
 - c) Steps in Environmental Planning
 - d) Identification and formulation of strategies of EPM
- ii) Environmental Analysis and EPM
 - a) Physical planning in relation to environment and land use classification
- iii) EPM for
 - a) Town and urban lands

- b) Rural and agriculture land
- c) Wastelands
- d) Lands reclaimed
- e) Wetlands
- f) Mining areas
- g) Industrial areas
- h) Transportation and urban planning

Unit V: EPM for Environmental Hazards

- i) Types of Environmental Hazards
 - a) Flood, draught, landslides, earth quakes, cyclones etc
- ii) Significance and characteristics of hazards in Environmental Planning and development
- iii) Opportunity and regional planning for hazard management

Unit VI : Environmental Auditing

- i) Cost benefit Analysis
- ii) Scope and types of Environmental audit
- iii) Audit Process – Pre , post audit process
- iv) International organization for standardization (ISO)
- v) ISO 14000 standards and certification

Refereneces:

1. World commission on Environment and Development ; “Our common future”. Oxford University Press publications.
2. Leela Krishnan, Law and Environment.
3. Adiseshiah M.S (1987) Economics of Environment.
4. Victor P.A (1972) The Economics of Pollution, Mathau, London Publication.
5. Rogene and Buchoiz (1993) Principles of Environmental management, Prentice Hall publications.
6. Indian Institute of Ecology and Environment, New Delhi.
 1. Occasional monographs – 11,22,41,42,51,70,77,87
 2. Environment International – 42,51,71,72,75,76,84,85,86.
7. Roscheraz, Environment law and policy in India.

ENS C 019- INSTRUMENTATION AND ANALYTICAL TECHNIQUE

Unit 1: Basic Concepts of Analytical Methods

1.Gravimetry

- 1.01. Principles and applications of gravimetric methods
- 1.02. Estimation of moisture content of soil,phytomass
- 1.03. Compost and vermin compost using moisture balance.

2. Volumetric methods

- 2.01. Acidimetry and alkalimetry -Standardisation of Reagent
- 2.02. Permanganometry
- 2.03. Dichrometry
- 2.04. Iodometry and Iodimetry
- 2.05. Argentometry
- 2.06. Complexometry
- 2.07. Colourimetry
- 2.08. Cerimetry (ferrous, iron)

3. Limitations of analytical methods

- 3.01. accuracy
 - 3.02. precision
 - 3.03. error
- Classification and minimization

Unit II: Electro Chemical Methods

- 1.01. pH meter
 - 1.011. glass and reference electrodes
- 1.02. Ion selective electrodes
- 1.03. conductometry-Electrical conductivity measurement
- 1.04. Potentiometry

Unit III: Photometric Methods

- 3.01. Nephelometry - Turbidimetry - Sulphide determination
- 3.02. Spectro photometry
 - 3.021. Beer-lambert's law
 - 3.022. Deviation from Beer - Lambertz law
 - 3.023. Optical design of filter photometer
 - 3.0231. Double beam, Electro magnetic radiation Spectrophotometry
 - 3.0232. U.V visible Spectro photometer, Interaction of radiation with different types of molecular energy, IR, NMR & Mass spectro photometers, Iron, nitrate, phosphate & ammonia
 - 3.024. Chemical interference
 - Concentration range
- 3.03. Flame photometry(fp)
 - Determination of Metals (Na, K)
- 3.04. Atomic absorption spectro photometry application
- 3.05. Atomic emission spectro photometry

Unit IV: Techniques

- A) Dosimetry

- Geiger Muller counter,
- Scintillation counter,

B) Electrophoresis,

- Gel Electrophoresis,
- Immune electrophoresis, (Elisa, blotting technique, RFLP etc)

References:-

1. B.K Sharma – Environmental chemistry –Goel publication.
2. A.K. De - Environmental Chemistry
3. Tyagi and Mehra - Environmental Chemistry
4. Trivedi P.R & Raj Gurdeo-Environmental water and soil Analysis Akasdeep Pub.House,New Delhi.
5. V.K.Alhuwalia, Environmental Chemistry Ahe books, India
6. S.P. Misra and S.N. Pandey – Essential Environmental studies-Ane books Pvt. Ltd.
7. P.L. Soni - Physical Chemistry
8. Vogel - Analytical Chemistry

ENS C 020 – NATURAL HAZARDS AND DISASTER MANAGEMENT

Unit 1 - Natural hazards:

