Manipur University
Structure of Undergraduate
B.Sc. Environmental Science (Elective) and (Honours)
under Semester system

Elective

Total Marks: 400 Duration: 2 Years

Examination	Theory	Practical	Total
1st Semester	75	25	100
2nd Semester	75	25	100
3rd Semester	75	25	100
4th Semester	75	25	100
Total	**300**	**100**	**400**

Honours

Total Marks: 600 Duration: 1 Year

Examination	Theory	Practical	Total
5th Semester	200	100	300
6th Semester	200	100	300
Total	**400**	**200**	**600**

Scheme of Academic Programme

Based on the assumption that there will be 180 working days in a year or 90 working days in a Semester and there will be 6-days teaching in a week, the expected working days for effective teaching are 15 weeks per Semester.

The Schedule for Environmental Science teaching:

Examination	Theory	Practical	Total
1st Semester	6 Hrs/Week 90 Hrs/Sem	3 Hrs/Week 45 Hrs/Sem	9 Hrs/Week 135 Hrs/Sem
2nd Semester	do	do	do
3rd Semester	do	do	do
4th Semester	do	do	do
5th Semester	16 Hrs/Week 250 Hrs/Sem	9 Hrs/Week 135 Hrs/Sem	25 Hrs/Week 385 Hrs/Sem
6th Semester	do	do	do

SEMESTER I

ENV -101

Fundamentals of Environmental Sciences

Full Marks - 75

90 Hrs/Sem

UNIT-I: Definition, Scope and Importance of Environmental Science	20 Marks

Definition; multidisciplinary nature of Environmental Science; scope and importance. Earth, Man and environment. Micro and mega environment, natural and man-made environment; Social environment; Environmental economics; Environmental ethics; Physico-chemical and biological factors in the Environment.

UNIT-II: Ecological Concepts	15 Marks

Concept of ecology; Concept of ecosystems, their structure and function; Components of an ecosystem; Energy flow through ecosystem; Food chain and food web; Ecological pyramids; Ecological niche; Edge effects; Ecotone; Keystone species; Carrying capacity; Liebig's law of minimum; Shelford's law of tolerance. Ecosystems – fresh water, marine, estuarine and terrestrial.

UNIT-III: Natural Environment and its Components	20 Marks

Atmosphere, lithosphere, hydrosphere and biosphere, their structure and composition. Bio-geochemical cycles – carbon, nitrogen, oxygen, phosphorous, sulphur and hydrological cycle. surface and ground water pollution.

UNIT- IV: Environmental Adaptation	20 Marks

Environmental adaptations: Animals – cursorial adaptation, fossorial adaptation, arboreal adaptation, volant adaptation, aquatic adaptation, desert adaptation. Plants – hydrophytes, mesophytes, xerophytes and halophytes.

Practical

Full Marks 25

45 Hrs/Sem

Preparation, plotting and collection studies:

Preparation of Environmental Diary

Collection and identification of local flora and fauna

Study of the following experiments:

Vegetative analysis of different ambient habitats – frequency, density and abundance

Measurement of temperature-(air, water, soil), relative humidity and rainfall

SEMESTER II
ENV -202
Natural Resource Management

Full Marks - 75
90 Hrs/Sem

UNIT-I : Natural Resource Conservation	15 Marks

Natural resources – Preservation and conservation; values of natural resources – intrinsic and extrinsic. Renewable and non renewable resources, Wildlife conservation; Biodiversity – definition, types, importance and value, threats to biodiversity, endangered, endemic species, species extinction. *In-situ* and *ex-situ* conservation, Genetic erosion, biodiversity conservation and agenda 21, IUCN Red Data Books, Bio-geographical regions of India.

UNIT-II : Forest Resources	20 Marks

Forest – Importance of forests, forest resources - timber and forest produce. Major types of forests in India – alpine, temperate, tropical, sub tropical, deciduous, evergreen forests. Mangroves ecosystems of India. Over exploitation of forest, deforestation, shifting cultivation. Forest management and conservation.

UNIT-III : Land and Mineral Resources	20 Marks

Land resources in India, overuse and abuse of land, concept of land use and land cover. Major types of soils in India, soil profile, structure, texture and properties of soil, soil fertility; Weathering and formation of soil, Soil erosion and control measures. Important minerals of India, ores, Exploration of mineral from the sea; consequences of overexploitation of mineral resources, conservation of mineral resources.

UNIT-IV : Water Resources	20 Marks

Water resources on the earth, consumption and uses of water, Inland and offshore water resources. Freshwater – surface and groundwater. Causes of wastage and depletion of water resources. Management and conservation of water resources; Rainwater harvesting. Watershed management.

