# ICTQual AB

## Qualification Specification

# Level 4 Diploma in Environmental Engineering 120 Credits – One Year


**Website**
www.ictqualab.co.uk

**Email:**
Support@ictqualab.co.uk

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## Contents

# Qualification Specifications about

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## About ICTQual AB

ICTQual AB UK Ltd. is a distinguished awarding body based in the United Kingdom, dedicated to fostering excellence in education, training, and skills development. Committed to global standards, ICTQual AB provides internationally recognized qualifications that empower individuals and organizations to thrive in an increasingly competitive world. Their offerings span diverse industries, including technical fields, health and safety, management, and more, ensuring relevance and adaptability to modern workforce needs.

The organization prides itself on delivering high-quality educational solutions through a network of Approved Training Centres worldwide. Their robust curriculum and innovative teaching methodologies are designed to equip learners with practical knowledge and skills for personal and professional growth. With a mission to inspire lifelong learning and drive positive change, ICTQual AB continuously evolves its programs to stay ahead of industry trends and technological advancements.

ICTQual AB's vision is to set benchmarks for educational excellence while promoting inclusivity and integrity. Their unwavering focus on quality and accessibility makes them a trusted partner in shaping future-ready professionals and advancing societal progress globally.

## Course Overview

The ICTQual Level 4 Diploma in Environmental Engineering is a comprehensive one-year program designed for individuals seeking to build advanced expertise in environmental systems, sustainability, and innovative engineering practices. Accredited for 120 credits, this qualification emphasizes both theoretical and practical knowledge essential for addressing modern environmental challenges.

The course equips learners with skills in areas such as waste management, water treatment, renewable energy technologies, and sustainable infrastructure. Through hands-on projects and rigorous academic modules, students gain practical experience in applying engineering principles to environmental conservation and resource management. Additionally, the curriculum aligns with global standards, preparing graduates for professional roles or higher education opportunities in environmental engineering and related fields.

With strong emphasis on sustainability and cutting-edge solutions, this diploma serves as a gateway to careers in environmental consultancy, research, and green infrastructure development. It also supports entrepreneurial pursuits for those aspiring to create eco-friendly solutions or innovations.

## Certification Framework

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| **Qualification title** | **ICTQual Level 4 Diploma in Environmental Engineering 120 Credits – One Year** |
| **Course ID** | ENE0003 |
| **Qualification Credits** | 120 Credits |
| **Course Duration** | 12 Months |
| **Grading Type** | Pass / Fail |
| **Competency Evaluation** | Coursework / Assignments / Verifiable Experience |
| **Assessment** | The assessment and verification process for ICTQual qualifications involves two key stages:<br><br>**Internal Assessment and Verification:**<br>✓ Conducted by the staff at the Approved Training Centre (ATC). Ensures learners meet the required standards through continuous assessments.<br>✓ Internal quality assurance (IQA) is carried out by the centre's IQA staff to validate the assessment processes.<br>**External Quality Assurance:**<br>✓ Managed by ICTQual AB verifiers, who periodically review the centre's assessment and IQA processes.<br>✓ Verifies that assessments are conducted to the required standards and ensures consistency across centres |

## Entry Requirements

To enroll in ICTQual Level 4 Diploma in Environmental Engineering 120 Credits – One Year, candidates must meet the following entry requirements:

- ✓ Applicants should have completed a Level 3 qualification in Environmental Engineering, Engineering, Science, or a related field. Equivalent qualifications or certifications in technical or scientific disciplines may also be considered.
- ✓ Individuals with relevant work experience in environmental engineering, sustainability, or a related industry may also be eligible, even if they lack formal qualifications, subject to assessment by the training provider.
- ✓ Proficiency in English is essential, as the program involves technical terminology, written reports, and communication within environmental engineering contexts.
- ✓ Candidates should possess foundational skills in mathematics and science to understand technical concepts covered in the course.
- ✓ Applicants should typically be 16 years or older to enroll in this program.