- a) Flood – causes, nature and frequency of flood. Flood hazard, Urbanization and flooding, Flood mitigation methods.
- b) Land Slides and Avalanches – Causes, prevention and correction.
- c) Coastal hazards – Tsunamis, coastal erosion, sea level changes and impact on coastal areas.
- d) Earth quakes – Causes, intensity and magnitude of earth quakes, geographical distribution of earth zones and seismic waves, nature of destruction, protection from earthquake hazards.
- e) Volcanism – Nature, extend and causes of volcanism, volcanic materials and pollution, geographical distribution of volcanoes.
- f) Lightning – Adverse affects and mitigation measures.
- g) Cyclone and Tornadoes – Causes effects and control measures.
- h) Drought - Causes, prevention and correction
- i) Fire - Causes effects and control measures.

Unit II Disaster Management:

Concept and scope of disaster management / emergency management.

Professional activities – Mitigation, preparedness, response, recovery, programme planning and management.

Unit II Tools of Disaster management – Forecasting and warning systems of disasters – Measurement of responses of disasters – Community reaction to disaster – Disaster management

- Emergency Management Information Systems (EIMS) - Phases of disaster management – Pre disaster phase – Actual disaster phase – Post disaster phase – Disaster Assistance – Technological assistance – Relief camps – Camp layout – Food requirement – Water needs – Sanitation - Security.

Unit IV Organizations related to disaster management.

- a) International organizations – International Association of Emergency Managers, Redcross/Red crescent, United Nations, World Bank.
- b) National Organizations – National Disaster Management of India, Emergency management and research institute (EMRI), National remote sensing institute (NIRS).

References:

1. Anil Tyagi, Environmental Science, Danika publishing company, New Delhi, 2007.
2. Barrington EJW, Environmental Biology. Resource and Environmental Science series, Edward Arnold (pub) Ltd. London.
3. Purohit, S.S, Shammi, Q. Land Agarwal, A.K; A text book of Environmental science, student edition publishers, Jodhpur, 2004.
4. R.K Khitoliya and K. Venkatachalam)(1997), Urban settlements and Natural hazards. Proceedings of seminar on Natural hazards in the Urban habitat. November, New Delhi.
5. Arya, A.S (1997) key note Address, Seminar on “Built Environment & Natural hazards”. Indian buildings congress. February, New Delhi.

ENS C 021 -PRACTICALS IN ENVIRONMENTAL CHEMISTRY

I - Determination of various Physico - chemical properties of Water, Soil and Air

A. Water

1. Determination of pH (2) Determination of conductivity
2. Determination of D.O (4) Determination of total solids (Gravimetry)
3. Determination of total dissolved solids (Gravimetry)
4. Determination of total suspended solids (Gravimetry)
5. Determination of chlorides
6. Estimation of iron of Copper.
7. Estimation of iron (Colourimetry)
8. Estimation of Oil & Grease
9. Estimation of residual chlorine
10. Estimation of H₂S
11. Estimation of Hardness, Calcium and Magnesium
12. Chemical oxygen demand

13. Biological oxygen demand
14. Estimation of fluoride
15. Estimation of phosphate
16. Estimation of Nitrate
17. Estimation of Nitrite
18. Estimation of Total Nitrogen (Kjeldahl method)
19. Estimation of Sodium & Potassium (Flame photometry)
20. Estimation of pesticides using TLC / paper chromatography -Column chromatography
21. Analysis of heavy metals – As, Hg, Pb, Cd
22. Estimation of sulphate
23. Estimation Acidity and Alkalinity.

B. Soil Analysis

1. Determination of soil pH
2. Determination of soil moisture content
3. Estimation of soil chloride
4. Determination of TOC
5. Determination of Ca^{2+} & Mg^{2+}
6. Analysis of soil sulphate (Gravimetry)
7. Determination Food Adulterants (Chromatographic methods)
8. Estimation of Na^{+} & K^{+} in soil

C Air Quality Analysis (Demonstration only)

1. Particulate matter
2. NO_x
3. SO_x
4. Pollen grains.

ENS C 022 -PRACTICALS IN ENVIRONMENTAL GEOLOGY

1. Study of minerals - Hand Specimens
2. Study of Rocks - Hand Specimens
3. Structural geology - Interpretations of geological maps.
4. Sedimentology - Exercise - Size classification of sediments, sediment and rock fragments.
5. Sieve analysis of sediments, pipette analysis, pebble classification.
6. Drainage Basin Analysis - Generation of drainage density and drainage frequency maps.
7. Interpretation of wave climate, tide and currents for the given data.
8. Determination of Physical and Chemical properties of Soil - N, P, K, TOC, Fertility value, Soil moisture, Soil texture, Porosity, Bulk Density, Elasticity and Permeability
9. Determination of Infiltration rate.
10. Testing ground water quality.

