Master of Technology (M. Tech)

Environmental Health Risk & Safety Management

SYLLABUS

Department Of Environmental Science

Faculty of Engineering & Technology, Jamia Millia Islamia
A Central University (NAAC accredited A++ grade)
New Delhi – 110025 (India)

Master of Technology (M. Tech)

(Environmental Health Risk & Safety Management)

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Faculty of Engineering & Technology
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New Delhi – 110025 (India)

2024-2025

Preface

The Department of Environmental Science was established in 2021 with great emphasis on the production of environmental scientists and managers which can utilize their expertise in the saving and managing of environmental resources of the country or worldwide. The syllabus was developed and published in printed form in 2022. The course structure and course content were developed keeping in view the current trends in environmental science education and the demands of the industry. The latest version of the syllabus is the outcome of a thorough revision of the course structure and course content with inputs from subject experts and professionals. The syllabus has been designed to provide a solid foundation in the areas of environmental engineering, environmental management and environmental health risk and safety management, keeping in view the latest developments in these core subject areas.

I wish to acknowledge the hard work put in by the faculty members in the development of the course structure and syllabus. I also wish to convey my sincere thanks to the subject experts who gave their valuable inputs in finalizing this syllabus.

Professor Sirajuddin Ahmed

Head

About the University

Jamia Millia Islamia, an institution originally established at Aligarh in United Provinces, India in 1920, became a Central University by an act of the Indian Parliament in 1988. In the Urdu language, Jamia means 'University', and Millia means 'National'.

The story of its growth from a small institution in pre-independence India to a central university located in New Delhi—offering integrated education from nursery to research in specialized areas—is a saga of dedication, conviction and vision of a people who worked against all odds and saw it growing step by step. They "built up the Jamia Millia stone by stone and sacrifice by sacrifice," said Sarojini Naidu, the nightingale of India.

Under colonial British rule, two dominant trends joined hands and contributed towards the birth of Jamia. One was the anti-colonial Islamic activism and the other was the pro-independence aspiration of the politically radical section of western educated Indian Muslim intelligentsia. In the political climate of 1920, the two trends gravitated together with Mahatma Gandhi as a catalyst. The anti-colonial activism signified by the Khilafat and the pro-independence aspirations symbolized by the non-cooperation movement of the Indian National Congress helped to harness creative energies and the subsequent making of Jamia Millia Islamia. Rabindranath Tagore called it "one of the most progressive educational institutions of India".

The prominent members of this movement were Maulana Mehmud Hasan, Maulana Mohamed Ali, Hakim Ajmal Khan, Dr. Mukhtar Ahmad Ansari, and Abdul Majid Khwaja. Hakim Ajmal Khan, Dr. Mukhtar Ahmed Ansari and Abdul MajeedKhwaja supported by Gandhiji shifted Jamia from Aligarh to Karol Bagh, in New Delhi in 1925. In 1925, after long deliberation, a group of three friends studying in Germany—Dr. Zakir Husain, Dr. Abid Husain and Dr. Mohammad Mujeeb—decided to serve Jamia. It was designated a Central University by an act of the Indian parliament in 1998.

Since then, Jamia Millia Islamia has grown tremendously by providing integrated education from nursery to research in numerous specialized fields, as well as educating students with devotion, conviction, and vision.

Currently, Jamia Millia Islamia has about 20,000 students, 800 academic members, 39 departments, and 30 centres of excellence and research. It has about 243 different courses. Jamia Millia Islamia's aims are to impart cutting-edge information and provide educational facilities for research and extension in a variety of academic areas.

It fosters education at all levels, from pre-school to PhD. Jamia's relentless pursuit of educational innovations leads to course reorganization, innovative ways of instruction and learning, and integrated personality development.

Today, Jamia Millia Islamia and Faculty of Engineering and Technology are placed third and twenty sixth in the NIRF rankings, respectively and has received an A++ grade from NAAC.

About the Program

The Department of Environmental science is the newly established department in the Faculty of Engineering & Technology. Currently the department is offering a master degree program in Environmental Sciences and Management and environmental health risk and safety management.

The objectives of this M. Tech programme in Environmental, Health Risk and Safety Management are to prepare professionals with in-depth knowledge and skills in assessing, managing and mitigating Industrial Environmental Pollution, health risks and Occupational safety and, to train students to become leaders in this field to serve industries in their efforts for sustainable development.