## Qualification Structure

This qualification comprises 12 mandatory units, totaling 120 credits. Candidates must successfully complete all mandatory units to achieve the qualification.

| Mandatory Units | | |
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| **Unit Ref#** | **Unit Title** | **Credits** |
| ENE0003-1 | Introduction to Environmental Engineering | 10 |
| ENE0003-2 | Environmental Impact Assessment | 10 |
| ENE0003-3 | Water and Wastewater Treatment | 10 |
| ENE0003-4 | Air Quality and Pollution Control | 10 |
| ENE0003-5 | Solid Waste Management and Recycling | 10 |
| ENE0003-6 | Renewable Energy Systems | 10 |
| ENE0003-7 | Sustainable Engineering Practices | 10 |
| ENE0003-8 | Environmental Regulations and Policies | 10 |
| ENE0003-9 | Climate Change and Environmental Risk Management | 10 |
| ENE0003-10 | Soil and Groundwater Contamination | 10 |
| ENE0003-11 | Environmental Project Management | 10 |
| ENE0003-12 | Advanced Topics in Environmental Engineering | 10 |

## Centre Requirements

Even if a centre is already registered with ICTQual AB, it must meet specific requirements to deliver the ICTQual Level 4 Diploma in Environmental Engineering 120 Credits – One Year. These standards ensure the quality and consistency of training, assessment, and learner support.

**1. Approval to Deliver the Qualification**

- ✓ Centres must obtain formal approval from ICTQual AB to deliver this specific qualification, even if they are already registered.
- ✓ The approval process includes a review of resources, staff qualifications, and policies relevant to the program.

**2. Qualified Staff**

- ✓ **Tutors**: Must have relevant qualifications in Environmental Engineering at Level 5 or higher, alongside teaching/training experience.
- ✓ **Assessors**: Must hold a recognized assessor qualification and demonstrate expertise in Environmental Engineering.
- ✓ **Internal Quality Assurers (IQAs):** Must be appropriately qualified and experienced to monitor the quality of assessments.

**3. Learning Facilities**

Centres must have access to appropriate learning facilities, which include:

- ✓ **Classrooms:** Modern classrooms equipped with multimedia tools to deliver engaging theoretical instruction on environmental systems, sustainability practices, and eco-friendly technologies.
- ✓ **Practical Areas:** Specialized labs featuring equipment for water and air quality testing, soil analysis, waste management simulations, and renewable energy experiments, offering hands-on experience in real-world environmental challenges.

- ✓ **Technology Access:** High-performance computers with industry-standard software (e.g., GIS mapping tools, environmental modeling software) and reliable internet for research, simulations, and project development**.**

**4. Health and Safety Compliance**

- ✓ Centres must ensure that practical training environments comply with relevant health and safety regulations.
- ✓ Risk assessments must be conducted regularly to maintain a safe learning environment.

**5. Resource Requirements**

- ✓ **Learning Materials:** Approved course manuals, textbooks, and study guides aligned with the curriculum.
- ✓ **Assessment Tools:** Templates, guidelines, and resources for conducting and recording assessments.
- ✓ **E-Learning Systems:** If offering online or hybrid learning, centres must provide a robust Learning Management System (LMS) to facilitate remote delivery.

**6. Assessment and Quality Assurance**

- ✓ Centres must adhere to ICTQual's assessment standards, ensuring that all assessments are fair, valid, and reliable.
- ✓ Internal quality assurance (IQA) processes must be in place to monitor assessments and provide feedback to assessors.
- ✓ External verification visits from ICTQual will ensure compliance with awarding body standards.

**7. Learner Support**

- ✓ Centres must provide learners with access to guidance and support throughout the program, including:
- ✓ Academic support for coursework.
- ✓ Career guidance for future progression.
- ✓ Additional support for learners with specific needs (e.g., disabilities or language barriers).

**8. Policies and Procedures**

Centres must maintain and implement the following policies, as required by ICTQual:

- ✓ Equal Opportunities Policy.
- ✓ Health and Safety Policy.
- ✓ Safeguarding Policies and Procedures.
- ✓ Complaints and Appeals Procedure.
- ✓ Data Protection and Confidentiality Policy.

