## Course Outline M.Sc. Environmental Engineering (2025 & Onwards)

| Code | Title | Existing Outline |
|---|---|---|
| **Core Courses** | | |
| Env-E-501 | Environmental Management & Impact Assessment | Environment and Environmental Issues, Environmental Organizations, Legislations, Standards ISO-14000 and NEQS, Concept of Pollution Charges, Components for Environmental Assessment, Screening, Scoping, Baseline Study, Prediction and Evaluation, Mitigation, Monitoring and Auditing, Environmental Impact Methodology, Environmental Impact Statements, Concepts of Sustainable Development, Risk Analysis, Strategic Environmental Assessment (SEA). |
| Env-E-502 | Physicochemical Processes in Environmental Systems | Water treatment: Objectives, water related diseases, sources and characteristics; Application of stochiometric models and chemical equilibria in treatment systems; Reaction kinetics: Types of chemical reactions. Rate of reactions, reactor design, mass transfer models of CSTR and plug flow reactors; Coagulation: Principle, types of coagulants, stability of colloidal matter, mechanisms for coagulation, chemistry, kinetics and design of coagulation systems; Flocculation: Types, chemistry kinetics and design of flocculation systems; Sedimentation: Types and sedimentation basins, design of sedimentation basins; Floatation systems; Filtration: Theory, types, slow sand filtration, rapid sand filtration, Ion exchange, mechanisms of water filtration, transport and attachment step, designing of water filtration systems; Disinfection: Types of disinfectants and their principles, design of disinfection systems; Adsorption: Types of adsorbents, principles and application in the industry, kinetics of adsorption and adsorption isotherms; Ion exchange and demineralization: Process and mechanism of Softening and demineralization systems; Membrane processes: Electro-Dialysis, Reverse Osmosis and other membrane systems; Sludge Management: handling, treatment and disposal of water treatment sludges. |
| Env-E-503 | Wastewater Treatment and Design | Need of wastewater treatment. Parameters for wastewater treatment technology selection. Wastewater characterization, flow measurement, equalization and pH adjustment. Design of primary treatment (screens, grit chamber and primary sedimentation tank). Principles of Biological and Natural Treatment Processes. Design of secondary treatment (activated sludge process, trickling filters, wastewater stabilization ponds, aerated lagoons, membrane bioreactors, sequencing batch reactors, upflow anerobic sludge blanket). Sludge handling and treatment. Household level wastewater treatment and disposal. |
| Env-E-504 | Experimental Methods in Environmental Engineering | Principles of Chemical, physical and microbial analysis of environmental pollutants. Instrumental techniques based on principle and working i.e., UV Visible Spectroscopy, Infra-Red Spectroscopy, Chromatography and its types, Atomic Absorption Spectroscopy, Mass Spectrometry; sampling procedure for examination of water, wastewater, air and solid waste. laboratory and field monitoring of parameters of importance causing environmental problems. assessment and interpretation of results using statistical tools. |
| Env-E-504L | Experimental Methods in Environmental Engineering | 1. Effect of Alum dose on removal of hardness<br>2. Effect of initial concentration on the removal of hardness<br>3. Effect of dose on removal of turbidity<br>4. Effect of initial concentration on removal of turbidity<br>5. Effect of dose on the removal of metals<br>6. Effect of initial concentration on the removal of metals<br>7. Estimation Lambda Max.<br>8. Verification of Beer Lamber Law<br>9. Estimation of BOD of wastewater sample<br>10. Estimation of COD of wastewater sample |

| Code | Title | Existing Outline |
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| | | 11. Estimation of total kjaldhal nitrogen.<br>12. Estimation of coliform and fecal coliform. |