India is grappling with resource management issues, and industrial development including water scarcity and Pollution, Air Pollution and soil degradation

The program will provide students with a solid foundation in the managerial aspects of implementing environmental policies and technology, Occupational health and Industrial safety management systems that can move organizations toward a more sustainable and socially responsible future.

The programme also has a global significance. It will help India's commitment to addressing environmental mitigation and occupational health Risk challenges. Graduates will be trained to effectively contribute to National and International Environmental initiatives, such as climate change mitigation Net Zero emission, Environmental Audit, and industrial safety, where India plays a crucial role.

The graduate would be equipped to tackle new and evolving challenges such as Climate change, Zero discharge of liquid (ZLD), Net Zero emission, Environmental Audit, industrial safety and Occupational Health, etc.

Program Objectives

The M. Tech programme in Environmental, Health Risk and Safety Management is designed to:

1. **Develop Expertise:** Equip professionals with comprehensive knowledge and skills to assess, manage, and mitigate industrial environmental pollution, health risks, and occupational safety issues.
2. **Leadership Training:** Prepare students to become leaders in the field, driving sustainable development within industries.
3. **Promote Sustainable Practices:** Provide a solid foundation in the managerial aspects of implementing environmental policies and technologies, as well as occupational health and industrial safety management systems.
4. **Global Relevance:** Align with India's commitment to international environmental initiatives, such as climate change mitigation, net-zero emissions, and industrial safety practices.

Program Outcomes

1. Apply advanced knowledge of environmental science, health sciences, engineering principles, and safety management to identify, assess, and mitigate environmental, occupational, and industrial health risks.
2. Analyze complex environmental health and safety problems using quantitative and qualitative risk assessment tools, hazard identification techniques, and exposure assessment methods, and propose scientifically sound solutions.
3. Design, implement, and evaluate risk management and safety systems for industrial, urban, and occupational environments in compliance with national and international standards, codes, and regulations.
4. Conduct independent research and experimental investigations, including field monitoring, laboratory analysis, and data interpretation, and present findings effectively in the form of technical reports, dissertations, and professional documents.
5. Apply principles of industrial safety, fire safety, electrical safety, and process safety to prevent accidents, control hazards, and ensure safe operation of industrial and infrastructural systems.
6. Use modern tools, software, and instrumentation for environmental monitoring, health risk analysis, safety audits, and decision-making in professional practice.
7. Integrate techno-economic, legal, ethical, and sustainability considerations while planning and managing environmental health and safety projects within realistic industrial and societal constraints.
8. Demonstrate effective communication skills through clear written reports, oral presentations, and visual documentation for diverse stakeholders including industry professionals, regulators, and the public.
9. Work effectively as professionals, safety managers, consultants, or team leaders in multidisciplinary environments, contributing to organizational safety culture and societal well-being.
10. Recognize the need for lifelong learning and professional development, enabling graduates to pursue advanced research, doctoral studies, certifications, or leadership roles in environmental health, risk, and safety domains.

SEMESTER I

SEMESTER-I						
S. No.	Course Title	Course Code	Credits	Marks		
				End Sem.	Mid Sem.	Total
1	Basic of Ecology	MEHS-101	4	45	30	75
2	Eco-toxicology and Bio Safety	MEHS-102	4	45	30	75
3	Water Treatment-I	MEHS-103	4	45	30	75
4	Hazard Identification and Risk Assessment	MEHS-104	4	45	30	75
5	Air & Noise Pollution Control	MEHS-105	4	45	30	75
6	Environmental Monitoring Lab- I	MEHS-111	2	20	30	50
Total			22	245	180	425

SEMESTER II

SEMESTER-II						
S. No.	Course Title	Course Code	Credits	Marks		
				End Sem.	Mid Sem.	Total
1	Fire Prevention and Safety	MEHS-201	3	45	30	75
2	Occupational Health	MEHS-202	3	45	30	75
3	Biological Wastewater Treatment	MEHS-203	3	45	30	75
4	Electrical Audit and Safety	MEHS-204	3	45	30	75
5	Industrial Hygiene and Chemical Safety	MEHS-205	3	45	30	75
6	First Aid and Safety Lab	MEHS-211	2	20	30	50
Total			17	245	180	425

SEMESTER III

SEMESTER-III						
S. No.	Course Title	Course Code	Credits	Marks		
				End Sem.	Mid Sem.	Total
1	Elective 1	----	3	45	30	75
2	Elective 2	----	3	45	30	75
3	Industrial Training	MEHS-312	8	80	120	200
4	Project Part-I	MEHS-313	4	40	60	100
Total			18	210	240	450

