SHIVAJI UNIVERSITY

M. Tech. Course in Environmental Science & Technology

Introduced from June, 2006

M.TECH PROGRAMMES

A. Computer Science and Engineering
B. Environmental Science and Technology
C. Energy Technology
D. Electronics.

1. Programme Duration : Two Years : Four Semesters

2. Intake : 18 per Programme

3. Programme structure and syllabus

First Year -

a. Theory Subjects :
   6 Compulsory Subjects
   4 Elective Subjects

b. Practicals for compulsory Subjects
c. Seminars - 2
d. Industrial Training – 8 weeks at the end of the First Year. (Summer)

Second Year –
a. Dissertation

4. Scheme of Marking

a.	Theory Subjects	-	1000
b.	Practicals	-	300
c.	Seminars	-	100
d.	Industrial Training	-	100
e.	Dissertation	-	500

	Total		**2000**

5. Eligibility : As per AICTE norms.

SHIVAJI UNIVERSITY, KOLHPUR

ADMISSION TO M. TECH. PROGRAMMES

A. Eligibility Criteria

1) The qualifying criteria for the M.Tech. course is as below.

1. Computer Science and Engineering

B.E. / B.Tech. (CSE/CT/CE/CS/IT/ Electronics/ Electrical)
M.Sc. (CS/ IT)
AMIE / IETE

2. Environmental Science and Technology

B. E. / B. Tech. (Cvil/ Chemical/ Environmental)
AMIE / IETE
M. Sc. (Environmental Science)

3. Energy Technology

B. E. / B. Tech. (Mechanical/ Automobile/ Production/ Chemical/ Electrical)
AMIE / IETE
M.Sc. (Electronics)

4. Electronics

B.E. / B. Tech. (ETC/ Electronics / Industrial Electronics)
AMIE / IETE
M. Sc. (Electronics)

B. Selection Basis :

Valid GATE Score.

Vacant seats, if any shall be filled up from the merit list prepared by conducting written test and interview by the University.

M. Tech. Course in Environmental Science & Technology

Course structure, scheme of evaluation (Semester-wise) and syllabus of M.Tech. programme in Environmental Science & Technology 2006-2007 in Shivaji University, Kolhapur

I) **Course Duration**: Two years four semesters, each semester of four months

II) **Course Structure:**
- (a) Theory Papers
- (b) Laboratory/ Practical training
- (c) Seminars
- (d) Industrial Training and Field Visits
- (e) Major Project

III) **Scheme of Marking**: (total marks 2000)

(a) Theory Papers	1000 marks
(b) Laboratory/ Practical training	0400 marks
(c) Major Project	0400 marks
(d) Seminars	0200 marks

IV) **Syllabus**: There are total ten theory courses consisting of six compulsory courses and four elective courses

V) **Eligibility**: B.E. / B.Tec. in Civil, Environmental/Civil construction/Civil water management /Civil rural management/chemical or M.Sc. in Environmental Science

VI) **Intake**: 18 as per AICTE rule

SHIVAJI UNIVERSITY, KOLHAPUR

M. Tech. (Environmental Science & Technology)

Course structure and scheme of Evaluation

Semester I

Course code	Name of the subject	Teaching Scheme		Examination Scheme		Total Marks
		Lectures	Practicals	Theory	Term Work	
ESTC 1	Introduction to Environmental Science and Ecology.	4	2	100	50	150
ESTC 2	Environmental Chemistry and Microbiology	4	2	100	50	150
ESTC 3	Energy and Environment.	4	2	100	50	150
ESTE 1	Elective I	4	-	100	-	100
ESTE 2	Elective II	4	-	100	-	100
ESTL 1	Seminar-I	---------	2	---------	50	50
Total		20	08	500	200	700

Total hrs. 28, Total Marks 700

Elective papers: I&II

Sr. No.	Subject
ESTE 11	Environmental Sanitation
ESTE 12	Optimization Techniques
ESTE 13	Environmental Biotechnology
ESTE 14	Industrial Waste Management
ESTE 15	Environmental Economics and Regulations

