

Sacred Heart College (Autonomous)

Department of Zoology

Master of Science [Zoology]

Course plan

Academic Year: 2015 – 16

Semester IV

**COURSE PLAN: PG ZOOLOGY ELECTIVE
COURSE 1 (SEMESTER 4)
Environmental Science- Concepts and Approaches**

COURSE OBJECTIVES

- To provide a broad and deep understanding on environment and influence of man on environment
- To equip the students to use various tools and techniques for the study of environment
- To enable the learner to understand, think and evolve strategies for management and conservation of environment for sustaining life on earth
- To take up further studies and research in the field

Basic Reference

Odum, E.P. and Barrett, G. W. 2005. Fundamentals of Ecology. Thomson Asia Pvt. Ltd., Singapore Primack, R.B. 1998. Essentials of Conservation Biology. Sinauer Associates.
Chapman, J.L. and Reiss, M.J. 2005. Ecology: Principles and Applications. Cambridge University Press, London. Forman, R.T. 1995. Land Mosaics: The Ecology of Landscapes and Regions. Cambridge Univ. Press, Cambridge, UK.
Krishnamurthy, K.V. 2004. An Advanced Textbook on Biodiversity: Principles and practice. Oxford and IBH. Publ. Co. New Delhi. Steiner, F. 1999. The Living Landscape: An Ecological Approach to Landscape Planning, 2nd Edition. McGraw Hill, Inc., New York.

Module I. The Physical Environment (20 hrs.)			
Sessions	Topic	Method	Remarks
1	Lithosphere - Weathering and soil formation,	Lecture with Visual supplements	
2	Soil colloids, adsorption and exchange of anions and cations.	Lecture with Visual supplements	
3	Role of microbes in soil, types of soil, soil profile	Lecture with Visual supplements	
4	Classification of rocks and their environmental significance.	Lecture with Visual supplements	
5	Classification of folds and faults and their environmental significance.	Lecture with Visual supplements	
6	Classification of dykes and their environmental significance.	Lecture with Visual supplements	
7	Geomorphological processes-plate tectonics, sea floor spreading, mountain building.	Lecture with Visual supplements	
8	Geomorphological processes- Evolution of continents and structural deformation.	Lecture with Visual supplements	

9	Atmosphere -Physico-chemical characteristics, divisions, composition and significance of atmospheric components.	Lecture with Visual supplements	
10	CIA I		
11	Hydrosphere -Visible and invisible hydrosphere, Range of aquatic habitats,	Lecture with Visual supplements	
12	Hydrosphere -Visible and invisible hydrosphere, Range of aquatic habitats contd...	Lecture with Visual supplements	

13	Water cycles between earth and the atmosphere,	Lecture	
14	Global water balance, ice sheets, origin and composition of sea water	Lecture with PowerPoint	
15	Global water balance, ice sheets, origin and composition of sea water contd..	Lecture with PowerPoint	
16	Sea level changes	Lecture with PowerPoint	
17	River basins and watershed.	Lecture with PowerPoint	
18	Physico-chemical characteristics of water- diffusion of oxygen from the atmosphere to surface waters.	Lecture with PowerPoint	
19	Influence of pH, turbidity and light on aquatic life.	Lecture with PowerPoint	
20	Influence of pH, turbidity and light on aquatic life.contd..	Lecture with PowerPoint	
Module II. Weather and Climate (12 hrs.)			
21	Definitions and scope of climatology, weather and climate	Lecture with PowerPoint	
22	Components of climate system	Lecture with PowerPoint	
23	Earth's thermal environment, earth intercepts solar radiation, seasonal variation in intercepted solar radiation	Lecture with PowerPoint	
24	Air temperature in relation to altitude, global circulation of air masses	Lecture with PowerPoint	
25	Wind and earth's rotation on ocean currents	Lecture with PowerPoint	
26	Influence of temperature on moisture content of air, global pattern of precipitation, influence of topography on regional pattern of precipitation.	Lecture with PowerPoint	
27	Classification of climate-Koepfen's classification and Thornthwaite's scheme, climatic types and zones.	Lecture with PowerPoint	
28	Global climatic phenomena-El Nino and La Nina, causes and factors of climate change.	Lecture with PowerPoint	
29	CIA II		