SEMESTER IV

SEMESTER-IV						
S. No.	Course Title	Course Code	Credits	Marks		
				End Sem.	Mid Sem.	Total
1	Industrial Pollution Control & Management	MEHS-401	3	45	30	75
2	Elective-III	---------	3	45	30	75
4	Project Part-II	MEHS-412	12	40	60	100
Total			18	130	120	250

List of Elective Subjects

SYLLABUS

SEMESTER –I

Basics of Ecology (Credit: 4)

Unit 1

History and scope of ecology, autecology, synecology, population, community, biome, tolerance range and limiting factors. Community organization- concept of habitat, functional role and niche, keystone species, dominant species, ecotone and edge effect. Analytical characters, synthetic characters like forms, species diversity and measurement of diversity.

Unit 2

Forest and forest environment: Structure of forest ecosystem, major forest types of the world, forest types and forest cover of India Forest ecosystem function: Primary productivity of forest ecosystems, litter production and decomposition, nutrient cycling and nutrient conservation strategies. Forest management systems, joint forest management, deforestation and sustainable forestry, Ecosystem services.

Unit 3

Biodiversity and its conservation: Definition, types, importance of biodiversity and threats to biodiversity. Concept and basis of identification of 'Hotspots'; hotspots in India. Measures of biodiversity. Strategies for biodiversity conservation: in situ, ex situ and in vitro conservation. National parks, Sanctuaries, biosphere reserves, Protected areas and Sacred groves in India. IUCN Red List criteria and different categories.

Unit 4

The ecosystem concept, abiotic and biotic components. Energy input in ecosystem, standing crop, biomass, primary and secondary production, gross and net production, concept of food chain food web, ten percent law, net community production, methods of measuring productivity, pattern of primary production and biomass in the major ecosystems of the world, Energy flow, Feedback and control. Biogeochemical cycles Hydrological cycle, carbon cycle, nitrogen cycle, Sulphur cycle, phosphorus cycle, nutrient budget, man's impact on nutrient cycles.

Unit 5

Population dynamics: models for single and interacting populations, stable points, stable cycles, chaos, competition, prey-predation, life history strategies (r and K selection), etc. Ecological succession, primary and secondary processes in successions, models of successions, climax community and types of climax.

REFERENCES

1. Ramade, F. (1985). Ecology of natural resources.
2. Sharma, P. D., & Sharma, P. D. (2012). Ecology and environment. Rastogi Publications.
3. Whittaker, R. H. (1970). Communities and ecosystems. Communities and ecosystems.
4. Odum, E. P., & Barrett, G. W. (1971). Fundamentals of ecology (Vol. 3, p. 5). Philadelphia: Saunders.
5. Matlock, M. D., & Morgan, R. A. (2011). Ecological engineering design: restoring and conserving ecosystem services. John Wiley & Sons.

SEMESTER -I

Ecotoxicology and Bio-Safety (Credit: 4)

Unit 1

Introduction to Ecotoxicology; Principles of Toxicology; Types of toxic substances: in the environment (Inorganic, organic, gases, heavy metal, nano-materials, electromagnetic radiations, bio-contaminants etc.), their sources, and entry routes; Factors influencing Toxicity.

Unit 2

Transport of toxicants by air and water; Transport through the food chain: bioaccumulation and bio-magnification in the food chain; Physiological and metabolic effects on plants, humans, animals, and microbes; Response of Planktons and Photosynthetic bacteria to toxicants.

Unit 3

Toxicology of major pesticides: biotransformation, biomonitoring, programs and parameters of biomonitoring; Environmental impacts of Pesticides; Bio-absorption of heavy metals; Biochemical basis of toxicity: Mechanism of toxicity and receptor mediated events, Acute and Chronic toxicity.

Unit 4

Concepts of Bioassay: Toxicity Testing; Microbial bioassay for toxicity testing; Aquatic toxicity tests; Bioassay test models and classification; Threshold limit value: LC50, LD50; Concept of Dosimetry: lethal, sub-lethal & chronic tests, Dose response curves.

Unit 5

Toxicology & epidemiology and occupational health; water pollution caused disease; air pollution caused disease; food-borne disease; electromagnetic radiation and human health; radioactive effects; vector-transmitted disease; risk assessment. Toxicants treatment, prevention and Disposal Methods; Bioremediation of Contaminated Sites; Quantitative risk assessment.

