DEPARTMENT OF ENVSSIRONMENTAL SCIENCE

Annexure-4

Department of Environmental Science

M.Sc. ENVIRONMENTAL SCIENCES

MAJOR COURSES					
Course Code	**TITLE OF THE COURSE**	**L**	**T**	**P**	**Credit**
ENVS-701	Fundamentals of environmental biology	2	0	1	3
ENVS-702	Environmental pollution	2	0	1	3
ENVS-703	Fundamental of ecology	2	0	1	3
ENVS-704	Environmental geo-science	2	0	1	3
ENVS-706	Renewable &Non- renewable resources	2	0	0	2
ENVS-707	Waste water treatment & application	2	0	1	3
ENVS-708	Solid waste management	2	0	1	3
ENVS-709	Environmental management	2	0	1	3
ENVS-710	Environmental laws and policies	2	0	0	2
ENVS-801	Environment & social issues	2	0	1	3
ENVS-802	Remote sensing & meteorological techniques	2	0	1	3
ENVS-803	Conservation of forest & wild life resources	2	0	1	3
ENVS-804	Environmental microbiology	2	0	1	3
ENVS-805	Aquatic environment	2	0	1	3
MINOR COURSES					
Course Code					
CHEM-709	Inorganic Chemistry	2	0	1	3
CE-725	Environmental Chemistry	2	0	1	3
SS - 727	Fundamental of soil science	2	0	1	3
SWLE-725	Fundamentals Of Remote Sensing, Image Interpretation And Advances In Remote Sensing	2	0	1	3
	SUPPORTING COURSE				
MAS – 815	Experimental design	2	0	1	3
CSIT-701	Computer orientation	2	0	1	3
AEAB - 704	Research methodology	1	0	1	3

DEFICIENCY COURSE					
AGRON-	Field Crops-I	2	0	1	3
MBFT-609	Agricultural microbiology	2	0	1	3
STFB-301	Forest ecology, biodiversity & conservation	1	0	1	2
SAC-508	Forest soil survey, land use & remote sensing	2	0	1	3
MAS- 511	Statistical methods(Deficiency)	2	0	1	3
	SEMINAR AND RESEARCH				
Course Code	**Title of the Course**	**L**	**T**	**P**	**Credit**
ENVS-780	Seminar-I	0	0	1	1
ENVS-880	Seminar-II	0	0	1	1
ENVS-899	Thesis/Dissertation	0	0	30	30
NON CREDIT COURSES					
MIS- 501	Library and information science	1	0	0	1
LNG-502	Technical writing and communication skill	1	0	0	1
AEAB-503	Intellectual property and its management in agriculture	1	0	0	1
Course Code	**Title of the Course**				
ENVS- 504	Basic Concept In Laboratory Techniques	0	0	1	1
AEAB-505	Agricultural Research, Research Ethics And Rural Development Programmes	1	0	0	1
ENVS- 506	Disaster Management	1	0	0	1

CORE COURSES

ENVS-701 FUNDAMENTALS OF ENVIRONMENTAL BIOLOGY 3 (2+0+1)

Theory

Classification of environmental biology and their applications in the environmental sciences, Classification of biomes, Biomes and habitat diversity, Major biotic elements of each biome and their characteristics. Biological diversity of India: Definition and nature, India's biogeographically history, Physiography, Climate and its impact on biodiversity. Indian forest and vegetation types and diversity of flora and fauna. Population and community ecology. Wetlands forests and semi- arid habitats of India: Definition and types of wetlands, Important wetlands of India and their conservation issues. Forests and semi-arid habitats of India: Their distribution in India, Ecological status of forests and arid lands, and their conservation. Environmental biotechnology. Role of biotechnology in conservation of species, *In-situ* and *ex-situ* conservation. Marine biology: biology of coastal and open sea environment, Their distribution, Adaptation and productivity. Biodiversity conservation: Global agreements and national concems. Ramsar sites, Cbd, Quarantine regulations, National forest policy, Biodiversity act. and Wild-life protection act.

Practical:

Identification of different tools and instruments, Identification of common weeds, Herbarium preparation, Collection of injured leaves from heavy polluted roadsides and its comparison with healthy leaves, A visit to aquatic ecosystem and methods for water and plankton collection, Plankton identification and quantification from river / lake water samples, Vegetation studies by line, Quadrates and belt transect methods and their analysis.

Theory

	Content	**Lecture**
•	Classification and their applications in the environmental sciences.	2
•	Classification of biomes, biomes and habitat diversity:	2
•	Major biotic elements of each biome and their characteristics.	2
•	Biological diversity of India: definition and nature, India's biogeographically history,	2
•	Physiography, climate and its impact on biodiversity.	2
•	Indian forest and vegetation, types and diversity of flora and fauna.	2
•	Population and community ecology.	2
•	Wetlands forests and semi-arid habitats of India:	2
•	Definition and types of wetlands, important wetlands of India and their conservation issues.	2
•	Forests and semi-arid habitats of India: their distribution in India,	2
•	Ecological status of forests and arid lands, and their conservation.	2
•	Role of biotechnology in conservation of species,	2
•	*In-situ* and *ex-situ* conservation.	1
•	Marine biology: biology of coastal and open sea environment, their distribution,	2
•	Adaptation and productivity. Biodiversity conservation	2

•	Global agreements and national concems. Ramsar sites, cbd, quarantine regulations,	3
•	National forest policy, biodiversity act. and wild-life protection act.	2

Practical:

	Content	Lecture
•	Identification of different tools and instruments,	1
•	Identification of common weeds,	2
•	Herbarium preparation,	3
•	Collection of injured leaves from heavy polluted roadsides and its comparison with healthy leaves,	3
•	A visit to aquatic ecosystem and methods for water and plankton collection,	2
•	Plankton identification and quantification from river / lake water samples,	2
•	Vegetation studies by line,	2
•	Quadrates and belt transect methods and their analysis.	2

References:

- Microbes, Man and Animals: The Natural History of Microbial Interactions : Linton, A. H. and Burns, R.G. (1982) john Wiley and Sons.
- Elements of Microbiology: Pelczar, M.J. and Chan ECS, 1981 McGraw Hill.
- General Microbiology: Stainer, R.Y.., Adelberg, E.A. and Ingraham, J.L. 1977. Macmillan Press.
- Microbial Methods for Environmental Biotechnology: Grainer, J.M. and Lynch, J.M. 1984. Academic Press.
- Microbiological Methods for Environmental Scientists and Enginners : Gaudy, A.F. and Guady, E.T. 1980, McGraw Hill

ENVS-702 ENVIRONMENTAL POLLUTION 3(2+0+1)

Theory

Introduction to pollution, Air pollution, atmospheric pollutant, air quality standards and criteria. Natural and anthropogenic sources of atmospheric pollutants, significance of these pollutants and their reactions in the atmosphere, Transport and dispersion of pollutants, Gaseous and particulate pollutants their analysis, Air pollution control equipment, Water pollution: types, sources and consequences, of water pollution, water quality parameters; criteria and standards, Physical, chemical and bacteriological parameter of water and waste water, Water and waste water treatment. Soil pollution: physical and chemical properties of soil, Industrial effluents of different kinds, their interactions with soil components, Problems of toxic heavy metals and pollution. Noise pollution: basic properties of sound, sound pressure and intensity levels, decibel, Measurement and analysis of sound. Equivalent sound pressure level (leq), noise pollution level (npl), sound exposure level (sel), traffic noise index

(tni), day-night level, Noise sources; machinery noise, pumps; compressors, building and construction equipment, domestic appliances, traffic – vehicular, train, aircraft. Noise control and abatement measures, sound absorbing materials, acoustic silencers, mufflers, barriers, vibration and impact isolation, Marine pollution: types, sources and consequences, Thermal pollution: types, sources and consequences, Solid waste management: types, sources and consequences, Classification of wastes – (domestic, industrial, municipal, hospital, nuclear, agriculture), Transfer and transport, recycle, reuse, recovery, Disposal methods – generation, sea disposal, land disposal, waste disposal on farm crops for irrigation purpose. Radio-active pollution: types, sources and consequences, radiation sources in the environment, Disposal of radiation waste, solid, liquid and gaseous;

Practical:

Measurement of RSPM (PM_{10}, PM_{2-5}), SOx, NOx, Measurement of sounds by Noise level meter in silent, industrial, residential and commercial zones. Estimation of ph of water, waste water and soil, Estimation of Phosphorus of water and waste water, Estimation of sulphate of water and waste water, Estimation of acidity water / waste water and soil, Estimation of alkalinity water / waste water and soil, Estimation of conductivity water, waste water and soil, Estimation of hardness water, waste water and soil, Estimation of turbidity of water and waste water

Theory

	Content	**Lecture**
•	Introduction to pollution, pollutant etc	**1**
•	Air pollution, atmospheric pollutant, air quality standards and criteria.	1
•	Natural and anthropogenic sources of atmospheric pollutants, significance of these pollutants and their reactions in the atmosphere,	2
•	Transport and dispersion of pollutants,	1
•	Gaseous and particulate pollutants their analysis	1
•	Air pollution control equipment,	2
•	Water pollution: types, sources and consequences, of water pollution, water quality parameters; criteria and standards,	2
•	Physical, chemical and bacteriological parameter of water and waste water	2
•	Water and waste water treatment.	2
•	Soil pollution: physical and chemical properties of soil	2
•	Industrial effluents of different kinds, their interactions with soil components,	1
•	Problems of toxic heavy metals and pollution.	1
•	Noise pollution: basic properties of sound, sound pressure and intensity levels, decibel,	1
•	Measurement and analysis of sound. Equivalent sound pressure level (leq), noise pollution level (npl), traffic noise index (tni), day-night level,	2

•	Noise sources; machinery noise, pumps; compressors, building and construction equipment, domestic appliances, traffic – vehicular, train, aircraft.	1
•	Noise control and abatement measures, sound absorbing materials, acoustic silencers, mufflers, barriers, vibration and impact isolation,	1
•	Marine pollution: types, sources and consequences	2
•	Thermal pollution: types, sources and consequences	1
•	Solid waste management: types, sources and consequences,	1
•	Classification of wastes – (domestic, industrial, municipal, hospital, nuclear, agriculture),	1
•	Transfer and transport, recycle, reuse, recovery,	2
•	Disposal methods – generation, sea disposal, land disposal, waste disposal on farm crops for irrigation purpose.	2
•	Radio-active pollution: types, sources and consequences, radiation sources in the environment,	1
•	Disposal of radiation waste, solid, liquid and gaseous;	1