| Env-E-505 | Industrial and Hazardous Waste Management | Introduction to Industrial Waste Management: Sources of Industrial wastes, types (Liquid waste, Solid waste, Air emissions) and characteristics (Physical, chemical and Biological) of Industrial wastes.<br>Environmental Standards and Regulatory loading limits of Industrial waste, Industrial Waste Survey, Development of material flow diagram of industrial processes. Estimation of Oxygen demanding waste.<br>Introduction to Industrial waste reduction and reuse techniques: Industrial waste minimization and management, Waste Audits, hazardous waste characteristics and treatment, General industrial waste treatment techniques (Preliminary techniques for SMEs, Standard techniques for large industries.<br>Hazardous and Clinical Waste Management: types, sources and general removal protocols.<br>Noise Management and Air pollution control techniques. |
| Env-E-509 | Air and Noise Pollution Control | Introduction, Sources, Classification and Effects of Air Pollutants. Sampling and Monitoring Techniques. Indoor & Outdoor (Industrial and Vehicular Emissions) Air Quality Assessment. Dispersion Model; Air Pollution Control Techniques, Air Pollution Laws and Regulations. Noise Pollution, Characteristics, Sources, their Effects and Control Measures. Introduction, Sources and Impacts of Global Warming. |
| Env-E-516 | Municipal Solid Waste Principles and Management | Generation Sources, Classifications, Characteristics, Onsite Handling and Storage, Collection, Transfer, Recycling & Disposal Techniques of Municipal Solid Waste. Landfilling, Site Selection, Investigation & Design, Thermal Conversion, Composting, Concepts of Integrated Solid Waste Management, Existing Practices & their Hazards. Economic Evaluation of the systems. |
| Env-E-517 | Research Methodology | Introduction to Research, Nature of Research, Purpose of Research, Ethics in Research. Types of Research, Tools of Research, Scientific Methods, Techniques & Pre-requisites for Scientific Research. Types of Questions, Types of Relationships, Variables, Hypothesis, Types of Data, Starting a Research Project/Research Proposal, Research Project. Conceptualization, Elements of a Research Proposal. Critical Thinking and Developing the Research Question, Defining the Research Problem; Choosing the Research topics. Research Proposal: its importance - A pre-requisite for Research, Research Proposal Writing Techniques. Research Design: Importance of Research Design, Formulation of Research Design Reliability, validity, generalization, Experimental design and use of indicators in research, Tradeoffs in design decisions.<br>Sampling Design; Introduction to sampling design, Logic of Sampling; Concepts and Terminologies, Types of Sampling Designs (Classifying experimental design, factorial design, randomized block design, covariance design, Quasi experimental design) Relationship among pre post design. Advances in Quasi Experimentation. Survey of Research, Questionnaires construction. How to put things together? Introduction, Objectives, Material and Method, Review of Literature, Bibliography, Literature Search: Database, Search Engines; Analytical tools in research: qualitative and quantitative methods; Evaluation Research: How to carry out evaluation research, Data Collection: Techniques in data collection: Quantitative & Qualitative Data, Experimental Research, Case Studies, Surveys, Interviews, Questionnaire.<br>Data Analysis: Conclusion, Validity Statistical analyses, Descriptive Statistics (Correlations) Inferential Statistics, Univariate Analysis, Bivariate Analysis, Multivariate Analysis (T-Test, generalized linear model, Factorial design, |

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<tr><th>Code</th><th>Title</th><th colspan="4">Existing Outline</th></tr>