REFERENCES

1. Crowl, D.A and Louvar, J.F. 2002. Chemical Process Safety: Fundamentals with Applications, Prentice Hall Publication Inc.
2. La Grega, M.D., Buckingham, P.L., and Evans, J.C. 1994. Hazardous Waste Management, McGraw-Hill International Editions, New York..
3. Freeman, H.W. 1989 Standard Handbook of Hazardous Waste Treatment and Disposal, McGraw Hill, New York.
4. Ira. S. Richards 2008. Principles and practices of toxicology in public health. New Central Book Agency.
5. Skeleton, B., 1997. Process Safety Analysis, Institution of Chemical Engineers, U.K.

SEMESTER –I

Water Treatment-I (Credit: 4)

Unit 1

Water quality parameters, grit removal, Screening of water, different types and arrangements of screens; Aeration: removal of emulsified and non-emulsified oil, dissolved gases, Sedimentation theory and design, different types of settling and their applications.

Unit 2

Coagulation and flocculation: basic concepts, various types of coagulants and their applications, design of flocculators; theory of filtration; Types of filters: rapid and slow sand filters and dual filters, various types of filter design.

Unit 3

Water softening methods: chemical precipitation; ion balance; Ion exchange: Ion exchange principles, cation and anion exchangers, types of resins and their suitability; Heavy metal removal.

Unit 4

Disinfection: theory of disinfection, common disinfectants, suitability of disinfectants; Chlorination: pre-chlorination, post-chlorination, super-chlorination, de-chlorination; design of disinfection facilities.

Unit 5

Advanced water treatment techniques: membrane separation techniques: micro-filtration, ultra-filtration, nano-filtration, reverse osmosis; Adsorption: types of adsorbents, applications, limitations and adsorption isotherms.

REFERENCES

1. Peavy and Row, Environmental Engineering, Tata McGraw Hills Pvt. Ltd. New Delhi, India.
2. Steel and McGhie, Water Supply, McGraw-Hill Publications.
3. Hammer and Hammer, Water Technology, Tata McGraw Hills Pvt. Ltd. New Delhi, India.
4. Kiely, G., Environmental Engineering, The McGraw Hill Co. USA.
5. Sincero and Sincero, Environmental Engineering, Tata McGraw Hills Pvt. Ltd. New Delhi, India.
6. Gilbert and Masters, Introduction to Environmental Engineering and Science, Pearsons, Education.

SEMESTER –I

Hazard Identification and Risk Assessment (Credit 4)

Unit 1

Introduction to Hazards; Definition, characteristics and different types of hazards. Evaluation of Hazards. Risk assessment: Definition, steps of risk assessment, Evaluation of risk severity, and established precautions. Basic concept of safety risk Assessment.

Unit 2

Hazards of electrical energy. Construction Industry hazard: Introduction of the Construction Industry, safety in the use of construction machinery. Working at Heights. Need for personal protection equipment (PPE). Occupational Health Hazards. Ergonomics Hazards.

Unit 3

Introduction to chemical hazards. Dangerous properties of chemicals, dust, gases and fumes. Route of entry to the human system. Biochemical action of toxic substances.

Unit 4

Industrial Hazards; Radiation: Types and effects of radiation on the human body. Disposal of radioactive waste. Noise and Vibration: Sources, and their control, Effects of noise on the auditory system and health. Fire and Other Hazards: Factors contributing to fire, general causes and classification of fire. Firefighting installations with and without water. Industrial Lighting and Illumination: Purpose of lighting. Sources and types of artificial lighting. Benefits of good illumination. The phenomenon of lightning and safety.

Unit 5

Legislation and Safety Management Systems: Factories Act, 1948; Chemical accidents (Emergency preparedness, planning and response) Rule 1986; The factories rules, History, Provisions under the factories Act and rules made there under with amendments, Bureau of Indian standards on safety and health 14489 -1998 and 15001 – 2000, OSHA, Process Safety Management (PSM) as per OSHA, PSM principles, OHSAS –18001.

REFERENCES

1. R. K. Jain and Sunil S. Rao, Industrial Safety, Health and Environment Management Systems, Khanna Publishers, New Delhi (2006).

SEMESTER –I

Air and Noise Pollution Control (Credit: 4)

Unit 1

Introduction; Definition of air Pollutants; primary and secondary pollutants; Criteria air pollutants; General nature of air pollution problem; Effects of major Pollutants on Human, Vegetation and other materials; Indian National Ambient Air Quality Standards; Indoor air pollution, Vehicular emissions and Urban air quality; air quality index.

