

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

M.Sc.

ENVIRONMENTAL SCIENCE

FIRST SEMESTER

EnS.: 101 Fundamental Environmental Science

1. Atmosphere - Regions of Atmosphere - Troposphere, Stratosphere, Mesosphere, Thermosphere - Their Boundaries and Temperature Profiles - Composition of Atmosphere, Hydrosphere and Lithosphere.
Important Terms: Pollutant, Contaminant, Source, Sink, Receptor, Speciation, Threshold Limit Value (TLV). Different cycles prevailing in nature.
2. Photo Dissociation and Photoionisation in upper Atmosphere - Mechanism for Ozone Depletion - Greenhouse Effect and Global Warming - Causes and Consequences. Causes of Acid Rain - Smog formation.
3. Hydrosphere and Lithosphere - Their Composition - and usefulness.
4. Biochemistry Fundamentals: Enzymes - Biodegradation - General Bio-Chemical Pathways - Energetic and Bacterial Growth - Novel Biotransformation.
5. Fundamentals of General and Physical Chemistry: Chemical Equilibrium - Factors Affecting - Ways of Shifting Chemical Equilibria-Electrochemistry - Chemical kinetics - Solvents Extraction - 1st and 2nd Law of Thermodynamics - Enthalpy, Entropy, Gibbs free Energy.
6. Fundamentals of Organic Chemistry: Soaps - Detergents - Pesticides - Pharmaceutical active compounds - Fate of Organics - Structure and Property activity relationships.!
7. Energy: Fuels - Fossil Fuels - Petroleum products - Natural Gas - Renewable Sources of Energy - Wood, Hydro Power, Wind Power, Biogas, Alcohol, Gasohol, Geothermal Energy, Solar Energy, Jam; is Primary Source - Nuclear Energy - Merits and Demerits of each

References:

1. Chemistry for Environmental Engineering and Science
C. N. Sawyer, P. L. McCarty and G. F. Parkin (5th Ed.), Tata-McGraw-Hill
2. Environmental Chemistry
B. K. Sharma Goel Publishing, Meerut

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ENVIRONMENTAL SCIENCE

FIRST SEMESTER

EnS.: 102 Environmental Chemistry

1. Chemical Bonding: Ionic Bond - Covalent Bond - Co-ordinate Bond, Hydrogen Bond, Vander Walls Forces, Metallic Bond.
2. Oxidation - Reduction: Modern Concept - Oxidising and Reducing Agents and their applications with relative merits.
3. Metal Complexes: Chelates, Complexometric Titrations with EDTA, Application.
4. Balancing of Reactions: Stoichiometric Calculation, Methods to Express Concentration of Solution viz. Molarity - Normality - Molality - PPM - Mole Fraction - Formality and Their inter Conversion.
5. Ionic Equilibrium: Strong and Weak Electrolytes - Theories of Acid and Base - Definition of pH and its Measurement - Buffer Solutions, and Their Preparation cV , Applications - Acid-base Indicators and its Theory.
6. Colloids and Surface Chemistry: Adsorption - Absorption - Colloids - Methods of Preparation of Colloids - Properties of Colloids - Coagulation - Protective Colloids - Applications - Surface Active Agents - Osmosis - Osmotic Pressure.
7. Radioactivity: Nature of Radiation - Interaction with Matter, Detection and Measurement of Radiation - Nuclear Reactions - Nuclear Fission and Fusion. Hazards of Radiation
8. Important Organic Compounds: Elementary Idea about - Nucleic Acids - Oils and Fats - Enzymes - Dyes - Drugs - Insecticides - Pesticides - Fertilizers - Detergents - Food Preservatives and Colours.
9. Polymers: Natural and Synthetic Polymers - PVC - Polyethylene - Polypropylene - Buna-S - Buna-N - Polystyrene - Nylon - Polycarbonate - Teflon." Biodegradable and Bio-non-degradable Polymers

References:

1. Chemistry: Central Science (5th Ed.) Brown, Lemay & Bursten, Prentice-Hall
2. Elements of Physical Chemistry S. Glasstone and Lewis
3. General Chemistry Mahan

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ENVIRONMENTAL SCIENCE

FIRST SEMESTER

EnS.: 103 Environmental Biology

1. Environment Microbiology: Classification of Microbes and their Application in Environmental Sciences - Cultivation and Growth of Microbes - Microbes and their Association with Man, Animals and Plants - "Microbes as Anti-Microbial Agents - Extremophiles -Microbial Metabolism
2. Biological Diversity of India: Definition and Nature - India's Biogeographical History - Physiography - Climate and its Impact on Biodiversity - Indian Forests and Vegetation Types - Flora and Fauna of Forests
3. Wet Lands and Semi Arid Habitats of India: Definitions and Types of Wet Lands - Important Wet Lands of India and their Conservation Issues - Semi-arid Habitats of India: Distribution, Ecological Status and their Conservation
4. Endangered, Endemic and Extinct Species of India: Threatened Species Categories of IUCN - Threatened Species of Plants & Animals in India, with Reasons - Red Data Books - Role of Biotechnology in Conservation of Species in Situ & Ex. Situ Conservation
5. Wild Life Management and Conservation: Protected areas Network in India - Goals of Management, Strategies for Planning - Factors Affecting wild life - Management, Such as Habits, Population, Behaviour, Food-habits, Health etc. - Important Projects for Conservation of Wild Life in India - Role of Local communities in Wild Life Management
6. Marine Biology: Biology of Open and Coastal Sea Environment Distribution Adaptation and Productivity

References:

1. Elements of Microbiology - M. J. Pelczar & ECS Chan 1981 2
Microbiological Methods for Environmental Scientists and Engineers -A.
F. Gaudy 1980 McPraw Hill
3. Microbial Methods for Environmental Biotechnology
4. Introduction to Environmental Biotechnology - A, K. Chatterjee 2005
5. Environmental Science: Towards a sustainable future, 8th Ed T Weight
& B. J. Nebeji PHI
6. Elements of Environmental Science for Engineering P. Meenaxi Puri
7. Biodiversity - W.B.M. Winiger 2001 Springer

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ENVIRONMENTAL SCIENCE

FIRST SEMESTER

EnS.: 104 Ecology: Principles & Scope

1. Fundamental of Ecology - Definition and Sub Divisions Basic Concepts of Ecology: Ecosystems - Energy Flow in Ecosystem -Development, and Evolution of Ecosystem - Food Chains - Limiting Factors
2. Habitat: Fresh Water Ecosystem - Marine Ecosystem - Estuarine Ecosystem - Terrestrial Ecosystem
3. Ecological Approaches: Basic Principles - Ecology Planning - Survey Ecological Determinants - Land Use - Allocation
4. Biogeochemical Cycles
5. Population and Community Ecology
6. Non-Conventional Energy: Tidal power - Wave Power - Wind Turbines - Solar Energy

References:

- (1) Fundamentals of Ecology - Eugene P. Odum
- (2) Modern Concepts of Ecology - H. P. Kumar
- (3) Essentials of Ecology & Environmental Science SVS Rana 2005 - Prentice Hall of India Pvt. Ltd.
- (4) Renewable Energy Sources and their Environmental Impact - S. A. Abbasi & N. Abbasi PHI
5. Ecology: Theories and Applications - 4th Edition PHI, Peter D. Stiling
6. Paradigms Lost: Theory' Change in Ecology - Eds. K. Cuddington & B. E. Beisner Elsevier A. P.
7. Principles of Terrestrial Ecosystem - Ecology-F. S. Chapin, P. Matson & H. A. Mooney Springer 2004
8. Integrated Land Use and Environmental Models 2003 .. - 3. Guhothakuita- Springer

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M.Sc.