Semester II

Course code	Name of the subject	Teaching Scheme		Examination Scheme		Total Marks
		Lectures	Practicals	Theory	Term Work	
ESTC 4	Physico -Chemical and Biological Treatment Processes	4	2	100	50	150
ESTC 5	Air Pollution and Control.	4	2	100	50	150
ESTC 6	Environment Management Systems.	4	2	100	50	150
ESTE 3	Elective III	4	-	100	-	100
ESTE 4	Elective IV	4	-	100	-	100
ESTL 2	Seminar-II	----------	2	---------	50	50
Total		20	08	500	200	700

Total hrs. 28, Total Marks 700

Elective papers: III&IV

Sr. No.	Subject
ESTE 21	Advanced Water and Waste Water Treatment Technique
ESTE 22	Environmental Toxicology
ESTE 23	Environmental Statistics and Experimental Design.
ESTE 24	Remote Sensing and GIS
ESTE 25	Solid Waste Management

Semester-III

Course code	Name of the subject	Evaluation		Total Marks
		Term Work	Orals	
T31	* Industrial Training	100	--	100
S32	Dissertation Phase-I	100	100	200
Total		200	100	300

* 8 Weeks at the end of First Year (summer)

Semester-IV

Course code	Name of the subject	Evaluation		Total Marks
		Term Work	Orals	
D42	Dissertation Phase-II	100	200	300

Total Marks For Four Semesters: -

Semester	I	II	III	IV	**Total**
Marks	700	700	300	300	**2000**

M. Tech. (Environmental Science and Technology)

(ESTC 2) Environmental Chemistry and Microbiology

Teaching Scheme:		Examination Scheme:	
Credits	: 3	Paper Marks :	80 Marks
Practical	: 0	Internal Marks	: 20 Marks

Unit 1

Chemistry of pollutants in the Atmosphere: Solid, liquid, gaseous and radioactive pollutants in the atmosphere, formation of physical processes of pollutants in the atmosphere, Effects of temperature, solar radiation and wind currant on the various pollutants, Effect of gravitational force and rain scrubbing on air pollutants, Chemical properties of air pollutants chemisorptions, effect of solar radiation on acidic basic characteristics, reducing, oxidizing properties of air pollutants.

Unit 2

Chemistry of pollutants in the water (Hydrosphere), Characteristics of water as a solvent. Interaction of water with organic, Inorganic species (Natural & Anthropogenic), Determination of water quality parameters, physical, chemical, biological and physiological parameters.

Unit 3

Air pollution control Engineering, Control of particulate matter Gravity setting, fabric filters, centrifugal imp actors, Electrostatic precipitators, scrubbers limitations of these techniques with reference to chemistry of pollutants.

Control of gaseous pollutants. Absorption, Adsorption, Condensation (cold trapping) Chemical conversions of gaseous pollutants. Control of specific gaseous pollutants, SO2, H2S, CO, CO2, NO, NO2

Unit 4

Water Treatment Technology : water and process waste water & its composition

Detection, estimation and removal of heavy toxic metals pesticides, organic residues, oxidizing, reducing agents in Waste Water. Reduce Recycle and Reuse of heavy toxic metals Ion exchange, catalytic conversion, stream gas stripping cooling & chilling, Organic pollutants in waste water & treatment technology Determination of BOD, DO, COD, TOC, & Organic loading, Aerobic & Anaerobic treatments Activated sludge process.

Unit 5

Instrumental methods of pollutant analysis, Spectroscopic techniques, AAS, NAA, GCMS, HPLC, Electro analytical techniques, EEM-608 , Industrial waste management and environmental audit, environmental sensing techniques.

Unit 6

Bacteria : classification and characteristics of bacteria, cell morphology, growth rate curve, culture techniques, Gram staining, microscopic methods, MPN, Plate count and membrane filter techniques,

Unit 7

Algae: classification, symbiosis, factors affecting algal growth, control of algae, Fungi, moulds, protozoa , population dynamics, role of microbes, in biological waste treatment, significance of F/M ratio, acclimatization of bacteria, bioassay tests, aerobic and aerobic metabolism.

Unit 8

Structure of prokryotic and eukryotic cells, Types and metabolic classification of micro organisms, Microbial metabolism, respiration and energy generation, ; enzyme kinetics and regulation; Bacterial genetics; structure of DNA nad RNA ; transcription and translation; Gene expression and regulation; Gene transfer and recombinant DNA technology.