Unit 2

Chemical composition of atmosphere; Meteorology; pressure, temperature, precipitation, humidity, mixing ratio, adiabatic lapse rate, environmental lapse rate; Stability conditions; Wind roses, Wind velocity profile; stack emissions, Stack plumes; Plume rise; Calculation of plume rise; Effective stack height. Fly ash: sources, composition and utilization.

Unit 3

Dispersion of pollutant in the atmosphere; Factors affecting the desperation phenomena; Eddy diffusion model; Gaussian dispersion equation; Reduction of Gaussian dispersion equation to ground level; C/L concentration and for line sources; Assumptions and limitations.

Unit 4

Gaseous pollutants control devices and their working principle; Absorption; Adsorption; Combustion and Condensation; SOx control and NOx control; Particulate control equipments: Gravity settling chambers, Cyclone separators, Fabric filters, Electrostatic Precipitators and Wet scrubber, Working principle, Design, Advantage, Disadvantages and limitations of equipment;

Unit 5

Noise Pollution: Sources, weighting networks, measurement of noise indices (Leq, L10, L90, L50, LDN, TNI). Noise dose and Noise Pollution standards. Noise control and abatement measures: Active and Passive methods. Vibrations and their measurements. Impact of noise and vibrations on human health. Sources of Thermal Pollution, Heat Islands, causes and consequences. Sources and impact of Marine Pollution.

REFERENCES

1. Air Pollution and Control, Crawford, McGraw Hill Series.
2. Environmental Engineering, Peavy and Rowe, McGraw Hill Series.
3. Air Pollution, Neol De Nevers, Tata McGraw Hill Pvt. Ltd. New Delhi India
4. Fundamentals of Air Pollution (Fourth Edition), Daniel A. Vallero, Science Direct.
5. Introduction to Environmental Engineering, Masters & Masters, Printice Hall.

SEMESTER -I

Environmental Monitoring Laboratory-1 (Credit: 2)

Title of Experiment

A. Basics of solution preparation and volumetric analysis

1. Standard solution preparation by titration.
2. Stock solution and serial dilution.
3. Strength of solution (Normality, molarity etc.).

B. Water and wastewater quality parameters

1. pH and Conductance.
2. Alkalinity.
3. Turbidity.
4. Hardness.
5. Dissolved oxygen (DO) and Biochemical Oxygen Demand (BOD).
6. Chemical Oxygen Demand (COD).
7. Sulphates and Chloride determination.
8. Total Kjehldal Nitrogen (TKN).
9. Coagulant dose determination by Jar Test.

REFERENCES

1. Chemistry for Environmental Sciences and Engineering, Sawyer and McCarty, Tata McGraw Hill Pvt. Ltd., New Delhi, India.
2. Wastewater Treatment, Treatment and Reuse, Metcalf and Eddy, Tata McGraw Hill Pvt. Ltd., New Delhi, India.
3. Standard Methods for Examination of Water and Wastewater, AWWA, APHA, 21st edition, USA.
4. Process Chemistry for Water and Wastewater Treatment, L.D. Benefield, Prentice Hall Inc. New Jersey, USA.
5. Instrumental Methods of Analysis (6th ed.) - HH Willard, LL Merritt, and JA Dean, CBS Publishers, New Delhi, 1986.
6. Modern Methods of Chemical Analysis - RL Recsok, LD Shields, John Wiley & sons, Inc, 1990.

SEMESTER -II

Fire Safety and Control (Credit: 3)

Unit 1

Fire Safety (7 hrs.) Chemistry of combustion, Product of flame and its characteristics, Structure of fire problems- nature of fire hazard, prescriptive and functional approach to fire safety, Fire safety objectives, fire safety design steps

Unit 2

Quantifying fire safety (7 hrs.) Burning and ignition, spread of fire, sudden massive flaming, Production and movement of smoke and toxic gases, post-flashover fire, Occurrence and growth of fire- fire starting, damage in fire, extent of fire spread, fire growth rate, fire severity

Unit 3

Fire Safety measures and modelling (10 hrs.) Performance of fire safety measures - automatic detectors, Automatic detectors, Sprinklers, passive fire protection, Fire extinguishers and ventilation systems, Introduction to fire safety modelling