ENVIRONMENTAL SCIENCE

FIRST SEMESTER

EnS.: 105 Instrumental Methods of Analysis

1. Spectrophotometer: Regions of EMR - UV - Visible Region - Laws of Absorption of Radiation - Calibration Curve and Standard Addition Method - Multi Component Analysis - Components of Spectrophotometer - Source - Monochromatic - Sample Compartment - Detector - Single Beam and Double Beam Instruments.

Illustrative Instruments: Milton-Roy Speet runic-20, Double Beam Spectrophotometer, "HACH" DR-2000 Spectrophotometer. Application (Minimum 25) in Environmental Analysis
2. Atomic Spectroscopy: Principles of Flame Emission and Atomic Absorption Spectrophotometry - Primary Idea about Instrument - One Illustration of Flame and Non-Flume Atomizer - Source in AAS - Applications.

Electrical Methods of Excitation - Principles - Inductively Coupled Plasma Source - Elementary' Idea - Applications
3. Ion Selective Electrodes: Elementaiy Idea about Class Electrode and Other ISE - Applications.
4. Electro analytical Methods: Elementary Idea of DC Polarography - Coulometriy - Anodic- Stripping Voltainctry.
5. IR Spectroscopy: Use of Nondispcrsive IR (las Analysers
6. Principles of Fluorescence - Phosphorescence and Chemiluminesconce and Applications.
7. Gas Chromatography: CISC - GLC - Principle of Separation •-Stationary and Mobile Phase - FID - TCD - ECD only Principle and Selectivity and Sensitivity - Selective Applications - Limitations.
8. HPLC: Principle - Components of Instruments -- Elementary Idl'fl Selective Applications in Separation and Eslim; lions.
9. Ion Exchange Chromatography: Ion Exchange Resins - Principles ol Ion Exchange - Detectors - Applications.
10. Turbidimetry and Naphelometry: Principles und Applications

References:

1. Instrumental Analysis by: Skoog, Holler and Niemann Saunder
College Publications
2. Instrumental Methods of Analysis: (5th Ed.) By Willard, Merritt and Dean

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ENVIRONMENTAL SCIENCE

FIRST SEMESTER

EnS.: 106 Practicals

Chemistry:

1. Water Analysis: Determination of TDS - Total Hardness - Calcium and Magnesium Hardness - Chlorides - Sulphate (Turbidimetric Method) - Nitrate - Total Alkalinity - Conductivity Measurement.
2. Analysis of Soil: Determination of Nitrogen by Kjeldahl's Method - Organic Carbon by Chemical Oxidation Method.
3. Paper Chromatography: Separation of Amino Acids and 2nd Group Cations.
4. Determination of Ascorbic Acid by Oxidation with Iodine.
5. Preparation and Standardisation of Standard Solutions: NaOH - KMnO₄, - Iodine - Sodium Tetravalent Sulphate - K₂Cr₂O₇.
6. Estimation of Polyhydric Alcohol
7. Spectrophotometric Determination: Iron - Copper - Nitrite - Ammonia - Manganese.
8. Simultaneous Determination (Spectrophotometric) of K₂Cr₂O₇ and KMnO₄ in Mixture.
9. Flame Photometric Determination of Na, K and Ca in Water Sample.
10. Gas Chromatography: Separation and Estimation of Hydrocarbon Mixture - Separation and Estimation of Natural Gas and LPG.
11. Determination of Total Cation Content of Water Sample using Ion-Exchange Chromatography.
12. Coulometric Titration of As₂O₃: with Internally Generated Iodine.
13. Gravimetric and Volumetric Determination of Fe.
14. Potentiometric Titration.
15. Conductometric Titration.
16. pH - Meter Calibration and pH - Metric Titration.
17. Non-Aqueous Titrations (To Determine Percentage Purity of Sodium Benzoate)

Microbiology:

1. Gram Staining
2. Special Staining - Spore Staining, Capsule Staining
3. Preparation of Media - Nutrient Agar, Mc Conekey Agar, EMB Agar
4. Growth Study of E-Coli
Phases of Growth, Calculation of Generation Time.
5. To Assess Microbiological Quality of Water: MPN Technique
6. Cultural and Biochemical Studies of E-Coli and Enterobacter

Examination:

Two short, and one long exercise extending over two days :
(Each day 7 hours.)