**9. Regular Reporting to ICTQual**

- ✓ Centres must provide regular updates to ICTQual AB on learner enrollment, progress, and completion rates.
- ✓ Centres are required to maintain records of assessments and learner achievements for external auditing purposes.

## Support for Candidates

Centres should ensure that materials developed to support candidates:

- ✓ Facilitate tracking of achievements as candidates progress through the learning outcomes and assessment criteria.
- ✓ Include information on how and where ICTQual's policies and procedures can be accessed.
- ✓ Provide mechanisms for Internal and External Quality Assurance staff to verify and authenticate evidence effectively.

This approach ensures transparency, supports candidates' learning journeys, and upholds quality assurance standards.

## Assessment

This qualification is competence-based, requiring candidates to demonstrate proficiency as defined in the qualification units. The assessment evaluates the candidate's skills, knowledge, and understanding against the set standards. Key details include:

1. **Assessment Process:**

    - ✓ Must be conducted by an experienced and qualified assessor.
    - ✓ Candidates compile a portfolio of evidence that satisfies all learning outcomes and assessment criteria for each unit.

2. **Types of Evidence:**

    - ✓ Observation reports by the assessor.
    - ✓ Assignments, projects, or reports.
    - ✓ Professional discussions.
    - ✓ Witness testimonies.
    - ✓ Candidate-produced work.
    - ✓ Worksheets.
    - ✓ Records of oral and written questioning.
    - ✓ Recognition of Prior Learning (RPL).

3. **Learning Outcomes and Assessment Criteria:**

    - ✓ **Learning Outcomes:** Define what candidates should know, understand, or accomplish upon completing the unit.
    - ✓ **Assessment Criteria:** Detail the standards candidates must meet to demonstrate that the learning outcomes have been achieved.

This framework ensures rigorous and consistent evaluation of candidates' competence in line with the qualification's objectives.

## Unit Descriptors

**ENE0003 -1: Introduction to Environmental Engineering**

The aim of this unit is to introduce learners to the foundational concepts of environmental engineering and its critical role in addressing environmental challenges. Learners will explore the core principles of environmental engineering and understand how they contribute to mitigating environmental impacts. The unit will focus on identifying key environmental issues, assessing their effects on ecosystems, human health, and society.

| Learning Outcome: | Assessment Criteria: |
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| **1. Understand the fundamental principles of environmental engineering and its role in addressing environmental challenges.** | 1.1. Define the scope and significance of environmental engineering, including its interdisciplinary nature and contribution to sustainable development.<br>1.2. Explain the principles of environmental protection, including waste management, water quality, air quality, and pollution control techniques.<br>1.3. Identify global environmental challenges, such as climate change, resource depletion, and biodiversity loss, and discuss the role of environmental engineers in addressing these issues.<br>1.4. Analyze the impact of human activities on natural ecosystems and propose engineering solutions for minimizing ecological footprints.<br>1.5. Evaluate case studies of successful environmental engineering projects, highlighting innovative approaches and technologies.<br>1.6. Demonstrate knowledge of key environmental regulations, standards, and policies that guide engineering practices and project implementation.<br>1.7. Describe the role of renewable energy and green technologies in promoting sustainable infrastructure and reducing environmental impact.<br>1.8. Discuss the importance of lifecycle assessments and sustainable design principles in environmental engineering projects.<br>1.9. Apply critical thinking to assess and design engineering solutions that balance economic feasibility, societal needs, and environmental |