Practical:

	Content	**Lecture**
•	Measurement of RSPM, PM_{10}, PM_{2-5}, SOx, NOx	3
•	Measurement of sounds by db meter in silent, industrial, residential and commercial zones.	1
•	Estimation of pH of water, waste water and soil	2
•	Estimation of phosphate, of water and waste water	1
•	Estimation of sulphate, of water and waste water	1
•	Estimation of acidity water, waste water and soil	2
•	Estimation of alkalinity water, waste water and soil	2
•	Estimation of conductivity water, waste water and soil	2
•	Estimation of hardness water, waste water and soil	2
•	Estimation of turbidity of water and waste water	1

References:

- Source book on atomic energy - S. Glasstone, D. Van Nastrand & Germany.
- Environmental radioactivity – M. Eisendbud, Academic press.
- Essentials of nuclear chemistry – II, T. Arnikar, Wiley easter.
- Nuclear chemistry through problems – II, T. Arnikar & N. S. Rajurkar, New age Int. (P) Ltd.
- Environmental Science – A study of Inter relationships, E. D. Enger, B. E. Smith, 5^{th} ed., W C B publication

ENVS-703 FUNDAMENTAL OF ECOLOGY 3(2+0+1)

Theory

History and scope of ecology and environmental science, conceptual development of ecological terminology, ecological landmark, autecoloty, synecology, zopulation, community, tolerance range and limiting factors, relationship of ecology with other branches of science, interrelatedness, importance of environmental science for human beings. Ecosystem concept: Biotic and abiotic components of ecosystem, ecotones and biomes, ecological pyramids of number, biomass and energy. food Chain, food web and trophic levels, ecological amplitude and ecological niches. Ecological energetics, first and second laws of thermodynamics and flow of energy in ecosystem Biogeochemical cycling carbon, Nitrogen, Phosphorus and Sulphur and Hydrological cycles and microbial ecology. Primary and secondary productivity of different ecosystems in the world methods of measurements of productivity and the factors affecting productivity

Study of different ecosystems: Forest ecosystem- Forest as an ecosystem, distribution of forests, types of forests, economics and ecology of forest, role of forests in protection of speices regulation of climate and production of various produce. Depletion of biodiversity from forest and the world forest conservation policies

Grassland ecosystem - Distribution and types of grasslands, rangelandsand biodiversity in grassland, and productivity in grasslands

Desert Ecosystem and Wastelands-Desert as ecosystems, hot and cold deserts, productivity, characteristics and global distribution of deserts. Desertification process, Ecological Geological Geographical and Geomorphological aspects of Thar desert, adaption in desert, fauna and flora, Vegitation types of Thar Desert, change in landuse pattern due to introduction of canals and envionmental consequences. Types and distribution of wastelands in India.

Aquatic Ecosystem: Lentic and lotic ecosystem, structure, energy flow and productivity in eusturies, marine ecosystem, structure biodiversity and productivity in, marine ecosystem Wetland Ecosystem- Distribution, energetics and productivity in wetlands. Biodiversity and economic importance of wetlands

Practical:

Estimation of site productivity, Study of micro-climate and forest soil, Study of ecological modification, Population dynamics using models system, Preparation of life tables, Study of succession in field and water bodies, Study of biodiversity, Growth and maintenance of bacteria; Selection of bacterial mutants; Biomass estimation and chlorophyll estimation, Cell organelles separation by differential centrifugation

Theory

	Content	Lectur
•	History and scope of ecology and environmental science, conceptual development of ecological terminology,	2
•	ecological landmark, autecoloty, synecology, zopulation, community, tolerance range and limiting factors, relationship of ecology with other branches of science,	2
•	interrelatedness, importance of environmental science for human beings.Ecosystem concept :Biotic and abiotic components of ecosystem, ecotones and biomes,	3
•	ecological pyramids of number, biomass and energy. food Chain, food web and trophic levels, ecological amplitude and ecological niches. Ecological energetics,	3
•	first and second laws of thermodynamics and flow of energy in ecosystem	3
•	Biogeochemical cycling carbon, Nitrogen, Phosphorus and Sulphur and Hydrological cycles and microbial ecology.	3
•	Primary and secondary productivity of different ecosystems in the world methods of measurements of productivity and the factors affecting productivity	3
•	Study of different ecosystems: Forest ecosystem- Forest as an ecosystem, distribution of forests, types of forests, economics and ecology of forest, role of forests in protection of speices regulation of climate and production of various produce. Depletion of biodiversity from forest and the world forest conservation policies	3
•	Grassland ecosystem - Distribution and types of grasslands, rangelandsand biodiversity in grassland, and productivity in grasslands	3
•	Desert Ecosystem and Wastelands-Desert as ecosystems, hot and cold deserts, productivity, characteristics and global distribution of deserts. Desertification process, Ecological Geological Geographical and Geomorphological aspects of Thar desert, adaption in desert, fauna and flora, Vegitation types of Thar Desert, change in landuse pattern due to introduction of canals and envionmental consequences. Types and distribution of wastelands in India.	4
•	Aquatic Ecosystem: Lentic and lotic ecosystem, structure, energy flow and productivity in eusturies, marine ecosystem, structure biodiversity and productivity in, marine ecosystem	3
•	Wetland Ecosystem- Distribution, energetics and productivity in wetlands. Biodiversity and economic importance of wetlands	2

Practical:

	Content	Lecture
•	Estimation of site productivity,	1
•	Study of micro-climate and forest soil,	1
•	Study of ecological modification,	1
•	Population dynamics using models system,	2
•	Preparation of life tables,	2
•	Study of succession in field and water bodies,	1
•	Study of biodiversity,	1
•	Growth and maintenance of bacteria;	2
•	Selection of bacterial mutants;	2
•	Biomass estimation and chlorophyll estimation,	2
•	Cell organelles separation by differential centrifugation.	2

References:

- Ecology in Practice, Castri and Barker, 1984. UNESOO, Paris
- Wetland Ecology, J.R.Etherington,1983. Arnold-Heinemann
- Ecology 2000 : The Changing Face of Earth. Hillary, S.E. 1984. London
- Desert Ecology Ishwar Prakash, Scientific Publisher, Jodhpur,1988
- Disease Ecology A. Learmonth, Slackwell, Oxford, 1988

ENVS – 704 ENVIRONMENTAL GEO-SCIENCE 3(2+0+1)

Theory

The earth systems and biosphere: conservation of matter in various geospheres - lithosphere, hydrosphere, atmosphere and biosphere, Energy budget of the earth, earths thermal environmental and seasons, General relation ship between landscape, biomass and climate, climate of india, El-nino, la-nino, droughts, Tropical cyclones and western disturbance. Earth process and geological hazards: Earth's processes (concept of residence, time, and rate of natural cycles) Catastrophic geological hazards, study of floods, land slides, earthquakes, volcanism, tsunami and avalanche. Mineral resources and environment resources and reserves minerals and population,: Oceans as new areas of exploration of minerals resources, ocean ore and recycling of resources. Environmental impact of exploitation, processing and smelting of minerals. Water resources and environment**:** global water balance, ice sheets and fluctuation of sea levels. Origins and composition of seawater, hydrological cycle factors influencing the surface water. Types of resources of oceans. Ocean pollution by toxic wastes.

Land use planning. The land use plans, soil surveys in relation to land use planning, Methods

of site selection and evaluation. Environmental geo-chemistry, concept of major trace element classification of trace elements. Mobility of trace elements, geochemical cycles, Biogeochemical factors in environmental health. Diseases induced by human use of land.

Practical:

Sketch of earth system, Sketch of different geological hazards, Identification of different mineral under petrological microscope, Identification of different type of rocks.

Theory

	Content	Lecture
•	The earth systems and biosphere, conservation of matter in various geospheres-lithosphere, hydrosphere, atmosphere and biosphere.	2
•	Energy budget of the earth, earths thermal environmental and seasons,	1
•	General relation ship between landscape, biomass and climate, climate of india.	2
•	El-nino, la-nino, droughts, Tropical cyclones and western disturbance.	3
•	Earth process and geological hazards:	1
•	Earth's processes (concept of residence, time, and rate of natural cycles)	2
•	Catastrophic geological hazards, study of floods, land slides, earthquakes, volcanism, tsunami and avalanche.	2
•	Mineral resources and environment resources and reserves minerals and population,:	2
•	Oceans as new areas of exploration of minerals resources, ocean ore and recycling of resources.	2
•	Environmental impact of exploitation, processing and smelting of minerals..	2
•	Water resources and environment**:** global water balance, ice sheets and fluctuation of sea levels.	2
•	Origins and composition of seawater, hydrological cycle factors influencing the surface water.	2
•	Types of resources of oceans. Ocean pollution by toxic wastes	2
•	Land use planning. The land use plans, soil surveys in relation to land use planning,	2
•	Methods of site selection and evaluation.	1
•	Environmental geo-chemistry, concept of major trace element, classification of trace elements. Mobility of trace elements, geochemical cycles,	3
•	Biogeochemical factors in environmental health.	1
•	Diseases induced by human use of land.	2

Practical:

	Content	Lecture
•	Sketch of earth system,	2
•	Sketch of different geological hazards,	4
•	Identification of different mineral under petrological microscope.	6
•	Identification of different type of rocks, and	5

References:

- Valdiya, K.S. 1987, Environmental Geology.
- Keller, E.A. Environmental Geology & Turk and Turk.

CE- 725 ENVIRONMENTAL CHEMSITRY 3(2+0+1)

Fundamental of environmental chemistry: Stochiometry, Gibbs energy, Chemical potential, Chemical equilibria, Acid-base reaction, solubility product, solubility of gases in water, Carbonate System, , Radionuclides, Carcinogenic compounds and their effects, Hydrocarbons : Chemistry of hydrocarbon decay, environmental effects, effects on macro and micro organisms, Surfactants : Cationic, anionic and nonionic detergents, modified detergents, Pesticides : Classification, degradation, analysis, pollution due to pesticides and DDT problems, Synthetic Polymers : Microbial decomposition, polymer decay, ecological and consideration, Photosensitize additives.