30	Effect of climate change on ecosystems and human welfare. Organisms and microclimate.	Lecture with PowerPoint	
31	International Agreements on Climate Change – UNFCCC - 1992	Lecture with PowerPoint	
32	Kyoto Protocol – 1997	Lecture with PowerPoint	

	Copenhagen accord, Paris agreement - 2015		
Module III. Climate of India (4 hrs.)			
33	Climatic regions of India, tropical monsoon climate-onset	Lecture with PowerPoint	
34	Rain bearing systems and influence of oceanic and continental factors on rain.	Lecture with PowerPoint	
35	Break in the monsoon, retreat of monsoon.	Lecture with PowerPoint	
36	Monsoon in Kerala	Lecture with PowerPoint	

Faculty 2

Module IV. Landscape Ecology (8 Hrs.)			
1	Land and Landscape processes; Hierarchy: ecosystems to land units;	ICT Enabled (ppt & images, video clippings); discussion	
2	Ecological principles at work with Landscapes	ICT Enabled (ppt & images, video clippings); discussion	
3	Concept of ecological land degradation desertification, water logging, salinisation and soil erosion	ICT Enabled (ppt & images, video clippings); discussion	
4	Concept of ecological land degradation desertification, water logging, salinisation and soil erosion..contd...	ICT Enabled (ppt & images, video clippings); discussion	
5	Ecological assessment of landscape for vegetation and habitats	1 Hr	
6	Integrated analytical techniques- land suitability analysis and carrying capacity studies	ICT Enabled (ppt & images, video clippings); discussion	
7	Use of soil survey, aerial photos, topographic maps and other resource data in landscape management	ICT Enabled (ppt & images, video clippings); discussion	
8	Use of soil survey, aerial photos, topographic maps and other resource data in landscape management contd..	ICT Enabled (ppt & images, video clippings); discussion	
Module V. Biodiversity and Conservation (24 Hrs.)			
9	Types of biodiversity-wild biodiversity, agro-biodiversity, domesticated biodiversity	ICT Enabled (ppt & images, video clippings); discussion	

10	Types of biodiversity-wild biodiversity, agro-biodiversity, domesticated biodiversity contd..	ICT Enabled (ppt & images, video clippings); discussion	
11	Values of biodiversity	ICT Enabled (ppt & images, video clippings); discussion	

12	Values of Biodiversity contd...	ICT Enabled (ppt & images, video clippings); discussion
13	Ecosystem functions and biodiversity, mobile links and valuating ecosystem services	ICT Enabled (ppt & images, video clippings); discussion
14	Drivers of biodiversity loss	ICT Enabled (ppt & images, video clippings); discussion
15	Tools and techniques for biodiversity estimation- biodiversity indices	ICT Enabled (ppt & images, video clippings); discussion
16	Tools and techniques for biodiversity estimation	ICT Enabled (ppt & images, video clippings); discussion
17	Tools and techniques for biodiversity estimation contd....	ICT Enabled (ppt & images, video clippings); discussion
18	Strategies for biodiversity conservation- In-situ conservation: sanctuaries, biospheres reserves, national parks, nature reserves, preservation plots.	ICT Enabled (ppt & images, video clippings); discussion
19	Ex-situ conservation: botanical gardens, zoos, aquaria, homestead garden; herbarium.	ICT Enabled (ppt & images, video clippings); discussion
20	CIA-I	1 Hr
21	In-vitro Conservation: germplasm and gene bank; tissue culture: pollen and spore bank, DNA bank. GEF-World Bank initiatives	ICT Enabled (ppt & images, video clippings); discussion
22	Biodiversity hotspots and their characteristics, global distribution	ICT Enabled (ppt & images, video clippings); discussion
23	National and international programmes and agencies for biodiversity conservation and environmental management: UN Conventions and Protocols, CBD, IUCN, WCMC, WRI	ICT Enabled (ppt & images, video clippings); discussion