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| | preservation. |
| **2. Identify key environmental issues and their impact on ecosystems, human health, and society.** | 2.1. Describe the major environmental issues, such as climate change, deforestation, water pollution, air pollution, soil degradation, and biodiversity loss, along with their underlying causes.<br>2.2. Analyze the direct and indirect effects of these issues on ecosystems, including habitat destruction, species extinction, and disruptions in ecological balance.<br>2.3. Explain how environmental problems impact human health through factors like air quality, water contamination, exposure to hazardous waste, and vector-borne diseases.<br>2.4. Assess the social and economic consequences of environmental degradation, such as displacement due to climate change, food and water scarcity, and loss of livelihoods.<br>2.5. Discuss the interdependence of ecosystems and human activities, emphasizing the cascading effects of environmental damage on societal well-being.<br>2.6. Highlight case studies of regions severely affected by environmental issues to illustrate the scope and severity of their impacts.<br>2.7. Evaluate the role of policy and governance in mitigating these issues, focusing on international treaties, regulations, and environmental frameworks.<br>2.8. Explore strategies for raising awareness and engaging communities in addressing environmental challenges and promoting sustainable practices.<br>2.9. Propose innovative engineering or technological solutions to alleviate key environmental issues and their adverse impacts. |
| **3. Demonstrate knowledge of global environmental policies, laws, and regulations that guide environmental engineering practices.** | 3.1. Identify key international frameworks, such as the Paris Agreement, Kyoto Protocol, and United Nations Sustainable Development Goals (SDGs), and explain their relevance to environmental engineering. |

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| | 3.2. Discuss the role of global environmental conventions, such as the Convention on Biological Diversity (CBD) and the Basel Convention on hazardous waste management, in shaping engineering practices.<br>3.3. Demonstrate an understanding of regional regulations, including the European Union's Environmental Directives, U.S. Clean Air Act, and similar legislative frameworks worldwide.<br>3.4. Explain the importance of Environmental Impact Assessments (EIAs) and Strategic Environmental Assessments (SEAs) in ensuring compliance with laws and policies.<br>3.5. Analyze the principles of key environmental laws, such as the Water Framework Directive, Endangered Species Act, and National Environmental Policy Act, in guiding project planning and implementation.<br>3.6. Highlight the role of regulatory bodies, such as the Environmental Protection Agency (EPA) and International Organization for Standardization (ISO), in enforcing global standards.<br>3.7. Evaluate the impact of environmental audits, certifications (e.g., ISO 14001), and legal compliance on engineering project sustainability.<br>3.8. Examine case studies where adherence to global environmental policies has led to successful engineering solutions and improved ecological outcomes.<br>3.9. Discuss emerging trends in environmental governance, such as carbon trading, renewable energy incentives, and circular economy principles, and their implications for engineering practices. |
| **4. Explain the importance of sustainability and its integration into engineering design and solutions.** | 4.1. Define sustainability and its core principles, including the balanced consideration of environmental, social, and economic factors in engineering solutions.<br>4.2. Explain the role of sustainable engineering in |

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| | mitigating global challenges such as climate change, resource depletion, and environmental degradation.<br>4.3. Demonstrate the importance of integrating renewable energy, waste reduction, and resource efficiency in the engineering design process to reduce the environmental impact of projects.<br>4.4. Analyze the concept of lifecycle assessments (LCA) and its application in evaluating the sustainability of engineering designs, from material sourcing to end-of-life disposal.<br>4.5. Discuss how sustainable practices in engineering contribute to compliance with international environmental regulations and standards, such as the Paris Agreement and ISO 14001.<br>4.6. Identify key sustainable design strategies, such as energy-efficient technologies, green building certifications (e.g., LEED), and low-carbon materials, and their integration into engineering projects.<br>4.7. Evaluate the economic benefits of sustainability, including cost savings through energy efficiency, waste reduction, and longer-term operational benefits of sustainable designs.<br>4.8. Discuss the societal benefits of sustainability, including improved public health, enhanced quality of life, and social equity through the development of sustainable infrastructure.<br>4.9. Explore emerging trends in sustainable engineering, such as circular economy principles and eco-innovation, and their future impact on engineering practices. |

**ENE0004 -2: Environmental Impact Assessment**

The aim of this unit is to provide learners with a comprehensive understanding of Environmental Impact Assessments (EIA) and their significance in the planning and execution of engineering projects. Learners will explore the methodologies and tools used in conducting EIAs, enabling them to assess potential environmental, social, and economic impacts. The unit will focus on evaluating the broader consequences of engineering projects, while ensuring that learners understand the legal and ethical considerations involved in environmental assessments.