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M.Sc. ENVIRONMENTAL SCIENCE

SECOND SEMESTER

EnS.: 201 Statistical Methods and Computer based Modeling in Environmental Sciences

1. Statistics - use of statistics in Environmental Sciences - Limitations of Statistics - Sources of Environmental Statistics
2. Data Collection - Types of Data - Organization of Data - Sampling
3. Statistical Techniques - Descriptive Statistics - Measures of Central Tendency and Dispersion Analysis with Statistical Packages
4. Statistical Methods: Probability and Distribution. Distributions, frequencies and cross-tabulations. Distributions and distribution fitting. Experimental designs. Statistical Model for Pollution (air, water, soil, waste), Air Quality Index. Introduction to remote sensing and GIS
5. Statistical Methods: Hypothesis testing, significance and correlation
Correlation: Linear models and regressions. Pearson and other correlation coefficients. Multiple regressions. Difference among means: F-test: One way ANOVA; P-test: Two way ANOVA Analysis with Computer Packages
6. Computer applications in environmental modeling
7. Computer based modeling: Linear, regression, validation and forecasting
8. Computer-based modeling for population and population studies

References:

1. Zar, Jarrold H. (1998). Bio-statistical Analysis. Prentice Hall, N., 1v,
2. Sokal, Robert and James Rohlf (1997). Biometry, Freeman Press, N.Y.—
3. Walpole, R. and R. Myers (1993). Statistics for Engineers and Scientists, 5th edn. MacMillan, N.Y. •
4. Wayne, K. OH (1995). Environmental Statistics and Data Analysis, CRC Press. .

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
M.Sc. ENVIRONMENTAL SCIENCE
SECOND SEMESTER

EnS.: 202 Water and Wastewater Management

1. Water Treatment Process:

(a) Domestic and Industrial Water:

- Demand
- General Standards for Water Quality
- Sources of Water
- Water Demand and its Fluctuations
- Water Intake Structures

(b) Necessity of Treatment:

- Water Demand Forecasting
- Conventional Treatment Plants
- Selection of Treatment Processes and Units
- Disinfections
- Theory of Treatment Plants

2. Wastewater Treatment:

(a) Domestic Wastewater:

- Sources and Characteristics
- Effluent Standards for Disposal of Wastewater
- Wastewater Generation and its Fluctuations

(b) Necessity of Wastewater Treatment:

- Conventional Treatment Plants
- Concept of Primary Treatment
- Concept of Biological Treatment
- Secondary Treatment Units
- Need of Tertiary Treatment
- Sludge Management
- Problems of Treatment Plants
- Operation and Maintenance.

References:

1. G. S. Birdie and J. S. Birdie, Dhanpal Rai and Sons 6TH Edition, 1993
2. Metcalf & Eddy & Co. Wastewater Treatment and Disposal, McGraw Hill Co. 1993
- 3.. C. S. Rao, A Textbook of Environmental Pollution and Control. Wiley Eastern Ltd., 1993
4. Indian Standards: IS 2490 (1981), IS 3300 (1965), IS 3307 (1905). IS 2488 I-IV.

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M.Sc. ENVIRONMENTAL SCIENCE

SECOND SEMESTER

EnS.: 203 Introduction to Environmental Pollution

1. Introduction: Introduction to Pollution - Factors Creating Pollution - Man's Impact on Environment - Urbanization and its effect on Environment.
2. Water Pollution: Types - Sources and Effects - Water Quality, Wastewater Disposed and its Standard.
3. Air Pollution: Sources. - Preliminary and Secondary Pollutants, Particulates and Gases - Effects on Plant - Animal and Man.
4. Land Pollution: Sources - Different Waste Disposal on Land, Treatment Methods - Effects of Land Pollution on the Under Ground Reservoirs.
5. Other Types of Pollution: Thermal Pollution - Hazardous Waste
6. Radio Active Waste - Noise Pollution - Salt Water Intrusion - Global Effects of Pollution.