Practical

Full Marks 25
45 Hrs/Sem

Preparation, plotting and identification:

Identification of mineral resources and rocks; Plotting of important natural resources, climate and protected areas

Study of the following experiments:

Determination of water transparency; Biomass estimation in aquatic and terrestrial ecosystem; Vegetation studies by line, quadrates and belt transect methods and their analysis

Field study:

Environmental assessment of particular local spots by conducting field visits

SEMESTER III

ENV -303 — Full Marks - 75

Environmental Pollution and Control Technology – Air and Water — 90 Hrs/ Sem

UNIT-I : Air Pollution	20 Marks

Types and sources of pollution; ambient and indoor; Primary and secondary pollutants; Oxidative and reductive smogs. Air pollution meteorology– pressure, temperature, precipitation, humidity, radiation and wind; Thermodynamics of atmosphere; turbulence, Plume behaviour, Gaussian plume model. Influences of inversion, mixing height and wind roses on air pollution; Vehicular pollution. Problems of fly ash; Effects of air pollution on human health, animals and plants. Bhopal gas tragedy.

UNIT-II : Air Pollution Monitoring and Mitigation	20 Marks

Air pollution sampling and monitoring, Air quality standards. National Ambient Air Quality Monitoring (NAAQM). Air quality control – cyclones, ESP, bag filters, scrubbers, catalytic converters, emission standards – Euro and Bharat; unleaded petrol; Use of alternative fuels – CNG, ethanol, gasohol. Concept of green belts in pollution control.

UNIT-III : Water Pollution	15 Marks

Types, sources and consequences of water pollution; Surface and ground water pollution, Thermal pollution. Types of solids in water and their impact on water quality, Marine pollution and its control, ocean oil spills. Ganga Action Plan. Eutrophication, Biomagnification.

UNIT-IV: Water Pollution Monitoring and Mitigation	20 Marks

Water quality parameter, sampling and pollution monitoring; Physico-chemical and bacteriological analysis of water quality; Waste water treatment processes; stabilization pond, aerated lagoon, activated sludge process, trickling filter, anaerobic treatment. Industrial wastewater treatment – dairy, textile, tannery, paper and pulp.

Practical — **Full Marks 25**, **45 Hrs/Sem**

Analysis of air pollutants:

Sulphur dioxide (SO_2); Nitrogen dioxide (NO_2); Suspended Particulate Matters (SPM); Respirable Suspended Particulate Matters (RSPM) and Dust fall

Analysis of water:

Temperature; Turbidity; pH; Biological Oxygen Demand (BOD); Conductivity and Total Dissolve Solids (TDS); Dissolve O_2 (DO); Chloride content and salinity; Hardness; Alkalinity; Calcium, Magnesium, Sodium and Potassium content.

SEMESTER IV

ENV -404

Environmental Pollution and Control Technology – Soil and Noise

Full Marks - 75
90 Hrs/Sem

UNIT-I : Soil Pollution	20 Marks

Soil pollution – Sources, types and consequences of soil pollution. Soil micro organisms and their functions. Physico-chemical and bacteriological sampling and analysis of soil quality. Soil pollution control. Soil pollution due to overuse of synthetic fertilizers and pesticides. Saline, alkaline and acidic soils.

UNIT-II : Soil Pollution Monitoring and Mitigation	20 Marks

Soil sampling and monitoring; Concept of organic farming – compost, vermi-composting, VAM; zero tillage agriculture; Soil microorganisms and their functions, degradation of different insecticides, fungicides and weedicides in soil.

UNIT-III : Noise Pollution and Monitoring	15 Marks

Noise pollution – Sources of noise pollution, measurement of noise, noise exposure levels and standards. Noise control and abatement measures. Impact of noise on human health, noise induce diseases. Noise sampling methods.

UNIT-IV : Solid Wastes Management	20 Marks

Concept of waste management, waste minimization, Wastes as resource; waste to energy, concept of R^5, recycling of wastes, treatment of biomedical and hazardous wastes; Waste characterization, biodegradable and non-biodegradable, Solid waste management – collection, transportation and disposal; open dumping, sanitary landfills, incineration, composting. Effects of improper waste disposal, problems of leachates.

Practical

Full Marks: 25
45 Hrs/Sem

Analysis of soil:

Moisture content; Temperature; Bulk density; Texture; pH; Conductivity; Chloride; Alkalinity; Organic carbon; Available phosphorous; Available phosphate; Total nitrogen; Nitrate and Sodium

Analysis of Noise pollution

Analysis of Air Pollution

Field study: Environmental assessment of particular local spots by conducting field visits

SEMESTER V

ENV (H)-505 Full Marks: 100

Restoration Ecology, Sustainable Development and Instrumentation 125 Hrs/Sem

UNIT-I : Bioremediation-I	12 Marks

Bioremediation – need and scope, constraints and advantages, types of bioremediation, bio-augmentation for bioremediation, removal of pollutants – nitrogen and phosphorous, removal of oil and grease, removal of toxic chemicals from industrial wastes, biological gas treatment systems.

UNIT-II : Bioremediation-II	12 Marks

Bioremediation of contaminated sites on land and water, phytoremediation – recovery of heavy metals from soil, treatment of municipal wastewater and industrial wastes. xenobiotic.

UNIT-III : Restoration Ecology	14 Marks

Environmental degradation – causes and consequences, restoration of degraded ecosystems – forestlands, mined areas, shifting cultivated areas, wetlands, eutrophication and restoration of Indian lakes, wastelands – causes of wasteland formation, reclamation of wasteland, restoration of agricultural lands – acid, saline, saline alkali, alkali and water logged soils and their reclamation.