Unit 4

Combustion models (8 hrs.) Basic concepts of atmospheric vapour cloud dispersion, Combustion models, ignition, blast and thermal radiation, Modelling of vapour cloud explosion, Modelling of flash fire, mechanism of BLEVE, Radiation due to BLEVE, blast effects of BLEVE and pressure vessel burst

Unit 5

Compartment Fire and material properties (8 hrs.) Thermal data for steel and concrete, material data for steel and concrete, Development of compartment fire, factors affecting growth phase, calculation of compartment temperature-time responses, Estimation of fire characteristics, fire severity and time equivalence, Factors influencing the behavior of materials under fire, Properties of materials under elevated temperature

REFERENCES

1. Introduction to Fire Dynamics, Dougal Drysdale, John Wiley & Sons, Chichester, UK.
2. SFPE Handbook of Fire Protection Engineering, Society of Fire Protection Engineers, Springer, New York, USA.
3. Fire Safety Engineering: Design of Structures, Margaret Law and Peter Newman, Butterworth-Heinemann, Oxford, UK.
4. Loss Prevention in the Process Industries (Vol. 1–3), Frank P. Lees, Butterworth-Heinemann, Oxford, UK.

SEMESTER -II

Occupational Health (Credit: 3)

Unit 1

Introduction to Occupational Health and Safety: Definition; Historical and legal context, Fundamental objectives and principles of Occupational Health and Safety, Occupational hazards and hygiene, Case studies related to Occupational hazards: global and Indian scenario.

Unit 2

Chemical Safety: Various forms of chemicals, classifications of chemicals (according to Globally Harmonized System of Classification and Labelling of Chemicals (GHS), purpose of the chemical classifications. Routes of entry to the human body, and the defense mechanisms of the human body. Risk assessment for chemicals.

Unit 3

Biological Hazards: Biological agent, various types of biological agents. Assessment of biological and control of biological agents at workplaces (hierarchy of controls). Noise: Meaning of noise, nature of sound, wave property, sound pressure and sound intensity, measuring sound (dB). Effect of sound to human (acute and chronic), noise risk assessment. Control measures according to hierarchy of controls.

Unit 4

Radiation: Meaning of radiation, types of radiation. Ionizing and non-ionizing radiations (with workplace examples). Control measures for radiations.

Unit 5

Vibration: Meaning of vibration. Effects of vibration to humans, risk assessment. Control measures according to the hierarchy of controls.

REFERENCES

1. Occupational Health Services Convention, 1985 (C161), ILO AND Recommendation, 2006 (No. 197)
2. Occupational Safety and Health Convention (C155) and Recommendation (R164).
3. Protocol of 2002 to the Occupational Safety and Health Convention, 1981 (P155).
4. Radiation Protection Convention, 1960 (No. 115) (C115) and Recommendation (R114).
5. Protection of workers against noise and vibration in the working environment, ILO Code of Practice.
6. HSG167: Biological monitoring in the workplace: A guide to its practical application to chemical exposure.

Semester II

Biological Wastewater Treatment (Credit-4)

Unit 1

Wastewater: Characteristics and Composition; Preliminary treatment systems: Screening, Grit removal and Primary sedimentation: Theory and design; Flow measurement techniques.

Unit 2

Biological treatment process: Aerobic and Anaerobic treatment systems; Basic fundamentals of aerobic and anaerobic treatment of wastewater; Reaction kinetics; Aeration principle and mechanism; Diffused and surface aerators.

Unit 3

Aerobic biological treatment systems; Suspended and attached growth systems; Activated sludge process (ASP) and its modifications; Attached growth systems; Trickling filter; Types of trickling filters: reaction kinetics, efficiency calculations and design; Bio-filters and rotating biological contactors: Working principle and design; Sequence Batch Reactor; Membrane bio reactor.

Unit 4

Anaerobic biological treatment systems: high-rate anaerobic system, suspended and attached growth systems; Up-flow anaerobic sludge blanket reactors; Anaerobic filter; Fixed Film Reactor; anaerobic baffled reactor; Anaerobic membrane bioreactor.

Unit 5

Low-cost systems: Stabilization ponds, Lagoons, Oxidation ditches; Tertiary treatment system; Sludge treatment generation and its treatment.