References

1) Chemistry for Environmental Engineers - Swayer and McCarty
2) Outlines of Biochemistry - Conn and Stump
3) Microbiology - Pelzar and Reid
4) Microbiology for Sanitary Engineers - Ray MaKinney

M. Tech (Environmental Science and Technology)

(ESTC-3) Energy and Environment

Teaching Scheme :	Examination Scheme:
Credits : 3	Paper marks: 80 Marks
Practical: 0	Internal Marks: 20 Marks

Unit1

Energy Crisis: Historical events, energy requirement of society in past and present situation, availability and need of conventional energy resources, major environmental problems related to the conventional energy resources, future possibilities of energy need and availability.

Unit 2

Non-conventional energy sources: Hydel power plant, tidal energy, biomass energy, wind energy, Hydrogen as a source of energy, energy conversion technologies, their principles, equipment and suitability in context of India. Environmental impacts of these technologies.

Unit 3

Solar Energy option: Sun as source of energy, direct methods of solar energy collection, process of photovoltaic energy conversion, solar energy conversion technologies and devices, their principles, working and application, environmental impacts of solar energy.

Unit 4
Biomass option: Concept of biomass energy utilization, types of biomass energy, conversion processes, biogas production, biomass gasification process and technologies, environmental impacts of biomass energy.

Unit 5
Energy Storage: Types of energy storage, devices for sensible and latent heat storage, energy storage in dry batteries, nickel-cadmium batteries, secondary heat storage, chemical storage, environmental consequences of energy storage systems.

Unit 6
Heat Energy recovery systems: Approaches to waste Energy Utilization, Equipment, Utilization System, objective , principles of heat transfer, Gas to Gas heat transfer, Gas to Liquid heat transfer, Recovery of waste heat in coil coating, Non-conventional liquid fuels, Heat recovery by Cogeneration.

References

1. Bewik M.W.M. - Handbook of organic waste conversion.
2. Bokris J.O. - Energy, the solar hydrogen alternative.
3. Rai G.D - Non-conventional Energy Sources.
4. Sukhatme S.P.- Solar Energy.
5. Kiang Y. H.- Waste Energy Utilization Technology.

M. Tech (Environmental Science and Technology)

(ESTC-4) Physico-Chemical and Biological Treatment Processes

Teaching Scheme:		Examination Scheme:
Credits	: 3	Paper Marks : 80 Marks
Practical	: 0	Internal Marks : 20 Marks

Unit 1
Mass transport processes, Mass balance analysis, types of reactions, reaction kinetics, Configurations of ideal and non-ideal reactors, principles of ideal reactor design. Basic principle of mass transfer, Gas-liquid mass transfer, Two film theory Introduction to process selection.

Unit 2
Coagulation processes, stability of colloids and destabilization, coagulants
Flocculation theory, orthokinetic and perikinetic Design of slow and rapid mixers.

Unit 3
Sedimentation, particle settling theory, types of settling and related theory, types of clarifier, high rate clarification, design of clarifiers.

Unit 4
Introduction to depth filtration, filtration processes, principal mechanisms of filtration, filter hydraulics, backwash hydraulics, Rate control patterns and methods, design and operation of slow sand, rapid sand and dual media filters.

Unit 5

Adsorption processes, causes and types of adsorption, influencing factors, adsorption equilibria and development of adsorption isotherms, activated carbon adsorption kinetics, analysis and design of GAC and PAC contactors.

Unit 6

Ion exchange, exchange materials, exchange capacity, ion exchange chemistry and reactions, applications for hardness and TDS removal, design of ion exchange softener, Introduction to membrane processes.

Unit 7

Disinfection, modes of disinfection, mechanisms, factors influencing, ideal disinfectant, chemistry of chlorination, ozone chemistry, estimation of ozone dosage, UV disinfection, Estimation of UV dose.

Unit 8

Corrosion processes, electrochemical nature of corrosion, types of corrosion, methods of corrosion control.

Unit 9

Objectives and fundamentals of biological treatment, types of biological treatment processes. Conventional activated sludge process, process kinetics and design considerations, process control measures, operational problems, Introduction to modifications. Trickling filter, classification, process design considerations. Fundamentals of anaerobic treatment, general design considerations, types of anaerobic reactors.