References:

1. Environmental Pollution Control - C.S.Rao, Wiley Eastern Ltd., 1993
2. Air Pollution, M. N. Rao, McGraw Hill, 1993
3. Air Pollution Control & Engineering - De Nevers, McGraw Hill. 1993

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M.Sc. ENVIRONMENTAL SCIENCE

SECOND SEMESTER

EnS.: 204 Analytical Techniques

1. Method of Sampling: ISI Methods to Collect Samples of Water - Air - Solid - Preservation of Samples
2. Principles of Gravimetric Analysis: Precipitation - Digestion - Filtering - Washing - Igniting - Weighing and Calculations.
Use of Organic Reagents in Gravimetric Analysis-Dimethyl Glyoxime, 8-Hydroxy Quinoline, etc.
3. Volumetric Analysis: Preparation of Standard Solutions-Primary and Secondary' Standards-Direct and Back Titrations. (Acid-base Titrations, Complexometric Titration, Redox Titrations, Precipitation Titrations and their Applications)
4. Analysis of Water and Wastewater: Permissible Limits According to ISI & WHO - Methods of Analysis with Principle - Description of Methods and Calculations.
Determination of Parameters like Colour - pH - Taste - Odour - Hardness (Total and individual) - TDS - Suspended Solids - Alkalinity - Chloride - Fluoride - Sulphate - Ammoniacal Nitrogen - Nitrite N - Nitrate - Phosphate - Iron - Fluoride - Heavy Metals - Poisonous Metals'- Silica - Dissolved Oxygen - COD - BOD - Phenols - Gases and Greases - Total Organic Carbon (TOC) - Traces of Pesticides (Classical as well as Instrumental Methods)
5. Analysis of Air Pollutants: Techniques of Air Sampling
Determination of Particulates - CO - CO₂ - SO_x - NO_x - H₂S - O₃ - Mercaptans - Non Dispersive IR Gas Analysers. (Classical as well as Instrumental Methods)
6. Elemental Analysis: Estimation of Carbon - Hydrogen - Nitrogen - Sulphur in Organic Compounds. (Modern Elemental Analyzer)

References:

1. Quantitative Analysis (6th Ed.) - Day & Underwood, Prentice-Hall
2. Chemistry of Environmental Engineering (4th Ed.) - C. N. Sawyer and P. L. Mc Carty, Tata McGraw Hill.
3. Standard Methods for Examination of Water & Wastewater - APHA (USA) (19th Ed.) 1995.
4. "HACH" Water Analysis- Handbook by "HACH" - Instrument (USA).
5. Environmental Chemistry (3rd Ed.) - A. K. Das, New Age International (P) Ltd.
6. Official Methods of Analysis - Published by Association of Official Analytical Chemists (AOAC) USA. (16th Ed.) and Latest Edition.

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SECOND SEMESTER

EnS.: 205 Technical Communication

1. Basic of Technical Communication liOOGOO
2. Barriers to Communication
3. Technology in Communication
4. Effective Presentation
5. Group Communication
6. Effective Writing, Reading Comprehension
7. Written Communication: Letters, Memos and E-mails, Reports
8. Technical Proposals
9. Research Paper, Dissertation, Thesis
10. Instructional Manuals & Technical Description

References:

1. Technical Communication: Principle's ft. Practice - Meenakshi Raman & Sangeela Sharma 2004, 04 P. U^
2. Essentials in Technical Communication - Sunil Gokhale, 2004, Himalaya Publishing House »
3. Communication in -IT age, Dhiraj Sharma, 2004, Himalaya Publishing House ,

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SECOND SEMESTER

EnS.: 06 Practicals Chemistry :

1. Determination of COD - Conventional and Spectrophotometric Method.
2. Determination of DO - Winkler Method.
3. Determination of BOD - Conventional and Modern Method.
4. Determination of Phenols.
5. Determination of Oil and Grease.
6. Air Sampling and Determination of SO₂, CO, NO_x.
7. Determination of Trace Pesticides using GC.
8. Separation and Determination of Pesticides Mixture by HPLC.
9. Determination of TOC of Water Sample.
10. Determination of As, Pb, Hg using AAS.
11. Use of "HACH" Spectrophotometer to Determine at least 10 Parameters like NO₃⁻¹, Fe⁺³, F⁻, NO₂⁻, SiO₂, PO₄⁻³, Mn⁺².