24	WWF, CI, CITES, TRAFFIC, Green Peace. National and Local NGOs. UNFCC and IPCC	ICT Enabled (ppt & images, video clippings); discussion
25	National Board of Biodiversity, State Board of Biodiversity	ICT Enabled (ppt & images, video clippings); discussion
26	Ecosystem people and traditional conservation strategies	ICT Enabled (ppt & images, video clippings); discussion
27	People's participation in conservation-PFM, Community reserves, Sacred groves,	ICT Enabled (ppt & images, video clippings); discussion
28	Biovillages, People's Biodiversity Register (PBR). Biodiversity Management Committee (BMC).	ICT Enabled (ppt & images, video clippings);

		discussion	
29	Wildlife values and eco-tourism, wildlife distribution in India. Threatened animals of India.	ICT Enabled (ppt & images, video clippings); discussion	
30	Restoration Ecology- need and policies, case studies and success stories - global and national;	ICT Enabled (ppt & images, video clippings); discussion	
31	Restoration Ecology- need and policies, case studies and success stories - global and national contd..	ICT Enabled (ppt & images, video clippings); discussion	
32	Restoration Ecology- need and policies, case studies and success stories - global and national contd..	ICT Enabled (ppt & images, video clippings); discussion	
Module VI. Major environmental/conservation laws and rules in India (6 Hrs.)			
33	Wildlife Protection Act 1972 amended 1991, Forest Conservation Act, 1980	Seminar; discussion	
34	Air (Prevention and Control of Pollution) Act 1981, Water (Prevention and Control of Pollution) Act 1974, amended 1988,	Seminar; discussion	
35	The Environment Protection Act, 1986 and Rules, 1991. The Biological Diversity Act 2002, Rules 2004	Seminar; discussion	

36	Coastal Regulation Zone (CRZ) Notification 1991 & 2011 – Classification of Coastal Zones and regulation of developmental activities.	Seminar; discussion	
37	Coastal Regulation Zone (CRZ) Notification 1991 & 2011 – Classification of Coastal Zones and regulation of developmental activities contd..	Seminar; discussion	
38	CIA II	2 Hrs	
Module VII. Biogeography (6 Hrs.)			
39	Discussion on CIA II, Major terrestrial Biomes	ICT Enabled (ppt & images, video clippings); discussion	
40	Major terrestrial Biomes contd...	ICT Enabled (ppt & images, video clippings); discussion	
41	Theory of island biogeography	ICT Enabled (ppt & images, video clippings); discussion	

42	Bio-geographical zones of India	ICT Enabled (ppt & images, video clippings); discussion	
43	Western Ghats and its significance	ICT Enabled (ppt & images, video clippings); discussion	
44	Western Ghats and its significance contd...	ICT Enabled (ppt & images, video clippings); discussion	
Module VIII. Biological Invasions (10 Hrs.)			
45	Introduction Elton's hypothesis	ICT Enabled (ppt & images, video clippings); discussion	
46	Invasion patterns and process biological attributes for invasion: Reproductive potential, Allelopathy Phenotypic plasticity, fitness to the new environment.	ICT Enabled (ppt & images, video clippings); discussion	