UNIT-IV : Environmental Biotechnology	14 Marks

Biotechnological approach of environmental pollution abatement – biodegradation of pollutants, pesticides, bio-mining, biological indicators, biotechnological for environmental friendly energy sources – biomass, biogas, bio-ethanol, bio-hydrogen, biotechnology for pollution free agriculture – biofertilizers, compost, biopesticides, role of biotechnology in conservation of species.

UNIT-V : Sustainable Development	12 Marks

Definition, concept of sustainability, important fundamentals concerning sustainable development; sustainable worldviews, carrying capacity, eco-feminism, environmental ethics – issues and possible solutions.

UNIT-VI : Demography	12 Marks

Population, elements of demography – rates, crude, specific and standardized, a complete life table and its construction, models for population growth, population explosion; impact of human population growth on environment, environmental effects of urbanization.

UNIT-VII : Principles of Analytical Methods	12 Marks

Titrimetry, gravimetry, colourimetry, spectrophotometry, chromatography, microscopy, flame photometry, general awareness of computers, computer application in environmental studies.

UNIT-VIII : Remote sensing and GIS	12 Marks

Principles of remote sensing, active and passive remote sensing, platform and air-borne sensors, types of sensors, application of remote sensing and GIS in environmental sciences, GPS.

SEMESTER V
ENV (H) -506
Environmental Management, Legislation and Biostatistics

Full Marks: 100
125 Hrs/ Sem

UNIT-I :Environmental Management — 14 Marks

Fundamentals of environmental management, environmental management system, ISO-14000 (series), preparation of environmental management plan, eco-levelling, eco-mark, the patents and intellectual property right, bio-piracy, carbon – foot print, trading, credit and sequestration, prospects and trends of eco-tourism.

UNIT-II : Disaster Management — 14 Marks

Disaster management – definition and types of natural catastrophies – earthquakes, floods, cyclones, landslides, tsunami, and disease epidemics, pre-disaster and post-disaster management, resettlement and rehabilitation of people, its problem and concerns with reference to big dams and frequently occurring disasters in India

UNIT-III : Environmental Assessment — 12 Marks

Environmental impact assessment (EIA): concept of EIA, various methods of EIA and their relative advantages, EIA as a management tool, environmental audit, case studies of mega- developmental projects.

UNIT-IV :Environmental Planning — 12 Marks

Environmental economics – cost benefit analysis, concepts of environmental planning, urban and rural planning, demographic consideration, development indices.

UNIT-V :Environmental Legislation-I — 12 Marks

Environmental provisions in the constitution of India – need for environmental legislation, existing environmental legislations; Factories Act 1948, Motor vehicle Act 1988, Wild Life Protection Act 1972, Forest (Conservation) Act 1980, Public Liability Insurance Act, 1991.

UNIT-VI :Environmental Legislation-II — 12 Marks

Anti Pollution Acts and Amendments – Water Act 1974, Air Act, 1981 and the Environmental Protection Act 1986, Hazardous Wastes (Management and Handling) Rules 1989,

UNIT-VII :Environmental Biostatistics — 12 Marks

Importance and scope of statistical method and experimentation, mean, median, mode, variance, correlation, regression, multiple regression and correlation, elements of probability theory – random experiments, sample space, random events, classical and frequency theory of probability, sum and product laws of probability, random variables and probability distributions, binomial, poisson and normal distribution and its application.

UNIT-VIII :Sampling and Designs — 12 Marks

Sampling – random and non-random, tests of significance – T-test, F-test, Chi-square (X^2) test and their applications, analysis of variance – one way and two way, designs of experiment – CRD, RBD and LSD.

SEMESTER V
ENV (H) -507 (P)

Full Marks: 100
135 Hrs/Sem

I. Analysis of solid wastes:

Waste characterization, dry matter analysis, decomposition analysis, pH, conductivity, organic matter, total nitrogen, phosphorous, potassium, sodium and chloride

II. Analysis of waste water:

Temperature, turbidity, pH, biological oxygen demand (BOD), conductivity and total dissolve solids (TDS),dissolve O_2 (DO), chloride content, fluoride content, salinity, hardness, alkalinity, calcium, magnesium, potassium and sodium content.

III. Bio statistical Analysis:

Calculation of mean, variance and standard deviation
Comparison of variation using co-efficient of variation

Testing the significance of:
Difference between the two sample means, correlation coefficient, independent of attributes,difference between and several means with the same data at a time.

IV. GIS: map registration, digitisation, database query management, data output.

V. Survey work: Survey on any environmental aspects

SEMESTER VI

ENV (H) - 609

Energy, Environmental health and safety

Full Marks: 100

125 Hrs/Sem

UNIT-I : Energy Resources: Fossil fuels	12 Marks

Fossil fuels – classification, composition, physico-chemical characteristics and energy content of coal, petroleum, tar sands, oil shale, synfuels and natural gas, consequences of rapid consumption of fossil fuels, emission from fossil fuel combustion.

UNIT-II : Energy Resources: Alternative Energy	14 Marks

Hydroelectric power, tidal, wind, geothermal energy, solar energy, biomass energy, producer gas and biogas, energy plantation, biodiesel, ethanol, gasohol, nuclear energy, energy from agricultural wastes, energy from urban municipal and industrial wastes, hydrogen energy, fuel cells, OTEC, energy and environmental pollutions.