ENS E 023 - CHEMOMETRICS AND GOOD LABORATORY PRACTICES

Unit I SI Units prefixes:

Chemical concentration –molarity & molality, ppm, ppb, unit conversions. Significant figures in addition, Subtraction, Multiplication and division, logarithm & anti logarithm. Types of errors: systematic and random errors. Precision and accuracy. Propagation of uncertainty- addition, Subtraction, Multiplication and division, mixed operations. The real role of significant figures.

Unit II Tools of the Trade

The laboratory-safety aspects in design and while working .Ethical handling of chemicals. Wastes –Labeling of chemicals & hazardous operations- hazard displays. Disposal of chemical wastes in the laboratory-special cases of cyanide, Cr, heavy metals toxic solvents chemicals. Safety practices in laboratory

Unit III Laboratory Measuring Practices

Laboratory note book recording of operations. Measuring devices-balance –care in weighing-mechanical piezoelectric balances, preventing weighing errors- buoyancy correction. Burettes, pipettes, volumetric glass wares.

Unit IV Laboratory Activities

Caliberation of pipette

Standard deviation of pippeting

Standard deviation of burette intervals

Making inventory of lab chemical consumptions

Reference

- 1) B.K Sharma – Environmental chemistry –Goel publication.
- 2) A.K. De - Environmental Chemistry
- 3) Tyagi and Mehra - Environmental Chemistry
- 4) Trivedi P.R & Raj Gurdeo-Environmental water and soil Analysis Akasdeep Pub.House, New Delhi.
- 5) V.K.Alhuwalia, Environmental Chemistry Ahe books, India
- 6) S.P. Misra and S.N. Pandey – Essential Environmental studies-Ane books Pvt. Ltd.
- 7) P.L. Soni - Physical Chemistry
- 8) Vogel - Analytical Chemistry

ENS E 024 – APPLICATION OF REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM

Unit I - Basics of Remote sensing

Definition

History, principle, concept and scope of remote sensing

Indian Remote Sensing Programmes

Unit II- Components of Remote sensing technique

Electromagnetic energy - Electromagnetic spectrum

Interaction between light and matter

Platforms for Remote sensing techniques - Sensors - Types of sensors -

Image characteristics – Image processing – Photo interpretation and photogrammetry.

Unit III - Source and application of remote sensing information

Aerial photography–characteristics of aerial photographs, Aerial photographs and their interpretation.

Satellite imagery-landsat imagery, Application of remote sensing into ground water exploration, mining of mineral resources, Landslides, subsidence and earthquake mitigation, waste land mappings, wet land conservation.

Unit IV - Geographic Information system (GIS)

History and Development

Terminology and scope of GIS

Principles of GIS

Introduction to mapping and GIS

Components and Organisation of GIS.

Fundamentals of computing GIS

Theory of GIS

Data concepts

Processing and visualization

Information analysis and digital data processing

Introduction to GIS Packages.

Unit V - Application of GIS in Environmental studies

Disaster Management, Forestry, Agriculture, Water resource management, Watershed management, Coastal zone management.

Reference

1. Arther Beiser, Applied physics, Schaum's outline series; Mc Grace Hills Book Co. New York.
2. Albert Miller, Jack C Thompson, Richard E Peterson and Donald R Haragan; Elements of Meteorology; Charles E Merrill publishing Co. Columbus.
3. Frederick K Lutgens and Edward J Tarbuck; The atmosphere; prentice Hall publications, New Jersey.
4. Floyd F Sabins; Remote sensing – Principles and Interpretation; W.H freeman and Co. San Francisco.
5. Erwin Schande, Springes–Verlag; Remote sensing for environmental sciences; Berling Heidelberg, New York.
6. E.C Barrett and L.F Curtis; Introduction to Environmental Remote Sensing; Chapman and Hall, London.
7. Lutgens and Tarbuck; The Atmosphere, Prentice Hall publication, New jersey.