47	Invasion patterns and process biological attributes for invasion: Reproductive potential, Allelopathy Phenotypic plasticity, fitness to the new environment...contd..	ICT Enabled (ppt & images, video clippings); discussion	
48	Hypotheses for invasion success: Natural enemy hypothesis evolution of invasiveness hypothesis, empty niche hypothesis, novel weapon hypothesis, disturbance hypothesis and Propagule pressure hypothesis.	ICT Enabled (ppt & images, video clippings); discussion	
49	Hypotheses for invasion success: Natural enemy hypothesis evolution of invasiveness hypothesis, empty niche hypothesis, novel weapon hypothesis, disturbance hypothesis and Propagule pressure hypothesis. ..contd..	ICT Enabled (ppt & images, video clippings); discussion	
50	Invasive alien species of India (plants and animals).	ICT Enabled (ppt & images, video clippings); discussion	
51	Databases of biological invasions.	ICT Enabled (ppt & images, video clippings); discussion	
52	Impacts and management of invasions: impacts of exotics on biodiversity, productivity, nutrient cycling	ICT Enabled (ppt & images, video clippings); discussion	
53	Management: Bio-control programmes, mechanical and chemical control Positive utilization Quarantine	ICT Enabled (ppt & images, video clippings); discussion	

54	EIA of biological invasion	ICT Enabled (ppt & images, video clippings); discussion	

ASSIGNMENTS

	Date of submission/completion	Topic of Assignment & Nature of assignment (Individual/Group – Written/Presentation – Graded or Non-graded etc)
1	Session 20	Individual assignments

Additional Reading List

1. Fashey , Tomas D, Insel , Paul M and Roth Walt (2005) Fit and Well. New York; Mc Graw Hill Inc
2. Greenberg, Jerol S and Dintiman George B (1997) Wellness Creating a life of Health and Fitness , London Allyn and Bacon Inc.
3. Rai. B.C. Health Education and Hygiene. Published by Prakashan Kendra, Lucknow.
4. K Park, (2008) Park’s Text Book of Preventive and Social Mediine 18th Edition. Banarasidass Bhenot Publication
5. Tom Sanders and Peter Emery. (2004) Molecular basis of human nutrition: Taylor & Francis Publishers Ane Book

COURSE PLAN: ZOOLOGY
ENVIRONMENTAL POLLUTION AND
TOXICOLOGY

COURSE OBJECTIVES

- To provide a broad and deep understanding on environment and influence of man on environment
- To equip the students to use various tools and techniques for the study of environment
- To enable the learner to understand, think and evolve strategies for management and conservation of environment for sustaining life on earth
- To take up further studies and research in the field

Basic Reference

Niesink, R.J.M., De Vries, J. and Hollinger, M.A. 1996. (Eds.). Toxicology- Principles and Applications. CRC Press.

TEACHER I			
Sessions	Topic	Method	Remarks/Reference
1	Module I. Introduction Brief history of human civilization, industrialization and urbanization	Lecture	
2	Definition of pollution. Different types of pollution	Lecture with interaction	
3	Air, Water and soil and their local, regional and global aspects.	,,	
4	Module III. Water Pollution Sources of water pollution-Domestic (municipal sewage), industrial and agricultural.	Lecture and interaction	

5	Health effects of water pollution	„	
6	Water borne and water related diseases.	„	
7	Effects of water pollution on aquatic system.	„	
8	Water quality standard for potability - Pollution parameters, BOD, COD, Coliform bacteria.	„	
9	Treatment of water for potable purpose (mixing, sedimentation, coagulation, filtration and disinfection)	„	
10	Primary and secondary treatment	„	
11	Sludge disposal. Biological treatment	„	
12	Kinetics of Biological growth- activated sludge treatment	Lecture and interaction	
13	Trickling filters - anaerobic digestion	„	
14	Combined aerobic and anaerobic treatment process, aerobic process	„	
15	Advanced waste water treatment - removal of dissolved organics and inorganic - precipitation	„	

16	Ion exchange, reverse osmosis, electro dialysis, adsorption and oxidation.	„	
17	Removal of nutrients	„	
18	Removal of heavy metals - overall waste water treatment for sewage water.	„	
TEACHER II			