UNIT-III : Environmental Health	12 Marks

Definition of environmental health, historical perspective, human environment and health status in urban and rural India, water and sanitation situation in urban and rural context, WHO and other bodies and their role in public health projects development, public awareness of sanitation and hygiene issues, current developments in the subject, environmental hazards.

UNIT-IV : Epidemiology	14 Marks

Water borne diseases, soil borne disease, food borne diseases, food additives, air borne disease, measures to prevent and control of spread of infectious diseases, brief life histories of common vectors and mechanism of transmission of disease, AIDs and its control measures.

UNIT-V : Occupational Health Hazards	12 Marks

Occupational health hazards – silicosis, asbestosis, byssinosis, anthracosis, bagassosis, occupational dermatoses, control of the occupational environment.

UNIT-VI : Environmental Toxicology-I	12 Marks

Environmental toxicology – toxicants, routes of exposure, exposure assessment, absorption and translocation of toxicants, biomagnifications, biochemical aspects of arsenic, biological half life, dose response relationship, threshold dose, acute and chronic toxicity, LC_{50}, LD_{50}.

UNIT-VII : Environmental Toxicology-II	12 Marks

Radiation sources in the environments – natural and man-made, biological effects of radiation, pesticides – classification, physical, chemical, mechanical and biological control of insects, integrated pest management (IPM), heavy metals – health effects of lead, cadmium and mercury, carcinogenic compounds and their effects.

UNIT-VIII : Environmental Health Management	12 Marks

Principles of environmental control, environmental quality, eradication programmes and their efficacy. environmental risk assessment, treatment of drinking water, advanced treatment methods – demineralisation, ultra filtration, reverse osmosis, colour and odour removal by active carbon, iron removal, electro dialysis, nano materials, health aspects of housing.

SEMESTER VI

ENV (H) - 610

Environmental Problems and Priorities

Full Marks: 100

125 Hrs/Sem

UNIT-I : Environmental Biology	12 Marks

Origin of life, Gaia hypothesis, concept of species, population and community, diversity of plants and animals life, principles of classification, growth forms and life forms, characters – analytical, quantitative, qualitative and synthesis, structure and function of communities, ecological succession.

UNIT-II : Environmental Chemistry	14 Marks

Chemistry of various organic and inorganic compounds, chemistry of water, concept of DO, BOD, COD, pH, chemical speciation, acid base reaction, solubility products, unsaturated and saturated hydrocarbons, radio nuclides, surfactants – cationic, anionic, non-ionic detergents, synthetic polymers – PVC.

UNIT-III : Global Environmental Issues-I	12 Marks

Greenhouse effect – causes and consequences of global warming, climate change, stratospheric ozone depletion – causes and consequences.

UNIT-IV : Global Environmental Issues-II	12 Marks

El-Nino, acid rain, global accumulation of nuclear wastes, water crisis – conservation of water, desertification and its control.

UNIT-V : National and Local Environmental Problems	14 Marks

Major environmental problems in India – population explosion, restoration of Indian lakes, erratic nature of Indian monsoon, local environmental problems – environmental effects of jhum cultivation, rapid urbanization, deforestation, changing land use pattern, dams in Manipur and Northeast India – Tipaimukh, degradation of wetlands – important rivers, community ponds and lakes, landslides.

UNIT-VI : Environmental Protection-I	12 Marks

Global and national environmental organisations and agencies – CITES, UNEP, MAB, IUCN, WWF, WHO, FAO, EPA., environmental movements in India – Chipko, Appiko, Silent valley project, Narmada bachao andalon, Sardar sarovar project, Tehri dam project conflict.

UNIT-VII : Environmental Protection-II	12 Marks

International treaties, conventions and protocols – Convention on biological diversity (CBD), CITES, Earth Summit, world summit for sustainable development, Kyoto protocol, Montreal protocol

UNIT-VIII : Environmental Education and Awareness	12 Marks

Environmental educational programmes – objectives, guiding principles, formal and non-formal, environmental education in India, role of NGOs and mass media in environmental conservation.

SEMESTER VI
ENV (H) -610 (P)

Full Marks: 100
135 Hrs/Sem

I. **Studies on Environmental adaptation:**

Cursorial, fossorial, arboreal, volant, aquatic, desert.

II. **Analysis of sediment (Lake/River/Pond):**

Moisture content, temperature, bulk density, texture, pH, conductivity, chloride, alkalinity, organic carbon, available phosphorous, available phosphate, total nitrogen, nitrate, potassium and sodium

III. **Microbial studies:**

Bacteriological examination of water – the coliform and MPN test, membrane filter techniques to detect faecal coliform bacteria in water, mounting and staining of bacteria, soil microbial studies – standard plate count.

IV. **Study of the following experiments:**

Detection of common adulterant in turmeric powder, milk, edible vegetable oils. Determination of leaf area index (LAI)

V. **Project Work**

A project work carrying twenty five marks will be allotted to each student. Submission of a report on the project is compulsory.