8. Barry and Charley; Atmosphere, Weather and Climate; The English Language Book Society, 1976.
9. A.A Ramasastry; Weather and Weather forecasting' Publication division, Ministry of Information and Broadcasting, Ministry of India, 1984.
10. Billings; Structural Geology; Tata Mc Grace Hill publication Co. New Delhi.
11. Holmes A; Principles of physical geology, Ronald, New York, 1965.
12. Berry, LG & Brian Mason; Mineralogy; Freeman publication, 1959.
13. A.V Strahles and A.H Strahles; Environmental Geo-Science; Wiley International, 1973.
14. Tyrell G.W; Principles of petrology; Methven publication, 1959.
15. Validia K.S; Environmental Geology; Tata Mc Grace Hill publishing Co. Pvt. Ltd- New Delhi, 1987.

ENS C 025 PROJECT WORK + VIVA VOCE

The Semester IV consists of a major project only and the students have to complete the project within six months in collaboration with any of the research institution located within or outside the state.

OPEN COURSE

ENS O 026 FUNDAMENTALS OF ENVIRONMENTAL SCIENCE

UNIT -1: Introduction to Environmental Science Definition, Scope and Importance of Environmental Science, Definition; Multidisciplinary nature of the environmental Science; Scope and importance; Need of Environmental awareness, Ecology, Interrelationship of ecology with other disciplines. Introduction to global environmental problems.

UNIT -II : Ecosystem Definition; Components of ecosystem; Abiotic components: Light, Temperature, Pressure, Water, Wind, Soil; Biotic components: Energy flow in an ecosystem: Primary production, Secondary production; Food chain: Grazing food chain, Detritus food chain; Ecological pyramids: Pyramid of number, Pyramid of biomass, Pyramid of energy; Food web; Ecological indicators. Biogeochemical cycles a) Gaseous cycles: Oxygen cycle, Carbon cycle and Nitrogen cycle. b) Sedimentary cycles: Phosphorus cycle, Sulphur cycle.

UNIT -III: Components of the Environment: a).The atmosphere or the air: Layers of Atmosphere , Composition of air; importance of atmosphere,. b) Lithosphere or the rock and the soil: Elementary composition of rocks in the earth crust. Types of rocks; Process of soil formation: Physical weathering, Chemical weathering of rocks; Role of soil in shaping the biosphere. c) Hydrosphere or water: Importance of water, distribution of fresh water at global, national and state level. Hydrological Cycle.

UNIT -IV: Environmental Pollution Definition, Types, Sources, Effects and Control measures. Air pollution, Water pollution, Soil / Land pollution- Pesticide pollution - Biotransformation of toxicants, Bioaccumulation of Xenobiotics, Bioconcentration and Biomagnification., Noise pollution, Radioactive Pollution Artificial rain, Acid rain, Global warming, Green house effect .Ozone layer formation & depletion, Global environmental problems.

UNIT -V: Biodiversity and its Conservation: 1. Introduction Definition, Types of biodiversity such as genetic, species and ecosystem biodiversity; Biodiversity at Global, National and local levels; The mega-diversity countries of the world; Biogeographical classification of India. Importance and value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values 2. Threats to biodiversity- Habitat loss and degradation, poaching of wild life, introduction of exotic species, genetic pollution, climate change, man wildlife conflict; Endangered and endemic species of India; extinction of species, key stone species, Hot spots of biodiversity.

In-situ conservation–protected areas-National parks, Wildlife sanctuaries, Biosphere reserves, Definition, concept and short description of and importance of major reserves; Nilgiri Biosphere Reserve , Agasthyamalai Biosphere Reserve, Sunderban, Andaman and Nicobar, Gulf of

Mannar. Project Tiger, Project Elephant , sacred groves with special reference to Kerala, Documenting traditional knowledge. Ex-situ conservation-Botanical gardens, zoos, aquaria, National Bureau of Plant Genetic Resources(NBPGR), National Bureau of Animal Genetic Resources(NBAGR), Documenting traditional knowledge

UNIT – VI: Natural resource conservation: Natural resource – Definition – Concept, classification of natural resources (Renewable and non renewable resources) Renewable resources – Land / Soil resources, Soil or land degradation, Causes of soil and land degradation, waste lands, desertification, conservation strategies. Water resources – sources of water, hydrological cycle, Use and exploitation of surface and ground water, conflict over water, water conservation strategies, Forest resources – Importance of Forest - Classification of Forest resources - Use and over exploitation, deforestation, basic causes of deforestation, management of forest resources. **Energy resources:-** Non renewable energy resources – Fossil fuels (Coal, Petroleum and natural gas), nuclear fuel. Renewable energy resources (Biomass, Bio fuel, Hydropower, Tidal energy, wave energy, wind energy, geothermal energy, solar energy, magneto hydrodynamic power, Hydrogen energy). Energy crisis, management of energy resources.