1	Sources and classification of air pollution	ICT Enabled (ppt & images, video clippings)	
2	Particulates and gaseous pollutants in the atmosphere.	ICT Enabled (ppt & images, video clippings)	
3	Primary and secondary pollutants.	ICT Enabled (ppt & images, video clippings)	
4	Effects of air pollutants on human health, animals, vegetation, materials and structures.	ICT Enabled (ppt & images, video clippings)	
5	Air pollution monitoring - methods	ICT Enabled (ppt & images, video clippings)	
6	Air pollution monitoring – methods.Contd..	ICT Enabled (ppt & images,	

		video clippings)	
7	Air pollution monitoring – methods.Contd..	ICT Enabled (ppt & images, video clippings)	
8	Air quality standards; ISI, EPA.	ICT Enabled (ppt & images, video clippings)	
9	Sampling and measurement of particulate matters (SPM)	ICT Enabled (ppt & images, video clippings)	
10	Gaseous pollutants, CO ₂ , CO, NO _x , SO ₂ , H ₂ S, oxidants, ozone and hydrogen fluoride.	ICT Enabled (ppt & images, video clippings)	
11	CIA I	1 hr; descriptive answers only	
12	Control of gaseous emission: adsorption by liquids, adsorption by solids, combustion and condensation.	ICT Enabled (ppt & images, video clippings)	
13	Control of SO ₂ , NO _x , CO, CO ₂ and hydrocarbons.	ICT Enabled (ppt & images, video clippings)	

14	Control of SO ₂ , NO _x , CO, CO ₂ and hydrocarbons.contd...	ICT Enabled (ppt & images, video clippings)	
	Module IV. Soil Pollution		
15	Introduction	Lecture	

16	Sources of soil pollution	ICT Enabled (ppt & images, charts, video clippings)	
17	Agricultural, industrial and domestic.	ICT Enabled (ppt & images, video clippings)	
18	Hazardous waste compounds, formulations and classes of substances,	ICT Enabled (ppt, images, animations & video clippings)	
19	Chemical classification of hazardous waste.	ICT Enabled (ppt & images, charts, video clippings)	
	CIA II	2 hrs	
	Module VII. Toxicology		
20	Toxic chemicals in the Environment – Biochemical aspects of As, Cd, Pb, Hg, Cu, O ₃ , PAN, pesticides, MIC and other carcinogens.	ICT Enabled (ppt & images, charts, video clippings)	
21	Toxic chemicals in the Environment...contd...	ICT Enabled (ppt & images, video clippings)	
22	Toxic chemicals in the Environment...contd...		
23	Bio accumulation and biomagnification.	ICT Enabled (ppt & images, charts, video clippings)	
24	Occupational toxicology	ICT Enabled (ppt & images,	

		charts, video clippings)	
25	Hazardous chemicals, disorders from chemical exposure at work,	ICT Enabled (ppt & images, charts, video clippings)	

26	Assessment of occupational hazards.	ICT Enabled (ppt & images, charts, video clippings)	
27	Toxicity testing; Bioassay – Definition, purpose, criteria for selection of test organism, methodology,	ICT Enabled (ppt & images, charts, video clippings)	
28	Estimation of LC50,	ICT Enabled (ppt & images, charts, video clippings)	
29	Limitation and importance of bioassay	ICT Enabled (ppt & images, charts, video clippings)	
30	Acute toxicity (single); sub acute toxicity; chronic toxicity;	ICT Enabled (ppt & images, charts, video clippings)	
31	Teratogenicity, carcinogenicity and mutagenicity.	ICT Enabled (ppt & images, charts, video clippings)	
32	Biomonitoring of toxic chemicals, objectives	ICT Enabled (ppt & images, charts, video clippings)	
33	Programs and Parameters	ICT Enabled (ppt & images, charts, video clippings)	

34	Concepts of bio indicators	ICT Enabled (ppt & images, charts, video clippings)	
35	CIA 2 hrs	ICT Enabled (ppt & images, video clippings)	
36	Revision & Evaluation of the course	ICT Enabled (ppt & images, video clippings)	