<tr><td></td><td></td><td colspan="4">randomized block analysis, Analysis of covariance, Regression Analysis), Data Interpretation, Current data interpretation with comparative studies (Inter-laboratory comparison), Inference based on findings; Research Presentation Techniques – Data presentation.</td></tr>
<tr><td>Env-E-521</td><td>Water Supply and Wastewater Collection System</td><td colspan="4">Water supply: Estimates of water demand of a community. Water consumption, factors affecting water consumption, variation in water consumption. Fire demand. Design period. Methods for estimation of design population. Design flows for various water supply components. Drinking water quality and human health. Water quality guidelines and standards. Water sources. Initial investigation for selecting water source. Design and construction of tube wells. Water collection systems for surface water sources. Hydraulics of pressurized flows/distribution systems. Design of transmission systems. Layouts, design and analysis of water distribution system. Overhead reservoirs, their function, location and capacity. Various types of pipes and valves. Water-quality aspects of construction and operation. Construction, testing and commissioning of distribution systems.<br>Wastewater collection: Sources of wastewater. Estimation of sanitary sewage and storm water runoff. Formulation of Intensity duration frequency relationships. Types of sewer systems. Design criteria. Layout and hydraulic design of sanitary sewers. Design of drainage and storm sewers. Sewer materials, strength, load on sewers and bedding. Design of sewage pumping station. Sewer appurtenances and installation.</td></tr>
<tr><td>Env-E-523</td><td>Water Quality Modeling</td><td colspan="4">Basic concept of modeling; Hydrological considerations in water quality modeling; Low flow frequency analysis; Sources of pollution and types of wastes; Point and non-point sources; General mathematical formulation of water quality models for streams and rivers, Biochemical oxygen demand BOD, Dissolved oxygen (DO), Bacterial decay and nitrification; Stream surveys for Model calibration and verification; Application of river models for water quality management; Steady state lake models for DO, thermal stratification in lakes and water quality modeling in stratified lakes, pollutant loading analysis in lakes, Eutrophication and water quality; Types of Estuaries, Estuarine water quality models; Ocean outfalls, mathematical models of wastewater dispersion in Oceans.</td></tr>
<tr><td>IS-615L</td><td>Fehm-e-Quran/Social Ethics-I</td><td></td><td>Weeks</td><td>Assignments/ Home Task</td><td>Linguistic Rules</td></tr>
<tr><td></td><td></td><td></td><td>1</td><td>Writing the meaning of Quranic words Lesson 1-8</td><td>Proper Noun Masculine & Feminine</td></tr>
<tr><td></td><td></td><td></td><td></td><td>Writing the meaning of Quranic words 9-14</td><td>Two kinds of plural Concept of (و) "And" Common Noun</td></tr>
<tr><td></td><td></td><td></td><td>2</td><td>Writing the meaning of Quranic words, phrases & translation of Sentences 15-17</td><td>Demonstrative Noun (This & That for Masculine هذه مناء Demonstrative Noun (This & That for Feminine) ذلك تلك)</td></tr>
<tr><td></td><td></td><td></td><td></td><td>Writing the meaning of Quranic words,</td><td>Laam for emphasis (لام التأكيد Superlative Degree like أكبر</td></tr>
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| Code | Title | Existing Outline | | | |
|---|---|---|---|---|---|
| | | | | phrases & translation of Sentences 17-19 **Quiz** | Revision of all Quranic Sentences |
| | | | 3 | Writing the meaning of Quranic words, phrases & translation of Sentences 1-3 | Emphatic Particle ان Preposition For" )اللام( Preposition )في( |
| | | | | Writing the meaning of Quranic words, phrases & translation of Sentences 4-6 | Preposition )على من إلى( |