Examination :

One long and two short Or 4 short exercises extending over 2 days (7 hours/day)

VEERNARMADSOUTH GUJARAT UNIVERSITY, SURAT

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THIRD SEMESTER

EnS.: 301 Solid & Hazardous Waste Management

1. Soil composition – organic soil constituents, inorganic soil constituents, soil reactions - soil pollution, soil degradation.
2. Definition of solid wastes - domestic solid wastes, types of domestic solid wastes, collection, transportation & characteristics, segregation, types of disposal methods, sanitary land fill, incineration, composting, vermicompost, recovery of energy from solid wastes.
3. Hazardous wastes - introduction, physical and biological of transport of hazardous substances, environmental laws, Indian scenario, special hazardous wastes, hazardous waste sources and characterization categories and control. Sampling and characterization, analysis of hazardous wastes, analytical approach for hazardous waste characterization, proximate analysis, survey analysis, directed analysis, analytical methods.
4. Hazardous waste management treatment technologies, waste recovery processes solidification, stabilization and encapsulation, biological processes, thermal processes.
5. Storage and transportation, disposal facilities, TSDK cradle to grave concepts, land disposal of wastes, landfills, underground disposal, sea disposal.
6. Waste minimization - waste recovery process, pollution prevention and recycling environmental feasibility assessment and audit waste minimization, hazardous waste remediation technologies.

References :

1. Principle of soil chemistry Kim H. Tan, second edition 1993.
2. Hazardous waste management Charles A. Wentz, Second edition 1995, McGraw Hill International.
3. Standard handbook of hazardous waste treatment and disposal Harry M. Kreeman, McGraw Hill 1997.

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M.Sc. ENVIRONMENTAL SCIENCE

THIRD SEMESTER

EnS.: 302 Air Pollution Control Technologies

1. Classification and properties-; ;>f air pollutants, emission sources, importance of anthropogenic sources, rare of air pollutants, photochemical smog, effect oi air pollution, health, vegetation and materia! damage in India. Aii pollution laws and standards, global climaticl and air pollution problems, green house gases, acid ram, slratosp-herfc ozone depletion,
2. Meteorological aspects of air pnihil ion dispersions, temperature lapse rates and stability, wind velocity and turbulence, plume behaviour of air pollutants.
3. Air pollution sampling and measurement* types of sampling and measurement, ambient air sampling, analysis of air pollutants, sulphur dioxide, nitrogen dioxide, carbon monoxide, oxidants and ozone, hydrocarbons, particulate niarua.
4. Control of sulphur dioxide emission, desulphnznation of flue gases, dry methods, wet scrubbing methods, control of NO, CO, hydrocarbons, mobile sources comparison of sound, basic principle of noise control.
5. (tmesis of vehicular emission, natural pollution, gasification ol vehicles, point sources in air, pollution from automobile, Indian scenario, population and pollution loads of vehicles, automobile, pollution control, control at sources, exhaust gas treatment devices, alternative fuel comparisons, thermal reactor, catalytic converter, automobile emission control, legal measures.
6. Air quality management, air quality assessment, conceptual frame work for air quality management, prepaiaaion of air shed discharge standards, background air quality and meirorotogieaj conditions, determination of air pollution.