TEACHER III

	Module IV. Soil Pollution		
1	Soil factors affected by pollution – physico-chemical	ICT Enabled (ppt & images, video clippings)	
2	Soil factors affected by pollution – biological impacts	ICT Enabled (ppt & images, video clippings)	

3	Case studies on soil pollution in wetland soils in Kerala	ICT Enabled (ppt & images, video clippings)	
4	Case studies on soil pollution in Highland soils in Kerala	ICT Enabled (ppt & images, video clippings)	
5	Control of soil pollution. Soil quality parameters and test methods.	ICT Enabled (ppt & images, video clippings)	
6	I CIA	1 hr Descriptive test	
	Module V. Solid Waste Management	ICT Enabled (ppt & images,	

		video clippings)	
7	Municipal solid wastes (MSW) - quantities and characteristics	ICT Enabled (ppt & images, video clippings)	
8	Waste collection and transport, waste processing and resources recovery and recycling	ICT Enabled (ppt & images, video clippings)	
9	Aerobic and anaerobic systems- composting, vermicomposting	ICT Enabled (ppt & images, video clippings)	
10	Biodigesters (Biogas plants); incineration, pyrolysis, plasma pyrolysis; sanitary land fills and open dumping yards	ICT Enabled (ppt & images, video clippings)	
11	Management of plastic and e-waste	ICT Enabled (ppt & images, video clippings)	
12	Better management strategies (any two model case studies)	ICT Enabled (ppt & images, video clippings)	
13	Treatment process for unsegregated waste, fixation of hazardous solid waste prior to disposal	ICT Enabled (ppt & images, video clippings)	
14	Hazardous waste in land fill.	ICT Enabled (ppt & images, video clippings)	
15	Hazardous waste (Management and Handling)	ICT Enabled (ppt & images,	

	Rules 1989 - the Manufacture Storage and Import of Hazardous Chemicals Rules 1989 contd...	video clippings)	
16	Biomedical Waste (Management and Handling) Rules 1998	ICT Enabled (ppt & images, video clippings)	
17	Plastic Act 1999 and Extended producer responsibility.	ICT Enabled (ppt & images, video clippings)	
	II CIA		
18	Revision and evaluation	ICT Enabled (ppt & images, video clippings)	

TEACHER IV

	Module V. Noise, Thermal and Oil Pollution		
1	Properties of sound and noise. Effects of noise on People and ecosystem	ICT Enabled (ppt & images, video clippings)	
2	Basic principles of noise control	ICT Enabled (ppt & images, video clippings)	
3	National and International Standards	ICT Enabled (ppt & images, video clippings)	
4	Assessment and measurement of sound	ICT Enabled (ppt & images,	

		video clippings)	
5	Thermal Pollution - causes and consequences (any two case studies)	ICT Enabled (ppt & images, video clippings)	
6	Oil pollution – causes and consequences (any two case studies)	ICT Enabled (ppt & images, video clippings)	
7	I CIA		
	Module VI. Radiation Pollution		

8	Radiation pollution- Definition, Radioactivity, Radionuclide, Radiation emissions, sources	ICT Enabled (ppt & images, video clippings)	
9	Radioactive decay and buildup	ICT Enabled (ppt & images, video clippings)	
10	Biological effects of radiation	ICT Enabled (ppt & images, video clippings)	
11	Radioactive pollution impacts on ecosystem	ICT Enabled (ppt & images, video clippings)	
12	Nuclear reactor disasters (Any two case studies), safety standards.	ICT Enabled (ppt & images, video clippings)	
13	Nuclear reactor disasters (Any two case studies), safety standards contd.....	ICT Enabled (ppt & images, video clippings)	
	Module VII. Toxicology		