REFERENCES

1. Wastewater Treatment, Treatment and Reuse, Metcalf and Eddy, Tata McGraw Hill Pvt. Ltd. New Delhi India.
2. Wastewater Technology, Hammer and Hammer, Tata McGraw Hill Pvt. Ltd. New Delhi India
3. Benefield, L.D., Process Chemistry for Water and Wastewater Treatment, Prentice Hall Inc. New Jersey, USA.
4. Qasim, S.R., Treatment Plant Design, TA Publishing, USA.
5. Gilbert Master's Introduction to Environmental Engineering and Science. Tata McGraw-Hill

Semester II

Electrical Audit and Safety (credit: 3)

Unit 1

Elementary Electrical Engineering, Basics of Electricity, Electrical Power System: Overview, Quality of Electrical supply, Power Distribution System – Basics, Distribution Line equipment, Transformers, Major Substation Equipment, Operation & Maintenance Practices

Unit 2

Electrical installation, Protective relay and circuit breaker, fuses, effect of current and voltage on human beings, Earthing, Electrical shocks and prevention,

Unit 3

Preventive and protective measures: Elements of Emergency Planning, Electrical area classification, Explosion prevention and protection

Unit 4

Electrical System Protection Important Electricity Rules Related to Safety, Electrical Safety Accident Prevention & Protection

Unit 5

First Aid related to electrical accidents, Electrical disaster management, and prevention

REFERENCES

1. Basic Electrical Engineering, V. K. Mehta and Rohit Mehta, S. Chand & Company Ltd., New Delhi, India.
2. Power System Analysis and Design, J. Duncan Glover, Mulukutla S. Sarma and Thomas Overbye, Cengage Learning, Stamford, USA.
3. Electrical Power Systems Protection, C. R. Mason, McGraw-Hill, New York, USA.
4. Electrical Safety: Systems, Sustainability, and Stewardship, J. C. McDonald, CRC Press, Boca Raton, USA.
5. Handbook of Electrical Safety, Hugh Hoagland, National Fire Protection Association (NFPA), Quincy, USA.

Semester -II

Industrial Hygiene and Chemical Safety (Credit: 3)

Unit 1

Industrial Hygiene: Introduction, definition, scope, significance and applications. Occupational environmental stresses, i.e., Physical stresses – Noise, vibration, illumination, ventilation, heat stresses, Chemical stresses: Toxic chemicals, hazardous chemicals. Airborne Chemicals: Dust or aerosols (respirable and non-respirable, inhalable and total dust), gases, fumes, vapours, mist and smoke. Concept of threshold limiting values(concentration), TLVs, time weighted averages (TWAs), short term exposure limits (STELs), minimal national standards (MINAS), International and national regulatory agencies like ACGIH, OSHA.

Unit 2

Industrial Work Environment: Monitoring of Work Environment: Identification of contaminants. Sampling strategies: monitoring methods/protocol on procedures. Sampling of airborne contaminants, viz dust, gases, fumes, vapours, mists, etc., in the workplace environment and analysis methods for quantification – Instrumental and manual methods.

Unit 3

Notifiable Diseases: Pneumoconiosis, Silicosis, Asbestosis, Bagassosis, Byssiniosis. Work environment control measures: substitution, isolation, ventilation, local exhaust systems, and engineering controls. Housekeeping and maintenance. Modification of the processes and operations. Process and product-specific control measures.

Unit 4

Safety: Precautions in the processes and operations involving explosives, flammables, toxic substances, dusts, vapours, cloud formation and combating. Safety precautions for transportation for hazardous chemicals. Safety audit in the chemical industry. Accidents and unusual occurrences reporting. Respiratory personal protective equipment (RPPE)& non-respiratory personal protective equipment (NRPPE): head protection, ear protection, face and eye protection, hand protection, foot protection and body protection. Quality control of protective equipment.

REFERENCES

1. Industrial Hygiene & Chemical Safety - M.H.Fulekar: I. K.International Publishing House, New Delhi.
2. Industrial Hygiene Reference And Study Guide- Allan K. Fleeger, Dean Lillquist, AIHA, 01-May-2006.
3. Personal Protective Equipment -Guide to Ports/Dock Workers - M.H.Fulekar : Government of India's Publication.
4. Fundamentals of Industrial Hygiene-Barbara A. Plog, Patricia J. Quinlan, National Safety Council Press, 2002.
5. Occupational safety management and engineering, Willie Hammer, Dennis Price, Prentice Hall, 2001.