Chemical composition of Air: Classification of Elements, Chemical speciation, Chemical process for formation of inorganic and organic particulate matter, Thermo-chemical and Photochemical reaction in the atmosphere, Oxygen and Ozone chemistry, Chemistry of Air pollutant.

Soil Chemistry: Inorganic and Organic components of soil, Nitrogen pathways and NPK in soil. Principles of Analytical Methods: Trtimetry, Gravimetry, Colourmetry. Spectrophotmetery, Chromatography, Gas chromatography AAS, GLC, HPLC, ELEC trophoreis, X-ray fluoresces, X-ray diffraction, flame photometry.

Practicals: Determination of different toxic element in air, water, and soil. Estimation of halides in water samples by potentiometry, Estimation of Co^{2+} and Ni^{2+} by colorimetry / spectrophotometry, Estimation of sulphates by turbidometry, Estimation of alkali metals in various samples by flame-photometry

Theory

Content	Lecture
• Fundamental of environmental chemistry: Stochiometry, Gibbs energy, Chemical potential, Chemical equilibria, Acid-base reaction, solubility product, solubility of gases in water	4
• Carbonate System, , Radionuclides, Carcinogenic compounds and their effects, Hydrocarbons : Chemistry of hydrocarbon decay, environmental effects, effects on macro and micro organisms	4
• Surfactants : Cationic, anionic and nonionic detergents, modified detergents, Pesticides: Classification, degradation, analysis, pollution due to pesticides and DDT problems,	4
• Synthetic Polymers: Microbial decomposition, polymer decay, ecological and consideration, Photosensitize additives.	4
• Chemical composition of Air: Classification of Elements, Chemical speciation, Chemical process for formation of inorganic and organic particulate matter.	4
• Thermo-chemical and Photochemical reaction in the atmosphere, Oxygen and Ozone chemistry, Chemistry of Air pollutant.	4
• Soil Chemistry: Inorganic and Organic components of soil, Nitrogen pathways and NPK in soil.	5
• Principles of Analytical Methods: Trtimetry, Gravimetry, Colourmetry. Spectrophotmetery, Chromatography, Gas chromatography AAS, GLC, HPLC, Elec trophoreis, X-ray fluoresces, X-ray diffraction, flame photometry	5

Practical

Content	Lecture
• Determination of different toxic element in air, water, and soil.	4
• Estimation of halides in water samples by potentiometry	2
• Estimation of Co^{2+} and Ni^{2+} by colorimetry / spectrophotometry	3
• Estimation of sulphates by turbidometry	2
• Estimation of alkali metals in various samples by flame-photometry	6

References:

- Environmental Chemistry : B. K. Sharma and H. Kaur.

- Elements of Environmental Chemistry : H. V. Jadhav
- Environmental Chemistry : S. K. Banerji
- Environmental Chemistry : J. W. Moore and E. A. Moore
- Environment Chemistry : A. K. de
- Environmental Chemistry : M. Satake, ., Do, S. Sethi, S.A. Eqba

ENVS-706 RENEWAL AND NON-RENEWAL RESOURCES 2(2+0+0)

Introduction: Renewable & Non renewable resources.

Forest resources: distribution of forests, wood production, carbon sequestration, non-wood forest produce, cost associated with forest exploitation, cost of felling/removal & transportation of forest produce, energy cost for forest exploitation, environmental cost, loss of habitat, deforestation impact reforestation and processing cost, sustainable management

Mineral resources: distribution and management, economics of mineral resources, cost associated with mineral exploitation, economic cost, energy cost, environmental cost, steps in mineral exploitation, recycling as an alternative.

Soil structure and use: soil formation, decomposition of parent rock, formation of humus and organic matter, soil properties, soil structure, soil texture, soil profile, soil erosion, water holding capacity, biological activity in soil, soil conservation practice, land capability classes, contour forming strip forming, terracing,, Water resources, water management wind erosion, use of wind breaks..

Food Resources: world food problem, changes cause by agriculture and overgrazing, effect of modern agriculture, fertilizer and pesticides problems, water logging, salinity, case studies

Energy Resources: Sun as source of energy, nature of its radiation, heat budget of the earth, earth's temperature and atmosphere. Photosynthesis, food-chains. Energy resources and their exploitation. Conventional and non-conventional energy sources: Fossil fuels-coal, oil and nature gas: hydroelectric power: tidal, wind, geothermal energy: biomass: solar collectors, photovoltaics, solar ponds: nuclear-fission and fusion, magnetohydrodynamic power (MHD). Resources of energy, energy use pattern in different parts' of the world and its impact on the environment. CO_2 emission in atmosphere, air, thermal pollution, and radioactivity from nuclear reactors, fuel processing and radioactive waste, hazards related to hydropower

Land Resources: land as resource, land degradation, man induced land slide, soil erosion and desertification

Theory

Content	Lecture

- Forest resources: distribution of forests, wood production, carbon sequestration, non-wood forest produce, cost associated with forest exploitation, cost of felling/removal & transportation of forest produce, 3
- energy cost for forest exploitation, environmental cost, loss of habitat, deforestation impact reforestation and processing cost, sustainable management 3
- Mineral resources: distribution and management, economics of mineral resources, cost associated with mineral exploitation, economic cost, energy cost, environmental cost, steps in mineral exploitation, recycling as an alternative. 5
- Soil structure and use: soil formation, decomposition of parent rock, formation of humus and organic matter, soil properties, soil structure, soil texture, soil profile, soil erosion, water holding capacity, biological activity in soil, soil conservation practice, land capability classes, contour forming strip forming, terracing,, Water resources, water management wind erosion, use of wind breaks.. 5
- Food Resources: world food problem, changes cause by agriculture and overgrazing, effect of modern agriculture, fertilizer and pesticides problems, water logging, salinity, case studies 4

- *Energy Resources: Sun as source of energy, nature of its radiation, heat budget of the earth, earth's temperature and atmosphere.Energy resources and their exploitation. Conventional and non-conventional energy sources: Fossil fuels-coal, oil and nature gas: hydroelectric power: tidal, wind, geothermal energy: biomass: solar collectors, photovoltaics, solar ponds: nuclear-fission and fusion, magnetohydrodynamic power (MHD). 5
- Resources of energy, energy use pattern in different parts' of the world and its impact on the environment. CO_2 emission in atmosphere, air, thermal pollution, and radioactivity from nuclear reactors, fuel processing and radioactive waste, hazards related to hydropower 4
- Land Resources: land as resource, land degradation, man induced land slide, soil erosion and desertification 4
- Numerical Problem reduse to resources.
- Sili vigil.

References:

- Environmental Science : E. D. Enger and B. F. Smith
- Dasgupta, P. Nature Conservation and Sustainable Development in India
- Environmental Impacts of Production and uses of Energy", EE. Hinnawai, UNEP, Nairobi, 1981

ENVS-707 WASTE WATER TREATMENT AND APPLICATION 3(2+0+1)

Water engineering : Water Requirements for Domestic Consumption. Population forecasting by different methods.
Quality of water required for followings, (a) Domestic, (b) Institutional (Schools, Hostels, Hospitals), (c) Fire fighting, (d) Commercial (Shopping complex, Hotels, Restaurant), (e) Industrial (Dairy, Sugar, Pulp and Paper, etc.)
Specifications for drinking water and waste water (physical, chemical & bacteriological)
Water Sources – Availability & quality of Surface water (River, Stream Lake, and dam) & Ground water (Open well & Bore well)
Water Treatment – Principal, Application of following Unit Operation in water treatment.
(Collection & pumping, Aeration, flocculation, Sedimentation, Filtration, Disinfections (Chlorination, UV, Ozonization), water softening Advance treatment methods
Inter-relations between water source, quality of raw water, solids in water & treatment process. Selection of appropriate unit operations for the treatment and flow chart of water treatment plant.

Wastewater engineering for Preliminary & Primary Treatment: Quantity & Quality of sewage generated, Impact of Future growth & development & change in quality of life on sewage quality & quantity. Specification of treated wastewater for disposal into surface water, on land & for treatment.
a. Collection & pumping, b. Screen chamber, c. Grit chamber, d. Oil & grease removal, e. Dissolve air floatation.
Wastewater engineering for Biological Treatment: Principal, role of microorganisms, ecosystem & designing of following biological Unit Operation in waste water treatment.
a. Stabilization pond, b. Aerated lagoon, c. Activated sludge process, d. Trickling filter, e. anaerobic treatment.
Industrial waste water treatment
.
Practicals: Collection of water sample, analysis of water sample related to different

Elements/Metals Estimation of Turbidity, PH, EC, BOD, DO, COD, TOC, MPN, Total solids TSS, TDS cl, in Water and Waste Water.

Theory

Content	Lecture
• Water engineering: Water Requirements for Domestic Consumption. Population forecasting by different methods.	2
• Quality of water required for followings, (a) Domestic, (b) Institutional (Schools, Hostels, Hospitals), (c) Fire fighting, (d) Commercial (Shopping complex, Hotels, Restaurant), (e) Industrial (Dairy, Sugar, Pulp and Paper, etc.)	2
• Specifications for drinking water and waste water (physical, chemical & bacteriological)	2
• Water Sources – Availability & quality of Surface water (River, Stream Lake, and dam) & Ground water (Open well & Bore well)	1

- Water Treatment – Principal, Application of following Unit Operation in water treatment. (Collection & pumping, Aeration, flocculation, Sedimentation, Filtration, Disinfections (Chlorination, UV, Ozonization), water softening Advance treatment methods — 4
- Inter-relations between water source, quality of raw water, solids in water & treatment process. — 2
- Selection of appropriate unit operations for the treatment and flow chart of water treatment plant. — 2
- Wastewater engineering for Preliminary & Primary Treatment: Quantity & Quality of sewage generated, Impact of Future growth & development & change in quality of life on sewage quality & quantity. — 4
- Specification of treated wastewater for disposal into surface water, on land & for treatment. a. Collection & pumping, b. Screen chamber, c. Grit chamber, d. Oil & grease removal, e. Dissolve air floatation. — 5
- Industrial waste water treatement — 4

Practical

Content	Lecture
Estimation of pH, EC & Turbidity.	
Estimation of BOD in Water and Waste Water.	5
Estimation of DO in Water and Waste Water.	1
Estimation of COD in Water and Waste Water.	1
Estimation of TOC in Water and Waste Water.	1
Estimation of MPN in Water and Waste Water.	2
Estimation of TSS in Water and Waste Water.	1
Estimation of TDS in Water and Waste Water.	1
Collection of water sample, analysis of water sample related to different Elements/Metals	5
Estimation of chloride in water & waste water sample.	