References :

1. Environmental Pollution Control, C.S. Rao, Wiley Eastern Ltd., 1993
2. Air Pollution M.N. Rao, McGraw Hills 1993
3. Air Pollution Control and Engineering, DcNcvers, McGraw Hills, 1993

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THIRD SEMESTER

EnS,: 303 Industrial Waste Water Treatment

1. Magnitude of Industrial Waste Problem
Undesirable Waste Characteristics
Disposal Standards and Stream Standards for disposal of wastewater
2. Necessity of Treatment Degree of Treatment required
3. Waste volume and Strength Reduction
Neutralization, equalization and proportioning
4. Sources, types and characteristic's of industrial wastewater
Aerobic and anaerobic treatment
Activated sludge system
Waste stabilization pond
Land application of Industrial sewage and sludge management
Physio-chemical, biological and tertiary treatment methodologies
'typical applications to different process industries

References :

1. Water Supply and Sanitary Engineering, G.S. Birdie Si, J.S. Birdie, Dhanpat Rai Sons Publishers 6'1' edition 1993.
2. industrial Wastewater Treatment, M.N. Rao, A.K. Dutta, Oxford & 1BH Publishing House, 1987
3. Wastewater Treatment & Disposal by Metcalf & Eddy & Co. McGraw Hill Co. 1993
4. A Textbook of Environmental Pollution and Control Engineering by C.S. Rao Wiley Eastern Ltd., 1993
5. Indian Standards: IS: 2490 (196 Sj), IS: 3306 (1065), IS: 3307 (1965) and IS: 2488 1-1V

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THIRD SEMESTER

EnS.: 306 Laboratory / Practicals

Solid & Hazardous Waste Management;

1. Determination of calorific value for solid waste.
2. Volatile analysis of solid waste-
3. Determination of N, P, K value for solid waste
4. Ultimate analysis of solid waste
5. Determination of energy content of solid waste.

Air Pollution Control Technologies:

1. To determine the concentration of SO_x in ambient air
2. To determine the concentration of NO_x in ambient air
3. To determine the Suspended Particulate Matter in ambient air
4. To study the Stack Monitoring Kit.
5. To determine the SO_x, NO_x and SP.M in stack.
6. To measure the respirable dust in ambient air.
7. To study the Environmental Monitoring Station.
8. To determine the CO, HC emission from vehicles.

Industrial Wastewater Treatment:

1. To study manufacturing process & Chemical characteristics of
from
 - a. Petrochemical Industry
 - b. Sugar Industry
 - c. Food processing Industry
 - d. Dairy Industry
 - e. Paper & Pulp -industry
 - f. Textile Industries
 - g. Fertilizer Industries
2. To study the treatment options for above industries.

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FOURTH SEMESTER

EnS.: 401 Environmental Management, Legislation and Policy

- 1.. Fundamentals of Environmental Management and ISO 14000 series:
Background and Development of ISO 14000 series. Developed and Developing Nations and ISO 14000.
2. Preparation of Environmental Management Plans (EMS):
Environmental Management overview. Environmental Management issues and considerations. Environmental Management Systems (EMS) principles and elements and The ISO 14001 - Environmental Management Systems - standard.
6. International Environmental Laws: Evolution and Development of International Environmental laws with reference to Stockholm Conference, Nairobi Declaration, Rio Conference, Rio+5 and the Rio+10, etc.

Global Environmental Issues and International Laws: to control Global warming, Ozone depletion, Acid rains, hazardous waste, CITES etc. Role of UN authorities at protection of Global Environment, Multinational authorities and agreements, future of International laws
4. Environmental laws in India: Environmental Policy and laws. Constitutional and statutory laws at India: Doctrine Principles of State Policy, Fundamental Duties and Fundamental Rights and Panchayat Raj System.