References

1. Theory and Practice of water and Wastewater treatment – Ronald Droste.
2. Environmental engineering – Peavy, Rowe and Tchnologous.
3. Physico-chemical processes of water purification – Weber
4. Wastewater Engineering treatment and reuse– Metcalf Eddy.

M. Tech (Environmental Science and Technology)
(ESTC 5) Air Pollution and Control

Teaching Scheme:		Examination Scheme:
Credits	: 3	Paper Marks : 80 Marks
Practical	: 0	Internal Marks : 20 Marks

Unit 1

Physics of atmosphere, Solar radiation, Wind circulation, Lapse rate, Inversion, Stability conditions, Pasquil stability model, maximum mixing depth, Wind rose, Plume behavior, Heat island effect, Green house effect, Rain drop formation, Visibility, Photochemical reaction.

Unit 2
Dispersion of pollutants in the atmosphere, eddy diffusion model, the Gaussian dispersion model, point source, Line source, maximum ground level concentration, Determination of stack height, sampling time corrections, Effects of inversion trap.

Unit 3
Particulate matter; Definitions of different particulate matter, Distribution and source of SPM, Terminal settling velocity, Hood and duct design, Particulate collection design.

Unit 4
Control equipment for particulate matter; Settling chamber, Cyclone, Wet collectors, Fabric filter, Electrostatic precipitator, Problems on design of equipment, Component detailing collection efficiency.

Unit 5
General control of Gaseous pollutants, Principles of absorption, Adsorption, Basic design of absorption and adsorption units, Incineration and after burner, Control of sulphuric dioxide, NOx.

Unit 6
Automobile source; Emission of pollutants from automobiles, Reduction of emissions by different methods, Alternative fuels and their utilizations.

Unit 7
Strategy for effective control of air pollution in India.

References
1. Air Pollution – Wark and Warner.
2. Air Pollution Vol. I and II– Stern.
3. Air Pollution and Control– Martin Crawford.

M. Tech (Environmental Science and Technology)

(ESTC 6) Environment Management System

Teaching Scheme:		Examination Scheme:
Credits	: 3	Paper Marks : 80 Marks
Practical	: 0	Internal Marks : 20 Marks

Unit 1
Environmental Impact Assessment (EIA): Definitions and Concept, Scope, Objectives, Types of impacts, Elements of EIA, Baseline studies, Methodologies of EIA, Prediction of impacts and its methodology, Uncertainties in EIA, Status of EIAs in India.

Unit 2
Environmental Impact Statement (EIS), Sustainable development,
Environmental management plan: Definition, Importance, Development, Structuring, Monitoring, Cost aspects.

Unit 3

Environmental auditing: Definitions and concepts, Scope and Objectives, Types of audit, Accounts audit, Environmental audit statement, Qualities of environment auditor.

Unit 4

Environmental ethics: Ethics in society, Environmental consequences, Responsibility for environmental degradation, Ethical theories and codes of Ethics, Changing attitudes.

Unit 5

ISO and ISO 14000 series: Introduction, Areas covered in the series of standards, Necessity of ISO certification. Environmental management system: Evolution, Need, Elements, Benefits, ISO 14001 requirements, Steps in ISO 14001 certification, ISO 14001 and sustainable development, Integration with other systems (ISO 9000, TQM, Six Sigma), Benefits of integration,

Unit 6

Evaluation of Environmental Performance, Environmental Labelling, Life-Cycle Assessment.

References

1. Environmental Impact Assessment – Canter.
2. Environmental auditing – CPCB
3. Environmental audit – Mhaskar
4. ISO standards.
5. Environment management centre web site.

M. Tech (Environmental Science and Technology)

(ESTE-11) Environmental Sanitation

Teaching Scheme:		Examination Scheme:
Credits	: 3	Paper Marks : 80 Marks
Practical	: 0	Internal Marks : 20 Marks

Unit 1

Ecology, man and his environment, types of ecosystem, food chain and web, population dynamics, imbalance of ecosystem causes and effects, Energy flow in nature, Non-conventional energy sources.