Reference:

- Waste water engineering, Met Calf & Eddy ; INC, Tata mc Graw Hill.
- Physico-chemical; Process of water quality control, W. J. Webber, Wiley inter-science.
- Waste water treatment for pollution control, Dr. Arceivala, Tata Mc Graw Hill.
- Indian standard for drinking water, BSI, New Delhi.
- Disposal of municipal waste, House report no. 2012, Report by sub committee on Govt. Operation, House of representative, March, 24 1965, UK.
- Water supply & sanitary engineering, Birdie G. S., Dhanpat Rai & Sons, New Delhi.
- Environmental Engineering II, Garg S.K.,

ENVS- 708 SOLID WASTE MANAGEMENT Credit: 3(2 + 1)

Principal of Municipal solid waste management, Composition, Characteristics and Quantity of solid waste, Construction and demolition waste, Slaughter house and dead animals, Industrial solid waste, Biomedical waste, Sorting and material recovery, Storage of waste at source, Primary collection of waste, Method of Primary collection of waste, Collection of domestic hazardous and toxic waste, Transportation of waste(domestic/trade/institutional waste), Routing of vehicle, Principal of composting-manual and mechanize method(Indore and Bangalore method of composting), Factor affecting the composting process, Control of composting processes, Mechanical composting, Energy recovery from municipal solid waste, Technological option (anaerobic digestion, land fill gas recovery, incineration, pyrolysis /gasification), Emerging processing technology (vermicomposting, biogas from MSW, conversion of solid waste to protein, alcohol fermentation), Land fill(site selection, site investigation and site characterization), Landfill Planning and designing, Design and construction of landfill liners, Construction and operational practices, Post-closure stabilization, operational and care, Landfill quality and quality control.

Practical: Find out physical characteristic: density, Moisture content, Size of waste, Colorific value, numerical analysis, route optimization problems, Planning and design of landfill sites(design life, waste volume and landfill capacity, landfill layout, landfill section).

Theory

Content	Lecture
• Principal of Municipal solid waste management,	1
• Composition, Characteristics and Quantity of solid waste	1
• Construction and demolition waste	1
• Slaughter house and dead animals	1
• Industrial solid waste	1
• Biomedical waste	1
• Sorting and material recovery	1
• Storage of waste at source	1
• Primary collection of waste	1
• Method of Primary collection of waste	1
• Collection of domestic hazardous and toxic waste	1
• Transportation of waste (domestic/trade/institutional waste)	2
• Routing of vehicle	1
• Principal of composting-manual and machinized method (Indore and Banglore method of composting), Factor affecting the composting process, Control of composting processes, Mechanical composting	4
• Energy recovery from municipal solid waste, Tecnological option (anaerobic digestion, land fill gas recovery, incineration, pyrolysis/gasification)	4
• Emerging processing technology (vermicomposting, biogas from MSW,	3

conversion of solid waste to protein, alcohol fermentation)

- Land fill (site selection, site investigation and site characterization), Landfill Planning and designing, Design and construction of landfill liners 4
- Construction and operational practices, Post-closure stabilization, operational and care 2
- Landfill quality and quality control. 2

Practical

Content	Lecture
• Characterization of solid waste	1
• Density of waste	1
• Moisture content	1
• Segregation, Volume and Size of waste	1
• Colorific value of water	1
• Numerical analysis	3
• Route optimization problems	3
• Planning and design of landfill sites (design life, waste volume and landfill capacity, landfill layout, and landfill section)	4

Reference:

Tchobanoglous, G., Theisen, H., Vigil, S., 1993. Integrated Solid Waste Management, 'Engineering Principles and Management Issues'. McGraw-Hill Inc., NY. ISBN: 0-07-06-3237-5.

ENVS-709 ENVIRONMENTAL MANAGEMENT 3(2+0+1)

Introduction to Environmental Impact Analysis, Origin and development of EIA, Relationship of EIA to sustainable development: EIA in project planning and implementation: EIA process: evaluation of proposed actions: scoping EIA methodologies, risk assessment and risk management: mitigation measures: comparison of alternatives: review and decision making: compensatory actions: green belts: review of procedures, practices and guidelines in India. Case studies: river valley projects: thermal power plants: mining projects: oil refineries and petrochemicals: tourism coastal zone development.

Preparation of Environmental Management Plans (EMS): Environmental management overview. Environmental management Issues and considerations. Environmental management systems (EMS) principles and elements– Environmental management systems – standard.

Environmental impact Statement and Environmental Management Plan, EIA Guidelines 1994. Notification of Govt. of India., Impact Assessment Methodologies, General approach to impact analysis, Procedure for reviewing Environmental impact analysis and statement, Guidelines for

Environmental audit, Introduction to Env. Planning, Base line information and predictions (Land, Water, Atmosphere, Energy etc.), Restoration and rehabilitation technologies.
Role of NGOs in environmental management, Concept and strategies of sustainable development, Cost-benefit analysis, Environmental priorities in India and sustainable development.
Practicals: Hypothetical EIA of Urbanization/Dam construction/Hydroelectric power generation/Tourism/sugar mills. EIA study on Highway project/Road, EIA study on Hilly development , Water Resources Project, Urban Development Project, Infrastructure Project.

Theory

Content	Lecture
• Introduction to Environmental Impact Analysis. Origin and development of EIA,	1
• Relationship of EIA to sustainable development EIA in project planning and implementation	1
• EIA process: evaluation of proposed actions, Scoping EIA methodologies	1
• Risk assessment and risk management, Mitigation measures, comparison of alternatives	1
• Review and decision making in EIA	1
• Compensatory actions: green belts: review of procedures, practices and guidelines in India.	2
• Case studies: river valley projects: thermal power plants: mining projects: oil refineries and petrochemicals: tourism coastal zone development.	2
• Preparation of Environmental Management Plans (EMS):	3
• Environmental management overview. Environmental management Issues and considerations. Environmental management systems (EMS) principles and elements– Environmental management systems – standard.	4
• Environmental impact Statement and Environmental Management Plan,	3
• EIA Guidelines 1994. Notification of Govt. of India., Impact Assessment Methodologies,	5
• General approach to impact analysis, procedure for reviewing Environmental 2 impact analysis and statement,	
• Guidelines for Environmental audit, Introduction to Env. Planning, Base line information and predictions (Land, Water, Atmosphere, Energy etc.), Restoration and rehabilitation technologies.	4
• Role of NGOs in environmental management,	2
• Concept and strategies of sustainable development, Cost-benefit analysis, Environmental priorities in India and sustainable development	2

Practical

Content	Lecture
• Hypothetical EIA of Urbanization.	2
• Hypothetical EIA of Dam construction	2
• Hypothetical EIA of Hydroelectric power generation	2
• Hypothetical EIA of Tourism	2

- Hypothetical EIA of Different Industries 9

Reference:

- Environmental Impact Assessment, L. W. Canter, Mc Graw Hill Publication, New York.
- Environmental & social impact assessment, Vanclay F., Bronstein DA (1995), John Wiley & Sons, New York.
- EIA – A Biography, B. D. Clark, B. D. Bissel, P. Watheam.

ENVS-710 ENVIRONMENTAL LAWS AND POLICIES 2(2+0+0)

Environmental protection laws in India: Environmental Policy and laws. Constitutional and statutory laws in India : Doctrine Principles of State Policy, Fundamental Duties and Fundamental Rights, Statutory protection of the Human Environment : such as Indian Penal Code, Factories Act, Motor Vehicle Act, Hazardous Waste legislation for pollution abatement, Anti Pollution Acts : Environmental protection law in India: wild life protection Act, Forest conservation Act, Indian forest Act, Prevention and control of pollution (Air, Water) Act, Motor Vehicle Act, Environmental protection Act and Public liabilities insurances Act etc. Fundamental right and duties (48A and 58A), The role of courts. National Environmental Policy and Implementation. Law of cruelty against animals, Scheme of labelling of environmentally friendly products (Ecomark), Fundamentals of environmental management and ISO 14000 series: Background and development of ISO 14000 series. Developed and developing nations and ISO 14000, United Nations Organization, UMEP, Stockholm Conference, Worldwide environmental issues.

Theory

Content	Lecture
• Environmental protection laws in India Environmental Policy and laws.	2
• Constitutional and statutory laws in India, Doctrine Principles of State Policy,	2
• Fundamental Duties and Fundamental Rights,	2
• Statutory protection of the Human Environment, Indian Penal Code	2
• Factories Act, Hazardous Waste legislation for pollution abatement	2
• Wildlife protection Act,	2
• Forest conservation Act, Indian forest Act	2
• Prevention and control of pollution (Air, Water) Act,	2

- Motor Vehicle Act, Environmental protection Act and Public liabilities insurances Act etc. 2
- Fundamental right and duties (48A and 58A), 2
- National Environmental Policy and Implementation, Law of cruelty against animals. 2
- Scheme of labelling of environmentally friendly products (Ecomark), 2
- Fundamentals o f environmental management and ISO 14000 series: 3
- Background and development of ISO 14000 series. Developed a n d developing nations and ISO 14000. 3
- United Nations Organization, UMEP, Stockholm Conference, Worldwide environmental issues. 2

References:

- Basic environmental technology: Jerry; A. Nathanson.
- Handbook of environmental management and technology: Gwendolyn Holmes, Ben Ramnarine Singh, Louis Theodore.
- The ISO 14000 Handbook: Joseph Cascio.
- ISO 14004 – Environmental management systems: General guidelines on principles, systems and supporting techniques (ISO 14004: 1996 (E)

BASIC COURSES

Course Code: MAS – 815 Experimental Design Credit: 3 (2+0+1)

Analysis of variance technique: Definition and assumption, One way classification, Two way classification with more than one observation per cell.