Semester -II

First Aid and Safety Lab (Credit: 2)

1. Cardiopulmonary Resuscitation (CPR) Technique.
2. First aid for a heart attack
3. First Aid after Burn Injury
4. First Aid after Fracture.
5. Vital parameters (BP, Pulse, Blood Sugar, Temperature, Saturation)
6. First Aid after Stroke
7. First Aid after Electrocution
8. Emergency Bandage/Dressing

Semester III

Elective Papers

S. No.	Name	Credit
1	Fundament and Sustainability Concepts	3
2	Non-conventional energy Resources	3
3	Climate Change Science	3
4	Waste to Energy Conversion	3
5	Introduction to Environmental Economics	3
6	Management, Safety, and Risk Analytics	3
7	Environmental Remediation of Contaminated Health	3
8	Environmental Impact Assessment	3
9	Safety Risk Analytics	3
10	Food Microbiology for Safe and Sustainable Food Systems	2

Semester III

Industrial Training (Credit: 8)

Students shall be fully aware of various processes involved in industries and research institutes, as well as universities related to environmental issues, and have hands-on exposure to data analysis

Semester III

Project Part - I (Credit: 4)

1. The purpose of field/industrial training is to familiarize students with the practical functioning of environmental health and safety systems in industrial and organizational settings. The training emphasizes on-site observation of workplace conditions, safety practices, statutory compliance, and emergency preparedness, enabling students to understand how environmental health and risk control measures are implemented in real operations.
2. Students are encouraged to observe and document occupational health hazards, safety practices, and environmental control measures across different industrial sectors. The training helps students develop the ability to identify gaps in existing safety and risk management practices, understand regulatory requirements, and appreciate the role of environmental health and safety professionals in preventing accidents, protecting worker health, and ensuring sustainable industrial operations.

SEMESTER IV

Industrial Pollution Control and Management (Credit: 3)

Unit 1

Characteristics and composition of different industrial waste; Sampling; Preservation and analysis techniques; Standards for waste disposal.

Unit 2

General methods of treatment of industrial effluent; Nutrient and its role in the treatment; Pre-treatment of effluent waste volume and strength reduction; Equalization and proportioning of wastes; Neutralization of wastes; Oil removal and floatation; Electrophoresis and its application in effluent treatment.

Unit 3

Sources of pollution generation: its characteristics and treatment scheme for high strength organic effluent industries such as textiles, dairy, sugar, brewery, distillery pulp and paper, textile and dying etc.

Unit 4

Sources of pollution generation, its characteristics and treatment scheme for chemical industries, such as fertilizer, tanning, iron and steel, metal finishing and thermal power plant, petrochemical.

Unit 5

Resource recovery from solid waste: its minimization, reuse and recycle; Case Study and development of industry; Specific Environmental Management Plan.

REFERENCES

1. Industrial Pollution Control, Numero Nelson, Tata McGraw Hill Pvt. Ltd., New Delhi, India.
2. Wastewater Treatment, Treatment and Reuse, Metcalf and Eddy, Tata McGraw Hill Pvt. Ltd. New Delhi India.
3. Industrial Pollution Control, Eckenfelder, Tata McGraw Hill Series.
4. Wastewater Treatment by M.N. Rao and A.K.Datta, Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
5. Design of municipal Wastewater Treatment Plants, WEF Manual of Practice No. 8, Vol.1, McGraw Hill Series, New York.

Semester IV

Elective papers (Credit: 3)

S.No.	Name	Credit
1	Industrial Safety Engineering	3
2	System design for Sustainability	3
3	Mine Closure and Sustainability Planning	3
4	Indoor Air Pollution: Sources, effects, Monitoring, Control and Modelling	3
5	Wastewater Treatment and Recycling	3
6	Ground Water Engineering	3
7	Availability and Management of Ground Water Resources	3
8	Water Society and Sustainability	3
9	Constitution of India and Environmental Governance: Administrative and Adjudication Process	3
10	Carbon Accounting and Sustainable Designs in Product Lifecycle Management	3
11	Environmental Modeling and Simulation	3
12	Hydrogen Energy: Production, Storage, Transportation and Safety	3
13	Environment and Development	3

Semester IV

Project Part - II (Credit: 12)

1. The purpose of Project II is to provide students with exposure to the fundamentals of data analysis, risk assessment, and interpretation of results, with emphasis on research related to environmental health hazards, occupational risks, industrial safety systems, and municipal or industrial operations. The project offers hands-on experience in developing risk mitigation strategies, safety management plans, and environmental health management frameworks for real-world scenarios.
2. Students are encouraged to critically evaluate environmental and occupational health problems through experimental, analytical, and field-based approaches, focusing on air, water, soil, workplace environments, and human exposure pathways, and to assess associated health, safety, and environmental risks using appropriate tools and methodologies.