Unit 2

Vital Statistics, Sources, population growth and its control, factors affecting, Infant mortality, Morbidity rates.

Unit 3

Transmission of diseases through air, water and food, control and prevention of diseases, Vectors as disease carriers, Vector and weed control, Pesticide use, Mosquito and its control, house fly and its control, Rodent control.

Unit 4

Sanitation aspects in food processing, dairy, public places, slaughterhouse, swimming pool, and industry. Building by laws for sanitation,
Rural sanitation, Low-cost sanitation, Privies, Waterless toilet.

Unit 5

Basic elements of good housing, Substandard housing and its effects, Ventilation and air-conditioning, house plumbing and drainage, backflow prevention, indirect waste piping.

Unit 6

Industrial hygiene, sources of dust and gaseous pollutants, occupational hazard, exposure tolerance, protective measures, Legal control.

Unit 7

Noise Pollution, Decibel scales, Noise characteristics & measurement, Levels of noise and standards, Control measures of community and industrial noise.

References:

1) Environmental Sanitation – Salvador.
1) Municipal Sanitation – Ethers and Steel.
2) Modern concepts of Ecology – H. D. Kumar.
3) Environmental Engineering and Sanitation – Salvato.

M. Tech (Environmental Science and Technology)

(ESTE – 12) Optimization Techniques (Computers)

Teaching Scheme:		Examination Scheme:
Credits	: 3	Paper Marks : 80 Marks
Practical	: 0	Internal Marks : 20 Marks

Unit 1

Optimization problem statement, Classification of optimization problems.
Classical optimization theory: Unconstrained optimization, Constrained optimization with equality and inequality, Method of Lagrange multipliers, kuhn-Tucker conditions.

Unit 2

Linear programming: Construction of LP model, Simplex method, Big M and two phase methods, Special cases, Duality and sensitivity analysis, Economic interpretation of duality.

Unit 3

Non-linear programming: Unconstrained optimization techniques, Classification of methods, Dichotomous optimization method, Steepest ascent, Newton method, Constrained optimization, Separable and quadratic programming.

Unit 4

Dynamic programming: Multistage decision process, recursive relationships, Principle of optimality, Computational procedure in DP, DP applications, Problem of dimensionality.

Unit 5

Genetic algorithm: Introduction, Representation of decision variables, Objective function and constraints, GA operators.
Introduction to Simulated annealing, Neural network based optimization and optimization of fuzzy systems.

Unit 6

Scope of Computer application in Environmental Science and Engineering, Applications of optimization techniques to Environmental systems.

References

1. Engineering optimization – S. S. Rao
2. Operation research – Taha.
3. Genetic algorithm – Goldberg.

M. Tech. in Environmental Science and Technology

(ESTE - 13) Environmental Biotechnology

Teaching Scheme :
Credits : 3
Practical: 0

Examination Scheme:
Paper marks: 80 Marks
Internal Marks: 20 Marks

Unit 1.

Concept of Environmental Biotechnology and Environmental Engineering, scope and importance. Genetic engineering structure of DNA, RNA, Replication of DNA, genetic code, Transcription, Protein synthesis.

Unit 2.

Introduction to Genetic Engineering and Recombinant DNA Technology(RDT), Restriction endonucleases, Steps in gene cloning, cDNA and genomic library, Chemical synthesis of gene, Polymerase Chain Reaction (PCR), Vectors and their types, Selection of recombinant clones.

Unit 3.

Microbiology of waste water treatment. a) Aerobic processes : Activated sludge, oxidation ditches, trickling filters, towers, rotating discs, rotating drums, oxidation ponds. b) Anaerobic processes : Anaerobic digestion, anaerobic filters, Up flow anaerobic sludge blanket reactor. Treatment schemes for waste waters of dairy, distillery, tannery, sugar and antibiotic industry.

Unit 4.

Air pollution and its control through biotechnology, Biotechnology in reduction of CO_2 emission, Bioscrubbers, Biobeds, Biotrickling filters and their applications.

Unit 5.
Microbiology of degradation of xenobiotic in environment – ecological considerations, decay behavior and degradative plasmids, hydrocarbons, substituted hydrocarbons, oil pollution, surfactants, pesticides. Biological detoxification of cynide, oxalate, urea, petrochemical industry effluents, toxic organics, phenols.