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: The Water Act 1974. The Air Act. 1986. The Environment Protection Act 1986
Objectives of the Anti-Pollution Act. Institutional Mechanism created under these acts and role and contribution in combating environmental pollution. The role of courts.
5. National Environmental Policy and implementation
6. Current Developments

References :

1. Declaration of: The Stockholm Conference, Rio, Rio+5 and Rio+10. sh
2. Anti-Pollution Acts (3) and Commentaries published theorem.
3. Constitution of India (Referred .articles Irani Part-III, Part-IV and part-IV-A)
4. Pares Distil. Environmental Laws in India (Deep. Deep, Lated edn.)
5. P. Leelakrishnan, Environmental and the last (Bullorthworths, Latold, edn.)
6. Basic environmental technology: Jen v; A. Nathanson
7. Handbook of environmental management and technology: Gwendolyn Holtnes, Ben Ramnanne Singh, Lou; Theodore
8. The ISO 14000 Handbook: Joseph Casern
9. ISO 14004 - Environmental Management Systems: General guidelines on principles, systems and supporting techniques (ISO 14001: 1900 (E)j

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FOURTH SEMESTER

402 Environmental Health and Safety

1. Safety, Health and Environment: Perspectives and concerns, interrelationship and integrated approach, development projects and related aspects of safety and health, environment as the ultimate beneficiary / loser.
2. Safety and Health Hazards: Identification of potential safety and health hazards in industrial and development projects, reduction strategies, policies and legislation, international and national perspective, safer standards and management system., ISO 18000. Industrial health safeguards and implementation mechanisms.
3. Health and Safety Risk Management: Risk identification, allocation and mitigation strategies, responsibilities and authority, potential of health risks in industrial and development processes, local and national policies, public awareness and participation in prevention practices. Industrial environmental conditions, emissions and noise abatement.
4. Toxicology: Basic concept-, toxicology and its impacts, industrial toxicants and hazardous materials, Toxic and hazardous waste management, measurement of toxicity, TLM and lethality studies, physiological and metabolic effects on flora and fauna. Evaluation of toxicity, methods, used to assess toxicants, such as VOC and organic solvents, used in industry heavy metals such as Mg, Cl, Cu, Pb, Al, As, Zn, Mutagenic and carcinogenic compound. And cancer drugs.
5. Water and Airborne Diseases; local and widespread effects, water and airborne bacteria and viruses, human immune-system and vulnerability to these agents, and viruses, preventive and curative measures, epidemics and disaster management, biological warfare and protective measures. Safeguarding water sources and ambient air quality, disaster management.
6. Effects of Global Warming: Concepts and considerations, atmospheric gases and their impacts on ionosphere, meteorology and dispersion of atmospheric gases, greenhouse effect, polar ice caps and snow melts due to temperature fluctuations, health and hygiene considerations.
7. Human Environment and Health Status in Urban and Rural India: Water and sanitation situation in urban and rural context., historical perspective-, WHO and other agencies and their role in public health development., credit programs and their efficacy, development impacts in urban and rural sectors, psychological impacts, public awareness of sanitation and hygiene issues and role of NGOs.

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First Semester

Course No.	Course Title	Marks
Ens. 101	Fundamentals of Environmental Science	100
Ens. 102	Environmental Chemistry	100
Ens. 103	Environmental Biology	100
Ens. 104	Ecology : Principles & Scope	100
Ens. 105	Instrumental Methods of Analysis	100
Ens. 106	Laboratory / Practicals	150

Second Semester

Course No.	Course Title	Marks
Ens. 201	Statistical Methods & Computer based modeling in Environmental Sciences	100
Ens. 202	Water & Waste-Water Management	100
Ens. 203	Introduction to Environmental Pollution	100
Ens. 204	Analytical Techniques	100
Ens. 205	Technical Communication	100
Ens. 206	Laboratory / Practicals	150

Third Semester

Course No.	Course Title	Marks
Ens. 301	Solid and Hazardous Waste Management	100
Ens. 302	Air Pollution Control Technologies	100
Ens. 303	Industrial Waste Water Treatment	100
Ens. 304	Group Project	100
Ens. 305	Dissertation Preliminaries (Review of Literature, Objectives, Methodology)	100
Ens. 306	Laboratory / Practicals	150

Fourth Semester

Course No.	Course Title	Marks
Ens. 401	Environmental Management, Economics, Legislation & Policy	100
Ens. 402	Environmental Health & Safety	100
Ens. 403	Dissertation	400 (300+100)