RECOMMENDED BOOKS/REFERENCES

SEMESTER I & II

BOOKS/REFERENCES:

Altman, I. and Stokols, D. (Eds.) *Handbook of Environmental Psychology*, Wiley, New York.

Ambasht, R. S. and Ambasht, N. K. *Plant Ecology*, Vanarasi.

Arora, S. *Fundamentals of Environmental Biology*, Kalyani Publishers, New Delhi.

Asthana, D. K. and Asthana, M. *Environmental Problems and Solutions*, S. Chand and Company, New Delhi.

Baum, A., Singer, J. E., and Valins, S. *Advances in Environmental Psychology*, Lawrence Erlbaum Associates, New Jersey.

Bera, A. K. *Environmental Concept*, New Central Book Agency(P) Ltd.Calcutta.

De, A. K. *Environmental Chemistry*, Wiley Eastern Ltd., New Delhi.

Kormondy, E. J. *Concepts of Ecology*, Prentice-Hall of India Private Ltd. New Delhi

Levin, H. L. *The Earth throug time.* Saunder College Publishing, Philadelphia. New York.

Miller, A. A. *Climatology,* Methuen and Co. Ltd. London.

Misra, K. C. *Mannual of Plant Ecology*, Oxford and IBH Publishing Co. Private Ltd., New Delhi.

Palwinder, S. *Socio-Cultural correlates of Environmental Pollution.* Anmol Publication, New Delhi.

Petterson. *Introduction to Metreology*, McGraw-Hill Book Company Inc., London.

Rastogi, V. B. and Jayaraj, M. S. *Animal Ecology and distribution of animals*, Kedar Ram Nath, Meerut.

Santara, S. C. *Environmental Science,* NCBA Private Ltd. Calcutta.

Savindra Singh. *Climatology,* Prayag Pustak Bhavan, Allahabad.

Sharma, B. K. and Kaur, H. *Environmental Chemistry,* Goel Publishing House, Meerut.

Sharma, P. D. *Ecology and Environment,* Rastogi Publication, Meerut.

Shrivastava, M. B. *Introduction to forestry,* Vikas Publishing House Private Ltd. New Delhi.

Turk, J. and Turk, A. Environmental Sciences, Saunder College Publishing, Philadelphia.

Vyas, L. N. and Garg, R. K. *Wetland conservation, Agro Botanical Publishers,* Bikaner, Rajasthan.

Savindra Singh. *Environmental Geography,* Prayag Pustak Bhavan, Allahabad

RECOMMENDED BOOKS/REFERENCES

SEMESTER III & IV

BOOKS/REFERENCES:

APHA. *Standard Methods for Analysis of water and wastewater.*

Asthana, D. K. and Asthana, M. *Environmental Problems and Solutions*, S. Chand and Company, New Delhi.

Banerji, S. K. *Environmental Chemistry*, Prentice-Hall of India Private Ltd., New Delhi

Chatwal and Anand. *Instrumental Methods of Analysis.*

Hussey, N. W. and Scopes, N. *Biological Pest Control, the glasshouse Experience*. Blandford Press, Poole.

Kannan, K. *Fundamentals of Environmental Pollution*, S. Chand and Company Ltd., New Delhi.

Katyal, T. and Satake, M. *Environmental Pollution*, Anmol Publication Private Ltd., New Delhi.

Kudesia, V. P. and Tiwari, T. N. *Noise Pollution and its control*, Pragati Prakashan, Meerut.

Kudesia, V. P. *Environmental Chemistry*, Pragati Prakashan, Meerut.

Kut, D. and Hare, G. *Waste recycling for Energy Conservation*. John Wiley and Sons, New York.

Lenihan, J. and Fletcher, W. W. *The Built Environment*. Blackie, London.

Louma. S. N. *Introduction to Environmental Issues*. Mc-Millan Publishing Company, New York.

Mahajan, S. P. *Pollution Control in Process Industries*. Tata Mc-GrawHill Publishing Company Ltd. New Delhi

Masters, G. M. *Introduction to Environmental Engineering and Science*, Prentice Hall of India Private Ltd. New Delhi.

Murugesan, M. and Balasubramanian, P. *Environmental Engineering*, Pratheeba Publishers, Coimbatore.

Palwinder, S. *Socio-Cultural correlates of Environmental Pollution*. Anmol Publication, New Delhi.

Rai, M. M. *Principles of Soil Science*, Mac Millan India Ltd. New Delhi.

Rao, C. S. *Environmental Pollution Control Engineering*. Wiley Eastern Ltd. New Delhi.

Rao, M. N. and Rao, H. V. N. *Air pollution*, Tata Mc-GrawHill Publishing Company Ltd. New Delhi.

Santara, S. C. *Environmental Science*, NCBA Private Ltd. Calcutta.

Sharma, B. K. and Kaur, H. *Environmental Chemistry*, Goel Publishing House, Meerut.

Trivedy, R. K. and Goel, P. K. *Chemicals and Biological Methods for water pollution studies.*

Trivedy, R. K. and Goel, P. K. *Current Pollution Researches in India*. Environmental Publication. Karat.

Turk, J. and Turk, A. *Environmental Sciences*, Saunder College Publishing, Philadelphia.