Design of experiments: Principles of experimental design, Randomized block design (RBD)

Latin square Design (LSD), Missing plot Technique in RBD and L.S.D., Critical difference (C.D.) Split plot design.

Factorial – Experiments: 2^2, 2^3, 3^2 & 3^3, factorial design. (Yates method of analysis), 2x3 & 2x4 factorials.

Durcan's Multiple Range Test, Newman's Kuel's Test

Sampling Techniques: Random sampling, Stratified Random Sampling & Systematic Sampling.

Practical

Analysis of variance, Randomized Block Design &Factorial Experiments

Theory

Content	Lecture
• Analysis of variance	2
• Definition and assumptions,	2
• One way classification,	2
• Two way classification.	2
• Sampling Techniques	2
• Simple random sampling	2
• Stratified random sampling	2
• Systematic sampling.	2
• Design Experiments	2
• Randomized Block design	2
• Latin Square design	2
• Factorial design (2^2, 2^3, 3^2, 3^3 factorials)	3
• Durcan's Multiple Range Test, Newman's Kuel's Test	3
• Split Plot Experiments	3
• Balanced Incomplete Block design	3

Content	Lecture
Practical	
• Analysis of variance	6
• Randomized Block Design	05
• Factorial Experiments	06

Reference

1. Bernard Ostle and R.W. Mensing, Statistics in Research.
2. C. H. Goulden, Method of Statistical Analysis.
3. G.W. Snedecor and W.G. Cochran, Statistical Methods.
4. R.G. Steel and J.H. Torrie, Principles and Procedures of Statistics (with special reference to Biological Sciences)
5. R. Rangaswamy, A Text Book of Agricultural Statistics.
6. Chandel S.R.S, A Text Book of Agricultural Statistics.
7. W.G. Cochran and G. M. Cox, Experimental Designs.

CSIT-701 Computer orientation **Credits: 3(2+0+1)**

1. Information Concepts
2. Computer Basics
    a. Defination, Characteristics & Application of Computers
    b. Computer Hardware: I/O Devices, Memory, CPU
    c. Software Concepts
3. Operating System
    a. DOS
    b. Windows
4. Application software
    a. MS Word
    b. MS Excel
5. Computer Programming
    a. Algorithm & Flowchart
    b. Introduction to ‘C’ Language

i. History

ii. Input & Output Statements

iii. Variables & Constant

iv. Expressions & Operators

v. Control statements

1. Branching Statements (if, if-else, Nested if)
2. Looping Statements (while, do-while, for)

vi. Functions & Arrays

6. Internet concept & Search Engine.
7. Application of statistical packages.

Reference Books:

J.B. Dixit, "Fundamental of Computers & Programming in 'C'", Laxmi Publications(P) Ltd.
Yashavant Kanetikar, "Let us C", BPH Publications
E. Balaguruswamy, "ANSI C", TMH

PRACTICAL LIST

1. Demo session on computer & its components, I/O devices, Memory, CPU.
2. **MS DOS:**
   Internal DOS Commands: md, cd, dir, time, del, type, edit, copy, exit, path, prompt, rem, ren, ver.
   External DOS Commands: attrib, backup, chkdsk, diskcomp, diskcopy, doskey, format, label, xcopy, move, tree, undelete
3. **Windows:** Login, Desktop, Icons & Folders, Taskbar, Changing Desktop properties, My computer, My Network Places, Recycle bin, My Documents, Control panel.
4. **Application software:**
   MS Word: Getting familiar with various tool bars, Tables and Columns, Mail merge.
   MS Excel: Working with Spreadsheets, Mathematical & Statistical functions Generating Charts, Creating Macros.
5. **C Programming:**

   - Programs illustrating use of Printf() and Scanf() statements
   - Practicing with decision making statements like IF, IF-ElSE, Nested IF, ELSE-IF Latter, Switch, Goto
   - Working with loops
   - Illustration of Arrays

- Designing programs to demonstrate concept of functions

6. Internet: Webpage, website, browser, URL, Surfing, Searching, creating mail accounts.

7. A glance over statistical packages like SPSS, MATLABS etc.

MINOR COURSES

CHEM 709 INORGANIC CHEMISTRY Credit: 3 (2 +0+ 1)

Structure of atom, Rutherford's model, Bohr model of atom. Chemical periodicity, Structure and bonding in homo- and heteronuclear molecules, including shapes of molecules. Concepts of acids and bases, Chemistry of the main group elements and their compounds. Allotropy, synthesis, bonding and structure, Chemistry of transition elements and coordination compounds
– bonding theories, spectral and magnetic properties, reaction mechanisms, Inner transition elements – spectral and magnetic properties, analytical Applications, Organometallic compounds - synthesis, bonding and structure, and reactivity, Organometallics in homogenous

catalysis,Cages and metal clusters, Analytical chemistry- separation techniques. Spectroscopic electro- and thermoanalytical methods., Bioinorganic chemistry – photosystems, porphyrines, metalloenzymes, oxygen transport, electron- transfer reactions, nitrogen fixation, Physical characterisation of inorganic compounds by IR, Raman, NMR, EPR, Mössbauer, UV-, NQR, MS, electron spectroscopy and microscopic techniques, Nuclear chemistry – nuclear reactions, fission and fusion, radio-analytical techniques and activation analysis.

Practical: Acid & Base and Oxidation- reduction titration, Estimation of Ca, Mg & Cl^- etc in solution, Principles of spectrophotometer, flame photometer, Analysis of cations in solutions, Estimation of iron(III) by photo chemical reduction method, Determination of calcium hardness and magnesium hardness of water sample, Determination of chloride in a sample of water (silver nitrate method).

Theory

Content	Lecture
Structure of atom, Rutherford's model, Bohr model of atom. Chemical periodicity, Structure and bonding in homo- and heteronuclear molecules, including shapes of molecules. Concepts of acids and bases, Chemistry of the main group elements and their compounds. Allotropy, synthesis, bonding and structure	8
• Chemistry of transition elements and coordination compounds – bonding theories,	2
• spectral and magnetic properties, reaction mechanisms,	3
• Inner transition elements – spectral and magnetic properties, analytical Applications, Organometallic compounds - synthesis, bonding and structure, and reactivity, Organometallics in homogenous catalysis,	4
• Cages and metal clusters,	1
• Analytical chemistry- separation techniques.	2
• Spectroscopic electro- and thermoanalytical methods.	2
• Bioinorganic chemistry – photosystems, porphyrines, metalloenzymes, oxygen transport, electron- transfer reactions, nitrogen fixation,	4
• Physical characterisation of inorganic compounds by IR, Raman, NMR, EPR, Mössbauer,	4
• UV-, NQR, MS, electron spectroscopy and microscopic techniques,	2
• Nuclear chemistry – nuclear reactions, fission and fusion, radio-analytical techniques and activation analysis	3

Practical

Content	Lecture
• Acid Titration.	1
• Base Titration.	1
• Oxidation Titration.	1
• Reduction Titration.	1
• Estimation of calcium in solution.	1

- Estimation of Magnesium in solution. 1

- Estimation of Iron in solution. 1
- Instrumental analysis of inorganic constituents. 2
- Principles of spectrophotometer. 1
- Principles of Flame photometer. 1
- Analysis of cations in solution. 1
- Estimation of iron(III) by photo chemical reduction method. 2
- Determination of calcium hardness and magnesium hardness of water sample. 2
- Determination of chloride in a sample of water (silver nitrate method). 1

Reference:

1. Inorganic chemistry, principles of structure and reactivity, 4thEdition by James E. Huheey: Elleu A. keiter: Richard L. Keiter.
2. Advanced inorganic chemistry by F.A.Cotton and G. Wilkinson.
3. Theoretical Inorganic Chemistry by Day and Selbin.
4. Concepts and Models in Inorganic Chemistry by Doughlas Mc Daniel.
5. Introductory Quantum Chemistry by A.K. chandra (Tata McGrawhill)
6. Chemistry of Lnathanides by T. Healler, chapman and Hall.
7. Chemical Applications of Group Theory by B.A. Cotton.
8. Basic concepts of Nuclear Chemistry by R.T. Overmann.9. Introduction to Nuclear Science by M.N.Sastri, East West Press, Madras.

SS – 727 FUNDAMENTAL OF SOIL SCIENCE 3(2+0+1)

Soil Genesis: Weathering processes and soil formation. Soil profile development, chemical mineralogical composition of soil. Soil classification, Physical and chemical properties of Soil

Soil Organic Matter: Sources, composition, microbial decomposition of organic matter, Humus formation. Nature and properties of humus. Clay-Humus complex, significance of C: N ratio. Soil colloidal system, cation and anion exchange phenomena. Soil reaction: Soil pH, Buffering capacity. Soil acidity, alkalinity, salinity-nature, formation and control. Soil major nutrients and Trace elements. Soil, water-Different forms, Hydroscopic, capillary and gravitational. Movement of soil water under saturated and unsaturated conditions. Soil Air: composition and gaseous exchange between atmosphere and soil air.

Soil Temperature, Absorption and loss of heat, Thermal conductivity through a soil profile.

Practical: Soil sampling, Preparation of soil samples for analysis, Determination of bulk density, particle density, Moisture content, Study of soil profile, Determination of soil pH, Ec, SAR,GR,OC and NPK.

Theory

Content	Lecture
• Soil Genesis: Weathering processes and soil formation.	2
• Soil profile development, chemical mineralogical composition of soil.	2
• Soil classification, Physical and chemical properties of Soil	2
• Soil Organic Matter: Sources, composition, microbial decomposition of organic matter	3
• Humus formation. Nature and properties of humus. Clay-Humus complex	2
• Significance of C: N ratio.	2
• Soil colloidal system, Cation and anion exchange phenomena	2
• Soil reaction: Soil pH, Buffering capacity.	2
• Soil acidity, alkalinity, salinity-nature, formation and control.	3
• Soil major nutrients and Trace elements.	3
• Soil, water-Different forms, Hydroscopic, capillary and gravitational..	3
• Movement of soil water under saturated and unsaturated conditions	2
• Soil Air: composition and gaseous exchange between atmosphere and soil air.	2
• Soil Temperature, Absorption and loss of heat	2
• Thermal conductivity through a soil profile	2

Practical

Content	Lecture
• Study of soil profile	2
• Soil sampling	1
• Preparation of soil samples for analysis	2
• Determination of bulk density	2
• Determination of particle density	1
• Determination of Moisture content	1
• Determination of soil pH	1
• Determination of EC	1
• Determination of SAR	1
• Determination of GR	1
• Determination of OC	1
• Determination of NPK	3

Reference:

- Fundamentals of Soil Sciences : Henry D. Forth
- Text-Book of Soil Sciences : T. D. Biswas and S. K. Mukherjee
- Soil Reclamation Processes – Microbiological Analyses and Application Robert L.