Unit 6.
Bioremediation, Types of bioremediations, Bioaugmentation for bioremediation, Bioreactors, Bioremediation of herbicides, pesticides, hydrocarbons, oil spills.

Unit 7.
Novel methods of pollution control – Vermitechnology, Methane production,Root zone treatment, Membrane technology, Biodegradable plastics.

References :

1. Microbial Biotechnology : A. N. Glazer and H. Nikaids .
2. Molecular Biotechnology : Gleek and Pasternack.
3. Biotechnology : A Text Book of Industrial Microbilogy, T. D. Brock,
4. Industrial Microbiology : Presscott and Dunn.
5. Biotechnology : B. D. Singh , Kalyani Publishers.

M. Tech (Environmental Science and Technology)

(ESTE- 14) Industrial Waste Management

Teaching Scheme:		Examination Scheme:
Credits	: 3	Paper Marks : 80 Marks
Practical	: 0	Internal Marks : 20 Marks

Unit 1
Water use in industry, Industrial water quality requirements, Deterioration of water quality, Classification and characterization of Industrial wastewater, Monitoring of wastewater flow in industries, Quality and quantity variations in waste discharge, Water budgeting.

Unit 2
Waste volume reduction, Waste strength reduction, Neutralization, Proportioning, Equalization. Reuse and recycling concepts.

Unit 3
Treatment techniques for removal of specific pollutants in industrial wastewaters, e.g., oil and grease, cyanide, fluoride, calcium, magnesium, toxic organics, heavy metals, radioactivity.

Unit 4

Treat ability aspects of raw industrial wastewater with domestic sewage, Partially treated industrial wastewater with domestic sewage, Completely treated industrial wastewater with domestic sewage.
Stream and Effluent standards.

Unit 5

Common Effluent treatment plant: Concept, Objectives, Methodology, Cost benefit analysis, Design, Operation and maintenance.

Unit 6

Classification of industries. Manufacturing processes, Water usage, Sources, Quantities, and characteristics of effluents, Pollution effects, Methods of treatment, utilization and disposal, in industries viz. sugar, distillery, dairy, pulp and paper mill, fertilizer, tanning, steel industry, textile, petroleum refining, chemical and power plant.

References

1) Theories and Practices of Industrial waste treatment- Nelson Nemerow.
2) Waste water treatment: M.N.Rao & Datta.
3) IS Standard guide for treatment and disposal of various industries.

M. Tech (Environmental Science and Technology)

(ESTE - 21) Advanced Water and Wastewater Treatment Techniques

Teaching Scheme:		Examination Scheme:
Credits	: 3	Paper Marks : 80 Marks
Practical	: 0	Internal Marks : 20 Marks

Unit 1

Gas transfer: Aeration systems, Energy requirement, Design of aeration systems.

Unit 2

Membrane filtration: Terminology, Process classification, Membrane configurations, Membrane operation for micro filtration, Ultra filtration and Reverse osmosis, Area requirement, Membrane fouling and its control, Application of membranes. Electro dialysis: Theory, Area and power requirement, Disposal of concentrate waste streams.

Unit 3

Grit removal: Types of grit chambers, Characteristics, quantities, processes and disposal of grit, Design of grit chambers, Flotation: Objective, Types of flotation systems, Design considerations. Chemical precipitation for removal of phosphorous, heavy metals and dissolved inorganic substances.

Unit 4

Microbial growth kinetics, Modelling suspended and attached growth treatment processes. Suspended growth processes for biological nitrification and de-nitrification, Biological nitrogen and phosphorous removal.

Unit 5

Anaerobic sludge blanket processes, Design considerations for Up flow Anaerobic Sludge Blanket process. Theory and design of Sludge treatment, sludge thickening, sludge drying, incineration, aerobic and anaerobic digestion of sludge.

Unit 6

Wetland and aquatic treatment systems; Types, application, Treatment kinetics and effluent variability in constructed wetlands and aquatic systems, Free water surface and subsurface constructed wetlands, Floating plants (water hyacinths and duckweed), Combination systems, Design procedures for constructed wetlands, Management of constructed wetlands and aquatic systems.