Vyas, L. N. and Garg, R. K. *Wetland conservation*, Agro Botanical Pub

RECOMMENDED BOOKS/REFERENCES

SEMESTER V & VI

BOOKS/REFERENCES:

Bernhardsen, T. *Geographic Information System: An introduction.*

Biswas, D. *Environmental Management,* Excel Books, New Delhi.

Chaudhuri, B. D. N. *Introduction to Environmental Management.* Interprint, New Delhi.

Chouhan, T. S. *Remote Sensing for Natural Resources Management.*

Chrisman, N. *Exploring G.I.S.*

Hussey, N. W. and Scopes, N. *Biological Pest Control, the glasshouse Experience.* Blandford Press, Poole.

Jensen. *Remote Sensing of the Environment.*

Joshi, P. C. *Biodiversity and Conservation.*

Karpagam, M. *Environmental Economics,* Sterling Publishers Private Ltd. New Delhi.

Kumar, A. *Environmental Contamination and Bio-reclamation.*

Louma, S. N. *Introduction to Environmental Issues.* Mc-Millan Publishing Company, New York.

Mohanty,S.K.*Environment and polution laws,*Universal Law publishing Co.Pvt.Ltd.

Newman, M. C. and Unger, M. A. *Fundamentals of Ecotoxicology.* Virginia Institute of Marine Science, Gloucester Point, SA.

Pandey, B. N. *Biodiversity Conservation, Environmental Pollution and Ecology,* Ekta Book Distributors, New Delhi.

Pandey, B. W. *Natural Resource Management.*

Sagwal, S. S. *Forest Ecology of India.*

Satendra, I. F. S. *Disaster Management in hills.*

Sharma, P. D. *Ecology and Environment,* Rastogi Publication, Meerut.

Singh, R. B. *Disaster Management.*

Solomon Raju, A. J. *A text book of Ecotourism, Ecorestoration and Sustainable Development.* New Central Book Agency (P) Ltd. Kolkota.

Tiwari, B. K., Barik, S. K. and Tripathi, R. S. *Sacred Forest of Meghalaya - Biological and Cultural Diversity, Regional Centre,* National Afforestation and Eco-development Board, NEHU, Shillong.

Trivedi, P. C. *Biodiversity Conservation.*

Trivedi, P. R. and Gurdeep Raj. *Environmental Management of Freshwater Ecology.* Akashdeep Publishing House, New Delhi.Trivedy, P. R. *Environmental Impact Assessment.*

Trivedy, P. R. *Natural Resources Conservation.*

The Environment(Protection) Act,1986, Universal Law publication .

Vyas, L. N. and Garg, R. K. *Wetland conservation,* Agro Botanical Publishers, Bikaner, Rajasthan.

Wadhera, B. L. *Law Relating to Intellectual Property,* Universal Law Publishing Co. New Delhi.

Bartee, T. C. *Digital Computer Fundamentals,* Mc-Graw Hill International Edition.

Chatwal and Anand. *Instrumental Methods of Analysis.*

Datta, A. K. *Basic Biostistics and its application,* NCBA Private Ltd. Calcutta.

Elias M Awad. *System Analysis and Design,* Golgotia Publications Private Ltd. New Delhi.

Khan, I. A. and Khanum, A. *Fundamentals of Biostatistics.* Ukaaz Publications. Hyderabad.

Satguru, P. *Fundamentals of Biostatistics,* Emkay Publication, New Delhi.

Trivedy, R. K. and Goel, P. K. *Current Pollution Researches in India.* Environmental Publication. Karat

Odum, E. P. *Fundamentals of Ecology,* WB Saunders Co., Philadelphia, USA.

Fulekar, M. H. *Environmental Biotechnology,* Oxford & IBH Publishing Co. Private Ltd., New Delhi.

De, A. K. *Environmental Chemistry.* New Age International Publishers, New Delhi.

Ambasht, R. S. and Ambasht, N. K. *Plant Ecology,* Vanarasi.

Arora, S. *Fundamentals of Environmental Biology,* Kalyani Publishers, New Delhi.

Asthana, D. K. and Asthana, M. *Environmental Problems and Solutions,* S. Chand and Company, New Delhi.

Banerji, S. K. *Environmental Chemistry,* Prentice-Hall of India Private Ltd., New Delhi.

Kormondy, E. J. *Concepts of Ecology,* Prentice-Hall of India Private Ltd. New Delhi.

Misra, K. C. *Mannual of Plant Ecology,* Oxford and IBH Publishing Co. Private Ltd., New Delhi.

Santara, S. C. *Environmental Science,* NCBA Private Ltd. Calcutta.

Sharma, B. K. and Kaur, H. *Environmental Chemistry*, Goel Publishing House, Meerut.
Sharma, P. D. *Ecology and Environment*, Rastogi Publication, Meerut.
Mukherjee, P. K. *A Text Book of Geology*, World Press Private Ltd. Calcutta
Omkar. *Concepts of Toxicology*, Vishal Publishing Co. Jalandhar.
Purdom, P. W. *Environmental Health*. Academic Press, New York.
Khoshoo, T. N. *Environmental concerns and Strategies*, Ashish Publishing House, New Delhi
Asthana, D. K. and Asthana, M. *Environmental Problems and Solutions*, S. Chand and Company, New Delhi
Louma. S. N. *Introduction to Environmental Issues*. Mc-Millan Publishing Company, New York.