ENVS. 801: **ENVIRONMENT AND SOCIAL ISSUES** **3(2+0+1)**

From unsustainable to sustainable development: case study, Urban problem related to energy: methods of Energy conservation-Barriers to energy conservation- Measures for promoting energy conservation- Energy Audit. Water conservation and management: Water conservation- Strategies to support water conservation-Rainwater harvesting-Watershed management
Resettlement and Rehabilitation of people: problem and concern with suitable case study. Environmental ethics: Issues and possible solutions, Climate change: Global warming and green house effect, acid rain, Depletion of the ozone layer, Nuclear accident and holocaust with suitable case study, Wasteland, Wetland and their Reclamations: Introduction and classification of waste land- significance of wastelands- Introduction and classification of wetland- significance of wetlands- reclamation process of waste and wet lands. Consumerism and waste products: Environmental costs of Consumerism, Human Population and the Environment, Population Explosion, Environment and human health, HIV/AIDS, Women and Child welfare, Dams construction controversies in India and their effect on environment
Slums of housing crisis and related issues.

Practicals: Preparation of different model for rain water harvesting, Identification of water shed land, Hydrological cycle diagram, Diagram of stone wall, Check dam, gully, percolating pond et. Identification of Wetlands and development of drainage system in wetland, Reclamation through plantation. Case studies of different developmental project in India.

Theory

Content	Lecture
• From unsustainable to sustainable development: case study,	3
• Urban problem related to energy: methods of Energy conservation-Barriers to energy conservation- Measures for promoting energy conservation- Energy Audit.	4
• Water conservation and management: Water conservation- Strategies to support water conservation-Rainwater harvesting-Watershed management	5
• Resettlement and Rehabilitation of people: problem and concern with suitable case study. Environmental ethics: Issues and possible solutions,	3
• Climate change: Global warming and green house effect, acid rain, Depletion of the ozone layer, Nuclear accident and holocaust with suitable case study,	5
• Wasteland, Wetland and their Reclamations: Introduction and classification of waste land- significance of wastelands- Introduction and classification of wetland- significance of wetlands- reclamation process of waste and wet lands.	4
• Consumerism and waste products: Environmental costs of Consumerism, Human Population and the Environment, Population Explosion,.	4
• Environment and human health, HIV/AIDS, Women and Child welfare,	3
• Dams construction controversies in India and their effect on environment Slums of housing crisis and related issues	3

Practical

Content	Lecture
• Preparation of different model for rain water harvesting,	4
• Identification of water shed land, Hydrological cycle diagram, Diagram of stone wall, Check dam, gully, percolating pond et.	4
• Identification of Wetlands and development of drainage system in wetland, Reclamation through plantation.	4
• Case studies of different developmental project in India	5

Reference:

- Heaven & Earth: Global Warming: The missing Sc. Ian Plimer-2009
- Reaction time: Climate change & Nuclear option By – Ian lowe-2007
- Crime Against nature: By Michael Braungent-2002
- Env. Issue of North East India- By Husain, Zahid-2003
- Env. Issue in India-By R. Uma Maheshwari-2008
- Sustainable development: Mobilization and Globalization by D.K. Bhatnagar -2008

ENVS- 802 REMOTE SENSING AND METEOROLOGICAL TECHNIQUES 3(2+0+1)

Introduction to Remote sensing & geographical information system, Principle of Remote Sensing and its application to Ground Water Environment, to mining of mineral resources, to Landslides, Land subsidence and earthquake, Waste land mapping, to Ecology, to environmental Impact Assessment. Environmental information system. Global position systems and its applications. A brief outline of Digital Image processing and Geological Information System, Role of information technology in human health.

Meteorology fundamentals – Weather & climate modification, Weather forecasting, Agro meteorology, Rain fall characteristics & water balance, Technique & methods of agro climatic Regional Station, Pressure, temperature, wind, humidity, radiation, atmospheric stability adiabatic diagrams, turbulence and diffusion. Scales of meteorology. Applications of micrometeorology to vegetated surfaces, urban areas, human beings, animals. Application of meteorological principles to transport and diffusion of pollutants. Scavenging processes. Effects of meteorological parameters on pollutants and vice versa. Wind roses. Topographic effects. Pollution climatology. Preliminary concepts of climate change. Seasons in India, Mansoons, El Nino, ENSO.

Practicals: Identification and principle techniques of different instrument used for meteorology.

Identification and principle techniques of different software's used for remote sensing and GIS.

Con

Theory	Content	Lecture
•	Introduction to Remote sensing & geographical information system	1
•	Principle of Remote Sensing	1
•	Application of RS and GIS in Ground Water Environment, to mining of mineral resources, to Landslides, Land subsidence and earthquake, Waste Land mapping, to Ecology, to environmental Impact Assessment	3
•	Environmental information system	1
•	Global position systems and its applications	2
•	A brief outline of Digital Image processing and Geological Information System	2
•	Role of information technology in human health	1
•	Weather & climate modification	1
•	Weather forecasting, Agro meteorology	1
•	Rain fall characteristics & water balance	1
•	Technique & methods of agro climatic Regional Station	2
•	Meteorology fundamentals – Pressure, temperature, wind, humidity, radiation, atmospheric stability adiabatic diagrams, turbulence and diffusion	3
•	Scales of meteorology	1
•	Applications o f micrometeorology to vegetated surfaces, urban areas, human beings, animals	3
•	Application of meteorological principles to transport and diffusion of pollutants	3
•	Scavenging processes	1
•	Effects of meteorological parameters on pollutants and vice versa	2
•	Wind roses	1
•	Topographic effects	1
•	Pollution climatology. Preliminary concepts of climate change	2
•	Seasons in India, Mansoons	1
•	El Nino,	1
•	ENSO	1

Practical

•	Identification and principle techniques of different instrument used for meteorology	7
•	Identification and principle techniques of different software's used for remote sensing and GIS.	10

Reference:

- Photocology : V.C. Miller.
- Remote Sensing – Lilles and Keifer.

ENVS – 803 CONSERVATION OF FOREST AND WILD LIFE RESOURCES 3(2+0+1)

Holistic and Sustainable approach of eco-system management and conservation of biological diversity and its significance. Endangered species of plants of India. Endangered fauna of India. Ethan botany in India Selected medicinal plants. Methods of wildlife conservation. Project Tiger, Project crocodile, Project Elephant, silent valley controversy. Conservation of Himalayan, Vindhayan and Gangetic eco-systems.

Practicals: Identification of ecological adaptation in plants and animals for desert, aquatic and arboreal etc. Herbarium of medicinal plants.

Theory

Content	Lecture
• Holistic and Sustainable approach of eco-system management	3
• Conservation of biological diversity and its significance.	3
• Endangered species of plants of India	3
• Endangered fauna of India	3
• Ethno-botany in India Selected medicinal plants	3
• Methods of wildlife conservation	3
• Project Tiger	3
• Project crocodile	3
• Project Elephant	3
• silent valley controversy	3
• Conservation of Himalayan, Vindhayanchal and Gangetic eco-systems	4

Practical

Content	Lecture
• Identification of ecological adaptation in plants and animals for desert	4
• Identification of ecological adaptation in plants and animals for aquatic	4
• Identification of ecological adaptation in plants and animals for arboreal etc.	4
• Herbarium of medicinal plants.	5

References

1. Robert, G.H. 1978. Wildlife management. W.H. Freeman and Co., San Francisco, U.S.A.
2. Anon, 1990. Collection and preservation of animals. Zoological Survey of India.
3. Grzimek, 1988. Encyclopedia of mammals. McGraw Hill Publishing House, New Delhi.
4. Katwal/Banerjee. 2002. Biodiversity conservation in managed and protected areas. Agrobios, India.
5. Negi, S.S. 1993. Biodiversity and its conservation in India. Indus Publishing Co., New Delhi.
6. Otto H. Frankal, A. Anthony, D. Brown and Jeremy J. Burdon. 1995. The conservation of plant biodiversity. Cambridge University Press.
7. Rajesh Gopal, 1992. Fundamentals of wildlife management. Justice Home, Allahabad, India.
8. Sale, J.B. and K. Berkmuller. 1988. Manual of wildlife techniques for India. WII, FAO, Dehra Dun, India.
9. Sharma, B.D. 1999. Indian wildlife resources: Ecology and development. Daya Publishing House, Delhi.