| | | | 4 | Writing the meaning of Quranic words & translation of Sentences 7-9 | Preposition )الباء( Absolute Negation Particle Exceptive Particle) (للجنس ) (ما الثانية) (إلا اعية | |
| | | | | Writing the meaning of Quranic words, phrases & translation of Sentences 10-13 **Quiz** | Subordinating Conjunction(as) Vocative Particle )حرف النداء |
| | | | 5 | Writing the meaning of Quranic phrases 1-2 | Quranic Adjective Compounds (صفة وموصوف ) |
| | | | | Writing the meaning of Quranic phrases & translation of sentences 3-5 | Quranic Possessive Construction (مضاف ومضاف إليه |
| | | | 6 | Writing the meaning of Quranic phrase translation of sentences 6-7 | Quranic Possessive Construction (مضاف ومضاف إليه ) |
| | | | | Writing the meaning of Quranic phrase & translation of sentences 8-10 **Quiz** | Active Participle اسم الفاعل Passive Participle اسم المفعول( Dual )مثنى( |

| Code | Title | Existing Outline | | | |
|---|---|---|---|---|---|
| | | | 7 | Writing the meaning of Quranic phrase & translation of sentences 1-2 | Personal Pronoun He المنفصل<br>Possessive Pronoun His المتصل |
| | | | | Writing the meaning of Quranic phrase & translation of sentences 3-4 | Possessive Pronoun with prepositions<br>like Pronoun "His" with prepositions like في بيته له، منه، فيه |
| | | | 8 | Writing the meaning of Quranic sentences 5-8 | Personal Pronoun You انت المنفصل<br>Possessive Pronoun Your المتصل<br>Possessive Pronoun with prepositions like في بيتك<br>Pronoun "your" with prepositions like لك، منك، فيك |
| | | | | | |
| | | | 9 | Writing the meaning of Quranic phrases & sentences 9-12 | Personal Pronoun She) هي المنفصل<br>Possessive Pronoun Her ها المتصل<br>Possessive Pronoun with prepositions like في بيتها Pronoun "Her" with prepositions like لهاء |
| | | | | Writing the meaning of Quranic phrases & sentences 13-16 | Personal Pronoun 1 ) أنا المنفصل<br>Possessive Pronoun Her المتصل<br>Possessive Pronoun with prepositions like في بيتي Pronoun "My" with prepositions like لي |
| | | | 10 | Revision of all Quranic sentences of Unit 4 **Quiz** | Adverb )ح( |
| | | | | Writing the meaning of Quranic phrases & sentences 1-2 | Masculine Plural جمع المذكر السالم و<br>جمع المذكر السالم المسبوق بحرف الجر |
| | | | 11 | Writing the meaning of Quranic phrases & sentences 3-4 | Possessive Construction with Plurals جمع المذكر السالم المسبوق بالإضافة |
| | | | | Writing the meaning of Quranic phrases, sentences & verses. 5-6 | Personal Pronoun They المنفصل<br>Possessive Pronoun Their هم المتصل |

| Code | Title | Existing Outline | | |
|---|---|---|---|---|
| | | 12 | Writing the meaning of Quranic phrases, sentences & verses 7-8 | Possessive Pronoun with prepositions like في بيتهم Pronoun "Their" with prepositions likeلهم |
| | | | Writing the meaning of Quranic phrases, sentences & verses. 9-11 | Personal Pronoun You ( أنتم المنفصل<br>Possessive Pronoun Your كم المتصل<br>Possessive Pronoun with prepositions like في بيتكم |
| | | 13 | Writing the meaning of Quranic phrases & sentences & verses 12-14 | Pronoun "Your" with prepositions like لكم Personal Pronoun We) نحن المنفصل<br>Possessive Pronoun Our نا المتصل |
| | | | Writing the meaning of Quranic sentences & verses 15-16 | Possessive Pronoun with prepositions في بيتنا like Pronoun "Our" with prepositions likeلنا |
| | | 14 | Writing the meaning of Quranic sentences & Verses 17-18 | Demonstrative Pronoun These, Those ) هؤلاء أولئك |
| | | | Writing the meaning of Quranic sentences & Verses 19-23 | ما / إلا إن / إلا إنما، ليس ما ، ( أم أن يل، كان( ) ألا، أليس، اليوم، يومئذ، سبحان ما بينهما، قل، إذن، بنس، نعم، كلا ما أدراك، حسب أعلم ب، (مصير مرجع دينا (تمييز |
| | | 15 | **Quiz** | |
| | | | Writing the meaning of Quranic Verbs &Translation of Quranic Sentences & Verses (1-3) | Introduction of Present ( فعل مضارع Tense Verbal Sentence ( جملة فعلية<br>Present Tense الفعل المضارع صيغة المفرد يعلم |
| | | 16 | Translation of Quranic Sentences & Verses 3-5 | Present Tense الفعل المضارع صيغة المفرد يعلم |