14	Definition, scope and history of toxicology, Acute and chronic toxicity	ICT Enabled (ppt & images, video clippings)	
15	Selective toxicity, dose, synergism and antagonism.	ICT Enabled (ppt & images, video clippings)	
16	Dose – Response relationships – Graded response, quantal response, Time action curves	ICT Enabled (ppt & images, video clippings)	
17	Limit value (TLV); LC50; Margin of safety; Toxicity curves; Cumulative toxicity and LD50 and CTF	ICT Enabled (ppt & images, video clippings)	
	II CIA		
18	Revision and Evaluation		

ASSIGNMENTS

	Date of submission/completion	Topic of Assignment& Nature of assignment (Individual/Group – Written/Presentation – Graded or Non-graded etc)
1	Session 16	Individual assignment
2	Session 6	Individual assignment

Additional Reading List

1. Butter, G.C.1988. *Principles of Ecotoxicology*. John Wiley and Sons.
2. Cockerham, G.L. and Shane, B.S. 1994. (Eds.). *Basic Environmental Toxicology*. CRC Press.
3. Eisenbude, M. 1998. *Environmental Radioactivity*. Academic Press , NY.
4. Fellenberg, G.1999.*Chemistry of Pollution*. John Wiley and Sons, New Delhi
5. Fellenberg, G.1999.Chemistry of Pollution. John Wiley and Sons, New Delhi
6. Hayes, W.A. 2001. Principles and Methods of Toxicology.CRC Press, NY.

COURSE PLAN: ENVIRONMENTAL MANAGEMENT AND DEVELOPMENT

COURSE OBJECTIVES:

Objectives:

- To provide a broad and deep understanding on environment and influence of man on environment
- To equip the students to use various tools and techniques for the study of environment
- To enable the learner to understand, think and evolve strategies for management and conservation of environment for sustaining life on earth
- To take up further studies and research in the field
- To equip the students to use various tools and techniques for the study of environment
- To enable the learner to understand, think and evolve strategies for management and conservation of environment for sustaining life on earth
- To take up further studies and research in the field

Basic Reference:

Agarwal, N.K. 2004. Essentials of GPS. Spatial Networks Pvt. Ltd., Hyderabad.

Agarwal, S.K. 2002. Eco informatics. APH Publishing Corporation, Hyderabad.

Anjanvelu. Y. 2002 Environmental Impact Assessment Methodologies, B.S.Publications, Sons. Blackwell Science London. 1999

Asit K. Biswas et.al., 1987. EIA for Developing Countries. United Nations University, Tokyo.

Bowers, J., Sustainability and Environmental Economics – An Alternative Text, Longman, London, 1997.

Canter, L.W., Environmental Impact Assessment, McGraw Hill, New York. 1996

Carter,L.1996. Environmental Impact Assessment. McGraw Hill,New Delhi

Coronel, C., Morris, S. and Rob, P. 2009. Database Systems: Design, Implementation and Management.9th edn., Course Technology.

Eagles, P.F.J.1987. The planning and Management of Environmentally Sensitive areas. Longman Group Ltd., USA.

Elachi, C. 1978. Introduction to Physics and Techniques of Remote sensing. John Wiley Pub., N.Y.

Ewing B., D. Moore, S. Goldfinger, A. Oursler, A. Reed, and M. Wackernagel. 2010.

Floyd F., and Sabins Jr.,W.H. 1987. Remote Sensing, Principles and Interpretation. Freeman & Company, New York, 2nd Ed., 1987.

Gadgil, M. and Guha, R. 1995. Ecology and Equity- The Use and Abuse of Nature in Contemporary India,.Penguin India.

Gadgil, M. and Guha, R.1998. The Fissured Land; An Ecological History of India; Oxford University Press, New Delhi.

Goldsmith, B. 1992. (Ed.) *Monitoring for Conservation and Ecology*. Chapman and Hall, London.