References

1. Wastewater Engineering treatment and reuse– Metcalf Eddy.
2. Theory and Practice of water and Wastewater treatment – Ronald Droste.
3. Physico-chemical processes of water purification – Weber
4. Wastewater Treatment for Pollution Control – Soli Arceivala.

M. Tech (Environmental Science and Technology)
(ESTE- 22) ENVIRONMENTAL TOXICOLOGY

Teachuing Scheme :	Examination Scheme:
Credits : 3	Paper marks: 80 Marks
Practical: 0	Internal Marks: 20 Marks

Unit 1

Introduction to Environmental Toxicology : Definition, classification, origin and general nature of toxicants in environment, factors affecting toxicity, nutritional and non nutritional food supplements and their effects, mutagenesis, teratogenesis, carcinogens, hellucinogens, phytotoxins and animal toxins.

Unit 2

Systematic and Eco-toxicology : Toxic response of different body systems likes respiratory, gastro-intestinal tract, Liver, kidney, immune system, reproductive system. Problems and approach, Environmental distribution of chemicals in air, water, sediments, soil and biota; Effects of toxicants on ecosystem, Detoxification of toxicants in resistant biota.

Unit 3

Experimental methods for measuring toxicity; Types of bioassays (Ames test, bioluminescence, algal toxicity, gene induction etc.), the interaction of chemicals with ecosystems; Methods for assessing the impacts of chemicals on ecosystems (toxicity tests, field assessment, special analyses such as biomarkers, bioaccumulation, mesocosm and microcosm studies).

Unit 4

Biotransformation, bioaccumulation and bio-magnification of toxicants ,Toxicants absorption and distribution of toxicants in animal body, Bio-transformation of toxicants, antidotes treatment and their detoxification of toxicants, Bio-accumulation, Bio-magnification.

Unit 5
Environment and health and environmental stress : Basic principles of environmental health, community health, impact of changing environment on biota, effect of stress on environment, adaptations and tolerance level of various organisms and stress factors, micro-organisms of extreme environment.

Unit 6
Occupational health hazards : Stress, man, machine and environment, ergonomics and occupational physiology and Hazards of working environment safety management of occupational hazards.

Unit 7
Ecological risk assessment process and evaluation of human exposure, Case studies related to accidental discharge of pollutants and their impacts on the ecology and inhabitants of the surrounding areas.

References

1. Principles of Ecotoxicology, Edited by : G. C. Butler
2. Basic Environmental Toxicology, Edited by: Cockerham, shane, CRC Press.
3. Environmental Toxicology by Wright.
4. A. P. H. A. Ed. 1992.
5. Modern Toxicology by Gupta and Salunkhe.

M. Tech (Environmental Science and Technology)

(ESTE- 23) Environmental Statistics and Experimental Designs

Teaching Scheme :	Examination Scheme:
Credits : 3	Paper marks: 80 Marks
Practical: 0	Internal Marks: 20 Marks

Unit 1.
Basic concepts : Variable, quantitative, discrete, continuos, data: Data representation, tabulation, diagrammatic representation. Measures of central tendency and dispersion, mean, median , mode, percentiles, range, variance, standard deviation, coefficient of variation measures skewness and kurtosis.

Unit 2.
Probability: sample space, events, equally likely out comes probability of events (frequency approach). Addition and ultiplication Theorems and condition probability.

Unit 3.
Standard distributions : Binomial, Poisson, normal, expon- ential. Computation of mean, variance and probability distribution function and generating function. Model sampling, simulation study.

Unit 4.
Correlation and regression: scatter plot, correlation coefficient, properties, rank correlation. Linear regression: Fitting of line and plane of regression.

Unit 5.
Methods of sampling: Simple Random sampling with and without replacement. Sampling distribution and standard deviation of sample mean.

Unit 6
Testing of hypothesis: Null and alternative hypothesis, types of errors, critical region. Testing of equality of proportion and for equality of means when variances are known and unknown. P-value chi-squre test of goodness of fit and of independence.

Unit 7
Basic concepts in Experimental Designs: Unit, treatment, Lay out of the experiment. Principles of designs of experiments, randomization, replication and local control. typical applications of experimental designs.