ENVS – 804 ENVIRONMENTAL MICROBIOLOGY 3(2+0+1)

Microbes and environment, classification occurrence, distribution, diversity and ecological importance, characteristics of protists, prokaryotes and viruses. Photoautotrophs, chaemolithotrophs, organotrophs, parasites and symbionts. Soil microorganisms and their interaction, soil borne diseases Water born pathogens and water borne disease microbial standards of water quality, biogenic pollution, microbial toxins, air borne microbes, microbial dispersal through air and water estimation of microbial biomass. Principals of Microbial ecology and their application to different ecosystems, Microbiology of ecosystem – Soil, rhizosphere, phyllosphere, water-fresh, marine and air. Microbial interactions – symbiosis, synergism, commensalisms, Parasitism, amensalism and predation, Functions of Micro-organisms in various ecosystems, Sources of pollution and use of microbes in their management, biogas production,

Practicals: Identification of different tools and Instruments used, Identification of different microorganisms their class, sub class and species etc. Isolation of Rhizobium bacteria and their culture from root nodules, Gram staining of Rhizobium bacteria, Isolation, purification and maintenance of fungal culture: sub culturing, mineral oil preservation, lysolization, Effluent treatment using microbes Analysis of microorganisms present in soil, air and sewage effluents

Theory

Content	Lecture
• Microbes and environment	1
• Classification, occurrence, distribution, diversity and ecological	2

• Importance, characteristics of protists, prokaryotes and viruses	2
• Photoautotroph, chaemolithotrophs, organotrophs, parasites and symbionts	3
• Soil microorganisms and their interaction	2
• Soil borne diseases	2
• Water born pathogens and water borne disease	2
• Microbial standards of water quality	2
• Biogenic pollution, microbial toxins	2
• Air borne microbes	2
• Microbial dispersal through air and water estimation of microbial biomass	2
• Principals of Microbial ecology and their application to different ecosystems	2
• Microbiology of ecosystem – Soil, rhizosphere, phyllosphere, water-fresh, marine and air	2
• Microbial interactions – symbiosis, synergism, commensalisms, Parasitism, amensalism and predation	2
• Functions of Micro-organisms in various ecosystems	2
• Sources of pollution and use of microbes in their management	2
• Biogas production	2

Practical

Content	Lecture
• Identification of different tools and Instruments used in microbiology	1
• Identification of different microorganisms their class, sub class and species etc.	1
• Isolation of Rhizobium	1
• Isolation of bacteria	2
• Culture from root nodules	2
• Gram staining of Rhizobium bacteria	2
• Isolation, purification and maintenance of fungal culture	2
• Sub culturing, mineral oil preservation	2
• Lysolization	2
• Effluent treatment using microbes Analysis of microorganisms present in soil, air and sewage effluents	2

Reference:

- Elements of Microbiology : Pelczar, M.J. and Chan ECS, 1981 McGraw Hill.
- General Microbiology : Stainer, R.Y.., Adelberg, E.A. and Ingraham, J.L. 1977. Macmillan Press.
- Microbial Methods for Environmental Biotechnology : Grainer, J.M. and Lynch, J.M. 1984. Academic Press.
- Microbiological Methods for Environmental Scientists and Enginners : Gaudy, A.F. and Guady, E.T. 1980, McGraw Hill.

- The Chemistry and Microbiology of pollution : I. J. Higgins and R. Burns

ENVS – 805 AQUATIC ENVIRONMENT 3(2+0+1)

Theory

Aquatic Environment: Important features of aquatic eco-system, Major physical and chemical factors (light, temperature, gases, nutrients). Lotic & Lentic water bodies and their ecological characteristics,

Aquatic biota: phytoplankton, zooplankton, benthos, periphyton, macrophytes, fish and other animals. Production in lakes, rivers, estuaries and wetlands. Nutrient dynamics in lakes, rivers, estuaries and wetlands. Eutrophication and water pollution: monitoring and control conservation and management of lakes, rivers and wetlands, Techniques to deal with Oil spill pollution of ocean. Impact of deep sea mining on coastal ecology.

Practicals: Study of different aquatic ecosystem. Study of bio-diversity in different aquatic system, Identify ecological adaptation to live in different water system.

Theory

Content	Lecture
• Aquatic Environment: Important features of aquatic eco-system	3
• Major physical and chemical factors (light, temperature, gases, nutrients)	3
• Lotic & Lentic water bodies and their ecological characteristics	3
• Aquatic biota: phytoplankton, zooplankton, benthos, periphyton, macrophytes, fish and other animals	4
• Production in lakes, rivers, estuaries and wetlands	3
• Nutrient dynamics in lakes, rivers, estuaries and wetlands	3
• Eutrophication	2
• Water pollution monitoring and control	3
• Conservation and management of lakes, rivers and wetlands	3
• Techniques to deal with oil spill pollution of ocean	4
• Impact of deep sea mining on coastal ecology	3

Practical

Content	Lecture
• Study of different aquatic ecosystem	5
• Study of bio-diversity in different aquatic system	5
• Identify ecological adaptation to live in different water system	7

Reference:

- Aquatic Env. & toxicology-By Arvind Kumar-2003
- Recent Research in Aquatic Env.By Ashutosh Gautam, N.K. Agrawal (1995)
- Trophic models of Aquatic ecosystem
- Edited by-V.Christensen & D.Pauly (1993)

DEFICIENCY COURSES

AGRON-401 PRINCIPALS OF AGRONOMY 3(2+0+1)

Theory

Principles of Crop, Production :Definition and scope of Agronomy and Agriculture, Classification of Crops – Botanical, Agricultural (Economics), based on season and crop duration and agronomical (special)**,** Principles of crop production pertaining to :- Climate- Soils- Varieties- Agronomic practices – field preparation to harvesting and threshing.**,** Principles underlying crop rotation**,** Mixed, inter and multiple cropping.

Soil and Water Management: Management of sandy, loamy and clayey soils, Problematic soils of U.P and their management. Definition and objectives of tillage. Modern concepts involved in tillage. Management of major and minor crop nutrients in soil. Classification of manures and fertilizers. Sources, doses, methods and time of application of manures and fertilizers. Importance of water for plants. Soils and moisture constraints. Water requirements of crops. Time, depth, method and frequency of irrigation. Drainage- necessity and methods.

Practical:

1. Calculation of soil amendments.
2. Preparation of fertilizers mixtures and calculation of fertilizers quantaties.
3. Measurements of irrigation water.
4. Calculation of consumptive use of water and irrigation requirement of crops.
5. Study of drainage requirement.

Theory

Content	Lecture
• Principles of Crop, Production :Definition and scope of Agronomy and Agriculture,	4
• Classification of Crops – Botanical, Agricultural (Economics), based on season and crop duration and agronomical (special)**,**	5
• Principles of crop production pertaining to: - Climate- Soils- Varieties- Agronomic practices – field preparation to harvesting and threshing.**,** Principles underlying crop rotation**,** Mixed, inter and multiple cropping	5
• .Soil and Water Management: Management of sandy, loamy and clayey soils, Problematic soils of U.P and their management.	4
• Definition and objectives of tillage. Modern concepts involved in tillage.	4
• Management of major and minor crop nutrients in soil.	3
• Classification of manures and fertilizers. Sources, doses, methods and time of application of manures and fertilizers.	4
• Importance of water for plants. Soils and moisture constraints.	2
• Water requirements of crops. Time, depth, method and frequency of irrigation. Drainage- necessity and methods	4

Practical

Content	Lecture
• Calculation of soil amendments.	2
• Preparation of fertilizers mixtures and calculation of fertilizers quantaties.	4
• Measurements of irrigation water.	3
• Calculation of consumptive use of water and irrigation requirement of crops.	4
• Study of drainage requirement.	3

Reference: i.

Singh, S.S. Principal and practices of Agronomy, Kalyani publisher, New Delhi
Prasad, Rajendra., A Text book of field crop production, ICAR, New Delhi
Katyanyan , Arun., Fundamental of Agriculture, Kushal publication ., Varanasi

STFB-301 FOREST ECOLOGY, BIODIVERSITY & CONSERVATION 2(1+1)

Theory:
Historical development of ecology as a science. Concept of levels of biological organization. Ecosystem – classification and distribution. Forest environment- Major abiotic and biotic components and their interaction, Nutrient cycling, trophic levels, food webs, ecological pyramids and energy flow. Population ecology - definition, population dynamics and carrying capacity, preparation of life table and its importance in forest management. Community ecology – Species interaction, Ecological succession, terminology, basic concepts, climax vegetation types, Methods to study effects of forest management on succession. Island Biogeography. Autecology of important tree species. Biodiversity and conservation – definition, levels of study, distribution of diversity in life forms, hotspots of biodiversity, measurement of diversity and diversity indices. Principles of conservation biology, Ex situ and In situ methods of conservation, Genetical and evolutionary principles in conservation. Biosphere concept. Conservation – efforts in India and worldwide.

Practical:
Estimating productivity of a site; Study of microclimate and forest soils; Study of ecological modifications of leaves; Effects of fire on forest ecosystem; Study of population dynamics using model systems; Preparation of life tables; Study of spatial dispersion among plants; Study of Forest composition; Niche analysis; Computation of diversity indices; Measurement of diversity of plants and insects in a near by forest; Study of succession in field and water bodies; Visit to different ecosystems.

Theory

Content	Lecture
• Historical development of ecology as a science.	1
• Concept of levels of biological organization.	1
• Ecosystem – classification and distribution.	1

• Forest environment- Major abiotic and biotic components and their interaction.	1
• Nutrient cycling, trophic levels, food webs, ecological pyramids and energy flow.	2
• Population ecology - definition, population dynamics and carrying capacity, preparation of life table and its importance in forest management.	2
• Community ecology – Species interaction, Ecological succssion, terminology, basic concepts, climax vegetation types.	2
• Methods to study effects of forest management on succession.	1
• Island Biogeography. Autecology of important tree species.	1
• Biodiversity and conservation – definition, levels of study, distribution of diversity in life forms, hotspots of biodiversity, measurement of diversity and diversity indices.	2
• Principles of conservation biology, Ex situ and In situ methods of conservation.	1
• Genetical and evolutionary principles in conservation.	1
• Biosphere concept, Conservation – efforts in India and worldwide.	1

Practical

Content	Lecture
• Estimating productivity of a site.	3
• Study of microclimate and forest soils.	1
• Study of ecological modifications of leaves.	1
• Effects of fire on forest ecosystem; Study of population dynamics using model systems.	2
• Preparation of life tables; Study of spatial dispersion among plants.	2
• Study of Forest composition; Niche analysis.	1
• Computation of diversity indices.	1
• Measurement of diversity of plants and insects in a near by forest.	2
• Study of succession in field and water bodies.	2
• Visit to different ecosystems.	1

References

1. Mishra, R. 1968. Ecology Work Book Oxford and IBH Publishing Co, Calcutta, pp. 244.
2. Odum, E.P. 1983. Basic Ecology. Saunders College Publishing, Holt Saunders, Japan, 613.
3. Odum, E.P. Fundamentals of Ecology, Natraj Publisher, Dehradun
4. Arvind Kumar. Biodiversity and environment. Published by A.P.M. Publishing Corporation, New Delhi.
5. Global biodiversity status of the earth's living resources. Published by Crapman and Hall, 2-6 Boundary Row, London SEI 8HN. Compiled by World Conservation Monitoring Centre.