| | | | Translation of Quranic Sentences & Verses | Present Tense<br>الفعل المضارع صيغة الجمع يعلمون |
| **IS-616L** | **Fehm-e-Quran/Social Ethics-II** | Weeks | Assignments/ Home Task | |

| Code | Title | Existing Outline | | | |
|---|---|---|---|---|---|
| | | | 1 | Understanding & Translation of Verses | Present Tense<br>صيغة جمع مذكر غائب مثل يعبدون |
| | | | | Understanding & Translation of Verses | Present Tense<br>صيغة جمع مذكر غائب مثل يعبدون |
| | | | 2 | Understanding & Translation of Verses | Present Tense<br>صيغة مفرد مذكر مخاطب (تعبد) وجمع مذكر مخاطب ( تعبدون) |
| | | | | Understanding & Translation of Verses | Present Tense<br>صيغة جمع مذكر مخاطب ( تعبدون)<br>صيغة المتكلم (أعبد) |
| | | | 3 | Understanding & Translation of Verses | Present Tense<br>صيغة جمع المتكلم (نعيد) |
| | | | | Understanding & Translation of Verses | Negative Imperative<br>صيغة المفرد وصيغة الجمع لا تعبد لا تعبدوا |
| | | | 4 | Understanding & Translation of Verses | Conditional Sentences & masdar moawal مووﻻ (مصدر)) |
| | | | | Understanding & Translation of Verses | Laam uttaleel (لام التعليل)Laam ul jhood (لام الجحود |
| | | | 5 | Understanding & Translation of Verses | Present with object pronouns & Passive Voice |
| | | | | **Quiz** | |
| | | | 6 | Understanding & Translation of Verses | Past Tense<br>صيغة المفرد الغائب |
| | | | | Understanding & Translation of Verses | Past Tense<br>صيغة المفرد الغائب |

| Code | Title | Existing Outline | | | |
|---|---|---|---|---|---|
| | | | 7 | Understanding & Translation of Verses | Past Tense<br>صيغة المفرد الغائب |
| | | | | Understanding & Translation of Verses | Past Tense<br>صيغة المفرد الغائب |
| | | | 8 | Understanding & Translation of Verses **Quiz** | Past Tense<br>صيغة المفرد الغائب |
| | | | 9 | Understanding & Translation of Verses | Past Tense<br>صيغة الجمع للغائب عبدوا |
| | | | | Understanding & Translation of Verses | Past Tense<br>صيغة الجمع للغائب عبدوا |
| | | | 10 | Understanding & Translation of Verses | Past Tense<br>صيغة الجمع للغائب عبدوا |
| | | | | Understanding & Translation of Verses | Past Tense<br>صيغة الجمع للغائب عبدوا |
| | | | 11 | Understanding & Translation of Verses | Past Tense<br>صيغة الجمع للمتكلم عبدنا |
| | | | | Understanding & Translation of Verses | Past Tense<br>صيغة الجمع للمتكلم عبدنا |
| | | | 12 | Understanding & Translation of Verses | Past Tense<br>صيغة الجمع للمتكلم عبدنا |
| | | | | Understanding & Translation of Verses | Past Tense<br>صيغة الجمع للمتكلم عبدنا |
| | | | 13 | Understanding & Translation of Verses | Past Tense<br>صيغه الجمع للمخاطب عبدتم |
| | | | | Understanding & Translation of Verses | Past Tense<br>صيغه الجمع للمخاطب عبدتم |

| Code | Title | Existing Outline | | |
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| | | 14 | Understanding & Translation of Verses | Past Tense<br>صيغه المتكلم والمخاطب عبدتُ عبدتَ |
| | | | Understanding & Translation of Verses **Quiz** | Past Tense<br>صيغة المؤنث للغائب عبدت |
| | | 15 | Understanding & Translation of Verses | Passive Voice (Past Tense)<br>فعل مجهول للمفرد |
| | | | Understanding & Translation of Verses | Passive Voice (Past Tense)<br>فعل مجهول الجمع |
| | | 16 | Understanding & Translation of Verses | Imperative Verb for singular<br>فعل الأمر للمفرد |
| | | | Understanding & Translation of Verses | Imperative Verb for plural<br>فعل الأمر للجمع |
| | | **Final Term** | | |
| **Elective Courses** | | | | |
| Env-E-513 | Marine Pollution and Control | Effects of pollution discharges, oil spills, coastal development, beach erosion, channel dredging and changing sea level on marine environment and control measures. Modeling for pollution dispersion/ Study of marine biology (organism, fisheries and mangroves), coastal-geology and estuarine ecology, Marine resources management and pollution control. Sea water intrusion and its control. | | |