Unit 8
Analysis of variance: One way and two way classification. Mathematical model assumptions. Hypotheses, and their testing. ANOVA table .

Unit 9
Standard designs : CRD, RBD and LSD, Lay-out, model, analysis, advantage

References :

1. Biostatistics : A foundation for Analysis in the Health Sciences 7/E Wayne W. Daniel, Wiley Series in Probability and Statistics.
2. Cochran& cox: experimental designs.
3. Goon, Gupta& Das gupta: Fundamentals of statistics Vol. I & II
4. Kempthorne: The design and analysis of experiment.
5."Geostatistics with Applications in Earth Sciences" By D.D. Sarma National Geophysical Research Institute (Council of Scientific and industrial Research) Hyderabad India
Publication: Capital Publishing Company New Delhi Kolkata,
6. Rechard A.Johnson: Probability and Statistics for Engineers.
7. Hogg and Tanis : Probability and Statistical Inference.
8. Douglas C. Montgomery : Design and Analysis of Experiments.

M. Tech (Environmental Science and Technology)

(ESTE - 24) Remote Sensing and GIS

Teaching Scheme:		Examination Scheme:	
Credits	: 3	Paper Marks :	80 Marks
Practical	: 0	Internal Marks	: 20 Marks

Unit 1
Concepts of remote sensing; Energy sources and Radiation principles, spectral characteristics of earth's surface and of atmosphere. Sensors and their characteristics; Radiometers, cameras, multi-spectral scanners and microwave systems. Aerial and satellite platforms.

Unit 2
Optical, infrared and microwave imagery, Analysis of imagery, Visual and machine interpretation of imagery, Ground truth data, Digital image processing.

Unit 3
Application of remote sensing – Land use and Land cover mapping, biodiversity, forestry and agriculture, soil erosion, water resources, wetland mapping, Wild life ecology, Environmental assessment, Environmental management, Urban and regional planning, Monitoring natural disasters.

Unit 4
Fundamentals of GIS: Definition, Components, spatial data, thematic characteristics, rasters and vectors, databases and database management.

Unit 5
Data input and Editing: Data stream, data encoding, map digitization and conversion, data analysis, network and surface analysis in GIS, analytical modelling, forms of GIS output, decision support systems, GIS project design and management.

Unit 6
GIS applications: Forestry, Bio-diversity, Environment, Soil resource management, Hydrological modelling, Public utilities (water distribution, sewerage, solid waste management).

References

1. Remote Sensing and Image Interpretation – Lillesand and Kiefer.
2. Introduction to the physics and techniques of Remote Sensing – Elachi.
3. Geographical Information System Vol. I and II– Longley.
4. An Introduction to GIS – Ian Haywood.

M. Tech (Environmental Science and Technology)

(ESTE- 25) Solid Waste Management

Teaching Scheme:		Examination Scheme:
Credits	: 3	Paper Marks : 80 Marks
Practical	: 0	Internal Marks : 20 Marks

Unit 1

Solid waste management: Objectives, Functional elements, Environmental impact of mismanagement. Solid waste: Sources, Types, Composition, Quantities, Physical, Chemical and Biological properties.

Unit 2

Solid waste generation rate: Definition, Typical values for Indian cities, Factors affecting. Storage and collection: General considerations for waste storage at source, Types of collection systems. Transfer station: Meaning, Necessity, Location, Economic analysis. Transportation of solid waste: Means and methods, Routing of vehicles.

Unit 3

Sorting and material recovery: Objectives, Stages of sorting, Sorting operations, Guidelines for sorting for material recovery, Typical material recovery facility for a commingled solid waste.

Unit 4

Composting of solid waste: Principles, Methods, Factors affecting, Properties of compost, Vermicomposting. Energy recovery from solid waste: Parameters affecting, Biomethanation, Fundamentals of thermal processing, Pyrolysis, Incineration, Advantages and disadvantages of various technological options.

Unit 5

Landfills: Definition, Essential components, Site selection, Land filling methods, Leachate and landfill gas management.

Unit 6

Indian scenario: Present scenario and measures to improve system for different functional elements of solid waste management system. Elements of financial management plan for solid waste system.

References

1)Manual on municipal solid waste management – Government of India publication.
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