UNIT -VII : Global strategy for conservation

Stockholm conference 1972, Nairobi Conference 1982, Montreal Protocol 1987, London, 1989, Rio Declaration 1992, Berlin Mandate 1995, Geneva Convention, 1996, Kyoto Protocol 1996, Johannesburg Conference 2002, Bishnoi Movement, Chipko Movement, Narmada Bachao Andolan, Apikko movement, Silent Valley Movement, Baliyapal Movement

UNIT -VIII: Environmental Laws / Policies and agencies. i) History of environmental law, environmental legislation in India, Central and state boards for the prevention and control of environmental pollution, powers and functions of pollution control boards, penalties and procedure, duties and responsibilities of citizens for environment protection ii) Wildlife Act 1972, Air and Water act, Water Cess Act, Forest Act, Environmental protection Act 1986, Hazardous waste (Management and Handling) rules 1989, Bio medical waste (Management and Handling) rules 1998. Ministry of Environment and forests – notification relating to hazardous microorganisms and genetically modified organism 1999. Public liability insurance Act 1995. Noise pollution 2000. Natural environment tribunal Act 1995. iii) International cooperative movements. Global Environment monitoring systems (GEMS) . Antarctica convention, Stockholm summit, UNCED and its four conventions- climate change, biodiversity, desertification , tropical forest, Ramsar convention. iv) National and international agencies - Earth watch, UN organization, WCN, UNEP and others, Co operation on ozone layer, migratory species, wetlands, mangroves, oceans. Major environmental issues in India and Kerala with case studies. Green movement and Eco feminism - Chipko movement, Naarmada Bachao movement, Baliapal movement, Silent valley movement.

UNIT -IX: Environmental Management. Introduction to EIA, Environmental auditing and basic concepts of remote sensing, GIS

References

1. Agarwal, S.K and Dubey, P.S, Environmental controversies. APH publishing corporation, ND, 2002.
2. Ahluwalia, V.K and Sunitha Malhotra, Environmental science, Ane Books Pvt. Ltd. publishers, ND.
3. Anil Tyagi, Environmental Science, Danika publishing company, New Delhi, 2007.
4. Anubha Kaushik, perspectives in Environmental studies, New Age International Publishers, N D, 2004.
5. Bedes, S, The Nature of sustainable development, scribe publication, Australia, 1993.
6. Bill Freedman, Environmental Ecology (Academic Press, New York)
7. Brijgopal, N. Bharadwaj, Elements of Ecology (Vikas Publishing house, New Delhi)
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12. Enger Smith, Smith, W. M. C. Brown, Environmental Science (Company Publishing)
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14. G. S. Dahliwal, G. S. Sangha P. K. Ralhan, Fundamentals of Environmental Science (Kalyani Publishers, New Delhi)
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20. Miller, G. Tyler, Environmental Science, Brooks/ Cole, Thomas Learning, Inc, USA, 8th edition, 2001.
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22. P. D. Sharma , Environmental Biology (Rastogi Publications, Meerut)
23. P. D. Sharma, Ecology and Environment (Rastogi Publications, Meerut)
24. P. K. G. Nair, Principles of Environmental Biology (Himalaya Publishing House, New Delhi)
25. P. S. Verma, V. K. Agarwal , Principles of Ecology (S. Chand and Co. New Delhi)
26. P. Kelu, Environmental Education – A Conceptual Analysis. University of Calicut publication
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28. Robert Leo Smith, Ecology and Field Biology (Harper Collins college publication)
29. S.P. Misra, S.N. Pandey, Essential Environmental Studies. (Ane Books Pvt. Ltd, Chennai)

30. Sharma, H.S and Khan, T.I, Environmental conservation of depleting resources and sustainable development, Aavishkar publishers, Distribution, Jaipur, 2003.
31. The World commission on Env. & Development; Our common future; Oxford University Press.
32. Turk & Turk, Introduction to Environmental Studies (Kalyani Publishers, New Delhi)
33. V.K.Ahluwalia, Sunita Malhotra, Environmental Science. (Ane Books Pvt.Ltd, Chennai
34. Watt K. E. F. (1973), Principles of Soil Science (Mc Graw Hill Book Company, New Delhi)

Sd/-
Dr.K.M.Khaleel
Course Director
Dept. of Environmental Studies
SAT Campus,Payyannur.