John Glasson, Riki Therivel and Andrew Chadwick. 2005. *Introduction to Environmental Impact Assessment*, 2nd Ed., UCL Press, Philadelphia, USA

Jorgensen, S. E., Chon, T S. and Recknagel, F. A., 2009. *Handbook of Ecological Modeling in and Informatics*. WIT Press

Jorgensen, S.E. 1996. *Applications of ecological modeling in environmental management*. Elsevier Sci. Co., London.

Kang-tsung, C. 2000. *Introduction to GIS*. Tata Mc Graw Hill, New Delhi.

s

Session	Duration	Topic	Method	Remarks
1	2 Hr.	An overview of Population	Lecture and animation videos	
2	2 Hr.	Resources and ecosystem management	Lecture and animation videos	
3	2 Hr.	Exponential growth in human numbers and the implications	Lecture and animation videos	
4	4 Hr.	The five basic laws of Ecology and their relevance for ecosystems management	Lecture and animation videos	
5	2 Hr.	Paradigm shifts in the management of Ecosystems- influence of economics in ecology	Lecture and animation videos	
6	6 Hr.	Management practices for various ecosystems: grasslands, forests, mountains, wetlands and coastal areas	Lecture and animation videos	

7	5 Hr.	Environmental planning and management of – waste lands, reclaimed lands, mining areas, human settlements, industrial lands and agricultural lands	Lecture and animation videos	
8	2 Hr.	Principles and concepts of Remote Sensing	Lecture and animation videos	
9	2 Hr.	spectral characteristics of surface features (rocks, soils, vegetations, water). Space Imaging Landsat, SPOT, IRS, NOAA, Seasat, ERS, RADARSAT, INSAT. Satellites and their sensors, geometry and radiometry	Lecture and animation videos	
10	3 Hr.	Digital Image Processing: Principles, Image Rectification and restoration, Image enhancement and Mosaicing. Image classification	Lecture and animation videos	
11	2 Hr.	Supervised, Unsupervised, Ground truth data and training set manipulation, Classification accuracy assessment	Lecture and animation videos	
12	4 Hr.	Geographical Information System (GIS): Basic principles and terminologies, Raster and vector data, Map projection, Topology creation, Overlay analysis, Data structure and Digital cartography	Lecture and animation videos	
13	4 Hr.	Software used in GIS Surveying: Leveling, Triangulation, Geodetic survey; Global Positioning System (GPS) Basic principles	Lecture and animation videos	

14	3 Hr.	Applications to environmental studies.	Lecture and animation videos	
15	1 Hr.	Basic principles: Management of physical, social, and economic environment.	Discussion and lecture	
16	1 Hr.	Concepts and scope of environmental planning, regional planning and management	Discussion and lecture	
17	1 Hr.	Cost-benefit analysis and Resource economics.	ICT Enabled (PPT)	
18	1 Hr.	Environmental modeling- simulation modeling, input-output modeling	ICT Enabled (PPT)	
19	1 Hr.	Linear programming, Software and resource management.	Lecture	
20	1 Hr.	CIA I	1 hr test	
21	1 Hr.	Carbon footprint, Water foot print	Discussion and lecture	
22	1 Hr.	Happy Planet Index (HPI), Ecological Economics	Discussion and lecture	
23	1 Hr.	Conflict resolution strategies. Eco funds.	Discussion and lecture	
24	1 Hr.	Eco labeling and certification	Discussion and lecture	
25	1 Hr.	Revision and group discussion	Lecture and ppt	
26	1 Hr.	Accreditation – need, objectives and benefits	Discussion and lecture	
27	1 Hr.	Corporate social responsibility and Corporate	Discussion	

		environmental responsibility		
28	1 Hr.	ISO 14000 family of standards	PPT	
29	1 Hr.	CIA II	PPT	
30	1 Hr.	ISO 14001 and 26001	PPT	
31	1 Hr.	OHSAS 18001	PPT	
32	1 Hr.	Revision	Seminar	