6. Kumar and Asija. Biodiversity – Principles and conservation. Published by Updesh Purohit for Agrobios, Jodhpur, India.
7. Singh, Vishwakarma. Forest environment and biodiversity. Daya Publishing House, Delhi.
8. Tewari, D.N. Biodiversity and forest genetic resources. Published by International Book Distributions, Dehra Dun.
9. Kovacs, M. 1995. Pollution Control and Conservation. Ellis Horwood Ltd., Chichester. 398p
10. Sinha, B.N. 1990. Eco-system Degradation in India. Ashish Publishing House, New Delhi.

SAC-508 FOREST SOIL SURVEY, LAND USE & REMOTE SENSING 3(2+1)

Theory:

Scope and objective; soil survey, sampling methods; planning, inventory, permanent sample plots; sample size allocation, landuse classes and planning. Aerial photography and remote sensing-definition, meaning, scope, merits and brief history. Electromagnetic spectrum; radiations, differential reflections by surfaces, active and passive remote sensing, earth observation satellites. Equipment and materials-aerial bases, cameras, filters, stereoscopes, computers, radars. Photogrammetry: Vertical and oblique photography. Photographs and images, scales, resolution, photo interpretation, photogrammetry, image analysis, mapping. Agencies involved in remote sensing and acquiring information from them. Remote sensing; principles, uses in forestry, status monitoring, fire, vegetation/cover classification and mapping, species identification, height and volume – estimation. Identification of tree species and their form stand delineation. Interpretation of land forms and soils; use of micro-level survey of farm forests, large scale photos in forest inventory, site selection. Imagery and image analysis – video satellite, computer and radars. Geographic Information systems- Computer softwares used. Characterization of wasteland, present status and extent of nonarable lands and their productivity. Salt affected soils, lateritic, marsh and swampy and rocky hills, rocky plains, murrammy and sandy soils, their characteristics and reclamation. Sites with superficial impervious hard pan. Eroded ravines and gullies, various techniques of afforestation of adverse sites, trees suitable for adverse sites. Afforestation and reclamation of mine wastes. Stabilization of tailing dumps and prevention of dust pollution. Sewage water as source of tree nutrients.

Practical:

Exercise on sampling methods; Exercises on land use classes; Exercises on lightspectral characteristics; Study of equipment and materials used in aerial photography and remote sensing; Study of scales; Case studies-aerial photography and satellite imageries; Case studies – Geographic Information System – application in forestry; Computer software used in GIS; Analysis of soil for Gypsum and lime requirement; Exercises on study of eroded soils; Study

on types of pits and trenches, tree species suitable for mined out areas; Visit to nearest mined areas.

Theory

Content	Lecture
• Scope and objective; soil survey.	1
• Sampling methods; planning, inventory, permanent sample plots; sample size allocation, Landuse classes and planning.	2
• Aerial photography and remote sensing-definition, meaning, scope, merits and brief history.	2
• Electromagnetic spectrum; radiations, differential reflections by surfaces, active and passive remote sensing, earth observation satellites.	3
• Equipment and materials-aerial bases, cameras, filters, stereoscopes, computers, radars. Photogrammetry.	2
• Vertical and oblique photography.	1
• Photographs and images, scales, resolution, photo interpretation, photogrammetry, image analysis, mapping.	2
• Agencies involved in remote sensing and acquiring information from them.	2
• Remote sensing; principles, uses in forestry, status monitoring, fire, vegetation/cover Classification and mapping,	2
• Species identification.	1
• height and volume – estimation.	1
• Identification of tree species and their form stand delineation.	1
• Interpretation of land forms and soils; use of micro-level survey of farm forests.	2
• large scale photos in forest inventory, site selection.	1
• Imagery and image analysis – video satellite, computer and radars.	1
• Geographic Information systems- Computer softwares used.	1
• Characterization of wasteland, present status and extent of nonarable lands and their productivity.	2
• Salt affected soils, lateritic, marsh and swampy and rocky hills, rocky plains, murrammy and sandy soils, their characteristics and reclamation.	3
• Sites with superficial impervious hard pan.	1
• Eroded ravines and gullies, various techniques of afforestation of adverse sites, trees suitable for adverse sites.	2
• Afforestation and reclamation of mine wastes.	1
• Stabilization of tailing dumps and prevention of dust pollution.	1
• Sewage water as source of tree nutrients.	1

Practical

Content	Lecture
• Exercise on sampling methods	1
• Exercises on land use classes	1
• Exercises on light spectral characteristics	1
• Study of equipment and materials used in aerial photography and remote	2

sensing

- Study of scales 1
- Case studies-aerial photography and satellite imageries 2
- Case studies – Geographic Information System – application in forestry 1
- Computer software used in GIS 2
- Analysis of soil for Gypsum and lime requirement 2
- Exercises on study of eroded soils 1
- Study on types of pits and trenches 1
- Tree species suitable for mined out areas 1
- Visit to nearest mined areas 1

References

1. Hamilton, I.S. 1987. Forest and Watershed Development and Conservation in Asia and the Pacific, International Book Distributors, Dehra Dun.
2. Rama Rao. 1980. Soil Conservation. Standard Book Depot, Bangalore.
3. Richard, Lee. 1980. Forest Hydrology, Columbia University Press, New York.
4. Curran, P.J. 1985. Principles of Remote Sensing, Long man Group Ltd., England
5. Janssen, L.F.2000. Principles of Remote Sensing. ITC. Edl. Text Book Series II. The Netherlands
6. Rolf A.de By. 2000. Principles of Geographical Information Systems. ITC. Edl. Text Book Series I. The Netherlands
7. Sabins, F.F.1978. Remote Sensing-Principles and Interpretation. W.H.Freeman and Co., San Francisco.
8. Sharma, M.K.1986. Remote Sensing and Forest Surveys, International Book Distributors, Dehra Dun

MCB-604 AGRICULTURAL MICROBIOLOGY 3(2+0+1)

Theory

History of Microbiology Concept of origin of life - abiogenesis - biogenesis - Spontaneous genesation theory, Methods in Microbiology: Sterilization - Discirfection; Isotation, Purification and preservation of Mecrobes, Principles of Staining of micro organisms, Microscopy: Light Phase contract, Epifluorescence and Election miscroscopy - Assay of antibiotics. Preparation of culture media, Distribution of microorganisms, organic matter decomposition - Microbiology and biochemistry. Biofertilizers Biological Nitrogen fixation, nitrification denitrification and microbial transofrmation of iron, sulphur and Phosphorus Ecto and Endo mycorrhizal association in plants and their significance, Microbial pesiticides - Microbial degradation of pesticides. Management of organic wastes: Utilization of agricultural wastes throughmicrobial degradation. Microbial composting.

Theory

Content	Lecture
• History of Microbiology Concept of origin of life - abiogenesis - biogenesis - Spontaneous genesation theory,	3

• Methods in Microbiology: Sterilization - Discirfection; Isotation, Purification and preservation of Mecrobes,	3
• Principles of Staining of micro organisms, Microscopy: Light Phase contract, Epifluorescence and Election miscroscopy - Assay of antibiotics.	5
• Preparation of culture media, Distribution of microorganisms, organic matter decomposition - Microbiology and biochemistry.	5
• Biofertilizers Biological Nitrogen fixation, nitrification denitrification and microbial transofrmation of iron, sulphur and Phosphorus	5
• Ecto and Endo mycorrhizal association in plants and their significance,	3
• Microbial pesiticides - Microbial degradation of pesticides.	3
• Management of organic wastes: Utilization of agricultural wastes throughmicrobial degradation.	4
• Microbial composting.	3

Practical

Content	Lecture
• Preparation of standard solutions and reagents – carbohydrates – qualitative reactions.	3
• Estimation of starch, reducing and non-reducing sugars-reactions of proteins and amino acids.	2
• Estimation of proteins by Lowry method – determination of acid value.	2
• Saponification value, iodine number of vegetable oils-vitamins.	2
• Estimation of ascorbic acidspaper and thin layer chromatography.	2
• Sterilization techniques; preparation of culture medium for establishment of explants of forestry plants.	2
• Multiplication of shoots, induction of roots; meristem culturing; callus cultures.	2

Reference:

- Microbes, Man and Animals : The Natural History of Microbial Interactions : Linton, A. H. and Burns, R.G. (1982) John Wiley and Sons.
- Elements of Microbiology : Pelczar, M.J. and Chan ECS, 1981 McGraw Hill.
- General Microbiology : Stainer, R.Y.., Adelberg, E.A. and Ingraham, J.L. 1977. Macmillan Press.
- Microbial Methods for Environmental Biotechnology : Grainer, J.M. and Lynch, J.M. 1984. Academic Press.

SWLE-725-Fundamental of Remote Sensing, Image Interpretation and Advances in Remote Sensing

3(2-0-1)

Physics of Remote Sensing-terms and definitions; Electromagnetic spectrum; black body radiation & radiation Laws; Scattering; Reflection; Absorption and Transmission; Platforms and sensors in Remote Sensing; Orbit of satellite for Remote Sensing; Types of sensors used in R S

and their geometry; Remote sensing data products; Ground truth data in remote sensing; Instruments for ground truth data collection; Spectral signatures of different objects in R S; Interpretation of MSS; Thermal and Microwave images; Aerial photo-interpretation0 objectives & definitions; Factors affecting image interpretation; Elements of image interpretation; Use of image interpretation keys; Image interpretation techniques and methods of analysis; Artificial intelligence; Radar interferometer; Laser altimetry.

Practical's- Study of satellite imagery, border information and marking reference system; Study of infrared radiometer; Collection of radiant temperature and Drawing of its graph of diurnal variation; Use of spectro-radiometer-production and analysis of spectral reflectance curves; Use and analysis of Densitometric data for a given images; Identification of features of single aerial photograph; Study of a given area in B/W, B/W IR; colour and IR colours photographs; Study of multi spectral photographs using additive colour viewer; Study of satellite imagery (B/W) in different bands and visual interpretation; Study of thermal image interpretation of various features and drawing of isotherms; Study of Radar (Microwave) imagery and interpretation of features; Interpretation of cultural details form IRS and SPOT imagery; Preparation of LANDSAT Map using satellite imager FCC.