| Env-E-515 | Agricultural Pollution and Control | Environmental issues in agriculture, Types of farming systems, agrometeorology, water and nutrients requirement. Types of fertilizers, pesticides, other agrochemicals. Water logging and salinity. Causes, effects, management and control of agricultural pollutants and issues. Soil and water conservation practices. Wastewater reuse in agriculture, management and control of agricultural waste, its recycling and reuse. | | |
| Env-E-518 | Environmental and Occupational Health and Safety | Principles of public health; Introduction and basic concept of environment related health problems; Public health issues; Communicable and non-communicable diseases; Water borne, air borne, food borne and sanitation related diseases and control measures.<br>Occupational health; Human exposure and health impact prevention and control; Industrial pollution and safety plans.<br>Accident prevention procedures, safety principles and practices; Standards of occupational health and safety; Occupational health and safety in Pakistan; Industrial and occupational rules and regulations in Pakistan.<br>Industrial hygiene and safety; Accident prevention and elimination plans; Fire protection techniques; Safety equipment. Spillage Protection Techniques, Personnel Protective Equipment. | | |

| Code | Title | Existing Outline |
|---|---|---|
| Env-E-519 | Ecological Risk Assessment and Management | Introduction, Principles and Concepts of Ecology and Eco-system. Energy in Eco-system. Biogeochemical Cycles. Principles pertaining to limiting factors. Principles and Concepts at the Community and population levels Models in Ecology. Fresh Water Ecology, Marine Ecology, Estuarine Ecology, Terrestrial Ecology. Concept and principles in Sustainable Development and Biodiversity; Introduction and components of Ecological Risk Assessment, Predictive Risk, Assessment, Case studies. |
| **Env-E-520** | Remote Sensing and GIS Applications in Environmental Systems | Introduction and Overview of GIS, Data Types and Data Models/structures, Raster Data Models, Vector Data Models, Conversion Between Raster and Vector Data Models , ArcGIS supported data formats d. File Geodatabase and tables, Earth Mode: Representing the Earth, Map Projections, Geographic and projected coordinate systems, Visualization of Spatial data and Basics of Cartography, Spatial Data Queries and Analysis, GIS Modeling and Modeling Tools, Introduction to Global Positioning System (GPS), Spatial Analysis, Network analysis, 3D analysis, Data Acquisition, Digital Image processing, Image interpretations for environmental systems, Application of GIS and remote sensing for determining peak runoff, groundwater pollution vulnerability, solid waste management, air pollution assessment and management, water supply and sanitation, and environmental impact assessment. |
| Env-E-522 | Environmental Chemistry and Microbiology | Physical and Chemical Properties of Water, Wastewater, Air and Soil. Acid-Base Equilibrium, Chemical Kinetics, Oxidation-Reduction and Solubility Reactions. Mechanism of Coagulation, Adsorption, Disinfections, Persistent Organic Pollutant (POPs). Biochemistry. Advanced oxidation processes, chemical reactions taking place in air.<br>Basic Classification, Nomenclature, Morphology, Physiology and Growth Mechanisms of Microbes: Energetic and Interaction among Biological population, Influence of Environmental Factors on Growth and Distribution of Microbes, Concept of Biotechnology as Applied to the Pollution Control and Waste Conversion. |
| Env-E-524 | Modeling of Environmental Systems | Basic concepts and definitions; Environmental systems modeling, objectives and choices; Sensitivity analysis and sources of error; Introduction to numerical methods; Reaction types and orders of reactions; Conservation of mass, energy and momentum; River/stream quality; Development of models; Water quality models of rivers, lakes, reservoirs, estuaries; Contaminants transport models for groundwater and soil; Air pollution dispersion modeling; Noise pollution models in urban centers; Environmental planning models. |