MANIPUR UNIVERSITY
CANCHIPUR: IMPHAL

Syllabus for BA/BSc (General) Environmental Science

SEMESTER V
ENV – 505 (Elective)

Full Marks - 75
90 Hrs/Sem

ENVIRONMENTAL MANAGEMENT, BIOSTATISTICS AND INSTRUMENTATION

UNIT – I: Environmental Management, Planning and Impact Assessment — 15 Marks

Fundamental of Environmental management, Environmental management system, Preparation of Environmental management Plan, Concept of environmental planning, rural and urban planning, demographic consideration, concept of Environmental impact assessment, various methods of EIA and their relative studies of mega-developmental projects.

UNIT – II: Biostatistics — 20 Marks

Diagrammatic Representation of Data : Line Diagram, Bar diagram, Pie chart; Graphical Representation of Data: Histogram, Frequency Polygon, Ogive; Sampling Techniques: Random and Non-random sampling Methods; Measures of Central Tendency; Mean, Median, Mode; Measure of dispersion: Range. Standard Deviation and co-efficient of variation; correlation; Test of Significance: Null hypothesis - Alternative hypothesis, Errors in Testing hypothesis – Level of Significance- Students't' Test.

UNIT – III: Bioremediation — 15 Marks

Concept and scope of Bioremediation, type of Bioremediation, Bioremediation of Xenobiotic Pollutants. Bioremediation: Contaminated Soils, Water, Marine oil slick.Reclamation of wasteland, agricultural lands- saline, waterlogged, restoration of wetlands, shifting cultivated areas.

UNIT – IV: Environmental Legislation — 10 Marks

Need for environmental legislation, Salient feature of existing environmental legislations. Water Act, 1974, Air Act, 1981, Environmental Protection Act, 1986. Wild Life Protection Act 1972, Provision of Indian constitution of Article 48A and 51A.

UNIT – V: Instrumentation, Remote sensing and GIS — 15 Marks

Titrimetry, Colorimetry, Spectrophotometry, Flame photometry, Chromatography, Principles of remote sensing, active and passive remote sensing, application of remote sensing and GIS

PRACTICAL

Full Marks 25
45 Hrs/Sem

1. Analysis of Solid waste and waste water – Waste characterization, dry matter moisture content analysis, decomposition analysis of Solid waste; chloride, Residual chlorine and alkalinity of waste water.
2. Estimation of COD – Dichromate Refluxion method
3. Bio-statistical analysis- Calculation of mean, variance and standard deviation, Testing the significance of difference between the two sample mean,correlation coefficient.
4. GPS study

SEMESTER VI
ENV – 506 (Elective)

Full Marks - 75
- 90 Hrs/Sem

ENERGY RESOURCES, ENVIRONMENTAL HEALTH AND ENVIRONMENTAL ISSUES

UNIT – 1: Energy resources – Fossil fuel. 15 Marks

Classification, compositions. Characteristics and energy content of coal. Petroleum and natural gas. Consequences of rapid consumption of fossil fuels. Alternative energy: Hydro-electricity, wind tidal, Geothermal, biogas, nuclear energy, solar energy.

UNIT – II: Environmental Health Hazards 15 Marks

Definition of environmental health and hazard water borne diseases, soil borne diseases, food borne diseases, air borne diseases, control of spread of infectious diseases, AIDS and its control measures, WHO and other bodies and their role in public health project development. Epidemiological issues (e.g. Goitre, Fluorosis, Arsenicosis etc.)

UNIT – III: Environmental Toxicology 15 Marks

Environmental toxicants, routes of exposure, absorption and translocation of tocicants; acute and chronic toxicity, Radiation and its biological effects, classification of pesticides, Integrated pest management, Effects of some important heavy metals viz lead, cadmium and mercury.

UNIT – 1V: Global Environmental Issues. 15 Marks

Causes and consequences of global warming and climate change ozone depletion, acid rain, deforestation, desertification etc.

UNIT – V: Major Environmental problems in India, causes and effects. 15 Marks

Population explosion, urbanization, Industrialization. Deforestation, Tehri Dam cinflcts. Chipko and Appiko movement. Local environmental problems- Tipeimukh dam, degradation of wetlands and important rivers, community pond and landslides.

PRACTICAL

25 MARKS

45 hrs/ Sem

1. Wind direction, Speed and wind rose.
2. Estimation of heavy metal concentration on in waters (Fe, Cr, Cu & Zn)
3. Toxicity test – observation & examination – Evaluation of data.
4. Microbiological examination of water – the coliform and MPN test, mounting and staining of bacteria, Soil microbial studies- Standard Plate count,
5. Detection of common adulterant in turmeric powder, milk, edible vegetable, estimation of Iodine content in common salt.