| EnS-552 | Climate Change Adaptation & Mitigation | Introduction, types and their climatic effects, Global Warming, causes, effects and control.<br>Climate Change and Wetlands: impacts, adaptation.<br>Basic understanding of the physical science of climate change, climate change impacts and the human response to climate change.<br>Adaptation to climate change, natural and anthropogenic drivers and direct observations of recent climate change. Potential adaptation strategies in different sectors. Climate change mitigation strategies, Carbon sequestration, Transition to carbon neutral energy sources, Geo-engineering as well as measures to increase energy efficiency.<br>Climate change policy and social change, international climate change negotiations, regulatory instruments, voluntary agreements and social change. Climate change and food production, climate change and its effects on Pakistan's water resources. |

| Code | Title | Existing Outline |
|---|---|---|
| EnS-553 | Strategic Environmental Assessment | Environmental Assessment Introduction and concepts, methods and tools for EA<br>Strategic Environmental Assessment: Key concepts.<br>SEA legislation and process, regulatory and planning framework of SEA and Implementation<br>SEA Tools and Techniques.<br>SEA case studies: examples from a wide spectrum of sectors<br>SEA case studies for Water and SEA case studies for Waste.<br>Future directions: Cumulative impact assessment, Sustainability assessment. |
| EnS-558 | Environmental Risk Assessment and Management | Environmental risk assessment and management; the what's, whys and how's a historical perspective: Risk assessment to human health, Risk assessment to ecological systems. Evaluation of the likelihood of, major accidents in different sectors,<br><br>Hazard identification, dose and exposure assessment, risk quantification,<br>Epidemiology and environmental risk assessment.<br>Risk assessment in legislation: Application of risk assessment in policy and legislation in developed and developing countries.<br>Balancing risks with other considerations: The psychology of risk and uncertainty, the economics of risk. Valuing risks. Natural hazards, risk analysis and risk management.<br>Risk management: Principles, approaches and concepts: Corporate management; a risk based approach.<br>Environmental risk assessment in business.<br>Risk assessment and management for water treatment and disposal.<br>Environmental risk assessment in development programs, the experience of World Bank.<br>Risk communication.<br>A framework for sustainable product development. |
| EnS-562 | Remediation Strategies for Contaminated Environment | Environmental remediation; Factors affecting remediation efficiency;<br>Evaluating speciation and contaminant availability in polluted environment; Factors affecting contaminant degradation;<br>Remediation strategies: Natural attenuation, Bioremediation and Phytoremediation, Conventional methods, Physical techniques, Chemical Oxidation and other chemical treatments, Photocatalytic processes, Electrochemical techniques, chemical and biological sorption, Integrated approaches for remediation,<br>Application of Nanomaterials; Social and economic aspects of remediation. |
| EnS-564 | Environmental Application of Nanomaterials | Introduction to nanomaterials; Application of nanomaterials in: remediation of polluted soil and water, Nano catalysts and their application in environmental science, pollutant sensing and detection, filtration membranes, green chemistry; Nanomaterials as adsorbents; Nanomaterials for groundwater remediation; Use of nanomaterials as antimicrobial agents;<br>Renewable energy and nanotechnology; Eco-toxicological risks associated with nanomaterials; Future challenges in nanotechnology. |