SEMESTER V
ENV -505

Environmental management Biostatics and Instrumentation

BOOKS/REFERENCES:

Bernhardsen, T. *Geographic Information System: An introduction.*
Biswas, D. *Environmental Management,* Excel Books, New Delhi.
Chaudhuri, B. D. N. *Introduction to Environmental Management.* Interprint, New Delhi.
Chouhan, T. S. *Remote Sensing for Natural Resources Management.*
Chrisman, N. *Exploring G.I.S.*
Hussey, N. W. and Scopes, N. *Biological Pest Control, the glasshouse Experience.* Blandford Press, Poole.
Jensen. *Remote Sensing of the Environment.*
Joshi, P. C. *Biodiversity and Conservation.*
Karpagam, M. *Environmental Economics,* Sterling Publishers Private Ltd. New Delhi.
Kumar, A. *Environmental Contamination and Bio-reclamation.*
Louma, S. N. *Introduction to Environmental Issues.* Mc-Millan Publishing Company, New York.
Mohanty,S.K.*Environment and polution laws,*Universal Law publishing Co.Pvt.Ltd.
Newman, M. C. and Unger, M. A. *Fundamentals of Ecotoxicology.* Virginia Institute of Marine Science, Gloucester Point, USA.
Pandey, B. N. *Biodiversity Conservation, Environmental Pollution and Ecology,* Ekta Book Distributors, New Delhi.
Pandey, B. W. *Natural Resource Management.*
Sagwal, S. S. *Forest Ecology of India.*
Satendra, I. F. S. *Disaster Management in hills.*
Sharma, P. D. *Ecology and Environment,* Rastogi Publication, Meerut.
Singh, R. B. *Disaster Management.*
Solomon Raju, A. J. *A text book of Ecotourism, Ecorestoration and Sustainable Development.* New Central Book Agency (P) Ltd. Kolkota.
Tiwari, B. K., Barik, S. K. and Tripathi, R. S. *Sacred Forest of Meghalaya - Biological and Cultural Diversity, Regional Centre,* National Afforestation and Eco-development Board, NEHU, Shillong.
Trivedi, P. C. *Biodiversity Conservation.*
Trivedi, P. R. and Gurdeep Raj. *Environmental Management of Freshwater Ecology.* Akashdeep Publishing House, New Delhi.
Trivedy, P. R. *Environmental Impact Assessment.*
Trivedy, P. R. *Natural Resources Conservation.*
The Environment(Protection) Act,1986, Universal Law publication .
Vyas, L. N. and Garg, R. K. *Wetland conservation,* Agro Botanical Publishers, Bikaner, Rajasthan.
Wadhera, B. L. *Law Relating to Intellectual Property,* Universal Law Publishing Co. New Delhi.

Bartee, T. C. *Digital Computer Fundamentals,* Mc-Graw Hill International Edition.
Chatwal and Anand. *Instrumental Methods of Analysis.*
Datta, A. K. *Basic Biostistics and its application,* NCBA Private Ltd. Calcutta.
Elias M Awad. *System Analysis and Design,* Golgotia Publications Private Ltd. New Delhi.
Khan, I. A. and Khanum, A. *Fundamentals of Biostatistics.* Ukaaz Publications. Hyderabad.
Satguru, P. *Fundamentals of Biostatistics,* Emkay Publication, New Delhi.
Trivedy, R. K. and Goel, P. K. *Current Pollution Researches in India.* Environmental Publication. Karat

SEMESTER VI
ENV -506

Energy Resources, Environmental health and issues

BOOKS/REFERENCES:

Odum, E. P. *Fundamentals of Ecology*, WB Saunders Co., Philadelphia, USA.
Pulekar, M. H. *Environmental Biotechnology*, Oxford & IBH Publishing Co. Private Ltd., New Delhi.
De, A. K. *Environmental Chemistry*. New Age International Publishers, New Delhi.
Ambasht, R. S. and Ambasht, N. K. *Plant Ecology*, Vanarasi.
Arora, S. *Fundamentals of Environmental Biology*, Kalyani Publishers, New Delhi.
Asthana, D. K. and Asthana, M. *Environmental Problems and Solutions*, S. Chand and Company, New Delhi.
Banerji, S. K. *Environmental Chemistry*, Prentice-Hall of India Private Ltd., New Delhi
Kormondy, E. J. *Concepts of Ecology*, Prentice-Hall of India Private Ltd. New Delhi
Misra, K. C. *Manual of Plant Ecology*, Oxford and IBH Publishing Co. Private Ltd., New Delhi.
Santara, S. C. *Environmental Science*, NCBA Private Ltd. Calcutta.
Sharma, B. K. and Kaur, H. *Environmental Chemistry*, Goel Publishing House, Meerut.
Sharma, P. D. *Ecology and Environment*, Rastogi Publication, Meerut.
Mukherjee, P. K. *A Text Book of Geology*, World Press Private Ltd. Calcutta
Omkar. *Concepts of Toxicology*, Vishal Publishing Co. Jalandhar.
Purdom, P. W. *Environmental Health*. Academic Press, New York.
Khoshoo, T. N. *Environmental concerns and Strategies*, Ashish Publishing House, New Delhi
Asthana, D. K. and Asthana, M. *Environmental Problems and Solutions*, S. Chand and Company, New Delhi
Louma. S. N. *Introduction to Environmental Issues*. Mc-Millan Publishing Company, New York.