| Learning Outcome: | Assessment Criteria: |
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| **1. Demonstrate an understanding of environmental impact assessments (EIA) and their importance in project planning.** | 1.1. Define Environmental Impact Assessment (EIA) and explain its purpose in evaluating the environmental, social, and economic consequences of proposed projects.<br>1.2. Outline the key stages of the EIA process, including screening, scoping, data collection, impact analysis, public consultation, and the development of mitigation measures.<br>1.3. Discuss the legal requirements for conducting EIAs, particularly for large-scale developments, and the role of international agreements and national regulations in shaping the EIA process.<br>1.4. Explain the importance of stakeholder engagement during the EIA process and the role of public participation in identifying potential environmental impacts.<br>1.5. Identify common environmental impacts assessed in EIAs, such as air and water pollution, habitat destruction, biodiversity loss, noise pollution, and social effects.<br>1.6. Describe the role of alternative project options and mitigation measures in minimizing negative environmental impacts and enhancing project sustainability.<br>1.7. Demonstrate an understanding of the relationship between EIAs and decision-making processes in project planning, ensuring that environmental considerations are integrated into the final design.<br>1.8. Evaluate the importance of EIA reports in informing policymakers, project developers, and the public about the potential risks and benefits of a proposed project.<br>1.9. Discuss the limitations and challenges of the |

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| | EIA process, including issues related to data quality, time constraints, and the balancing of environmental concerns with economic and social goals. |
| **2. Identify and apply methods and tools used in conducting an EIA.** | 2.1. Define key methods and tools used in conducting Environmental Impact Assessments (EIAs), such as qualitative and quantitative techniques, GIS (Geographic Information Systems), and modeling tools.<br>2.2. Explain the process of screening and scoping in EIA, identifying which methods and tools are appropriate for these stages.<br>2.3. Demonstrate the use of GIS and remote sensing technologies in assessing environmental impacts, including mapping and spatial analysis.<br>2.4. Describe how environmental modeling tools, such as air quality, water flow, and noise pollution models, are used to predict potential environmental effects.<br>2.5. Apply environmental impact matrices and checklists to assess the significance of environmental impacts, including mitigation options.<br>2.6. Analyze and apply methods for public participation and stakeholder consultation in the EIA process, such as surveys, workshops, and public hearings.<br>2.7. Evaluate the use of risk assessment tools to identify and mitigate potential hazards to human health, safety, and the environment during the EIA.<br>2.8. Discuss the importance of baseline data collection in the EIA process and apply methods for gathering accurate environmental data, including field surveys and remote sensing.<br>2.9. Demonstrate how to integrate the findings from various methods and tools into a comprehensive EIA report that informs decision-making and regulatory compliance. |
| **3. Evaluate the potential environmental, social, and economic impacts of engineering projects.** | 3.1. Analyze the environmental, social, and economic impacts of engineering projects |

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| | using established frameworks and methodologies, such as Environmental Impact Assessments (EIAs) and Social Impact Assessments (SIAs).<br>3.2. Evaluate the direct and indirect environmental consequences of projects, including pollution, resource depletion, biodiversity loss, and ecosystem disruption.<br>3.3. Assess the social implications of engineering projects, focusing on factors such as community health, safety, displacement, and the preservation of cultural heritage.<br>3.4. Examine the potential for economic growth and job creation through engineering projects, while considering the risks of economic displacement and unintended financial consequences.<br>3.5. Apply cost-benefit analysis to evaluate the long-term economic viability of projects, considering both direct financial returns and indirect social or environmental costs.<br>3.6. Identify mitigation strategies to reduce negative environmental and social impacts and improve the sustainability of engineering solutions.<br>3.7. Discuss the role of stakeholder engagement in assessing the social and environmental impacts of projects, ensuring that the concerns and needs of affected communities are addressed.<br>3.8. Evaluate the effectiveness of existing environmental, social, and economic regulations and policies in mitigating negative impacts and promoting sustainable development.<br>3.9. Demonstrate the integration of environmental, social, and economic considerations into the decision-making process for engineering projects to ensure balanced, sustainable outcomes. |
| **4. Interpret and comply with legal and ethical considerations involved in environmental assessments.** | 4.1. Define the key legal and ethical principles that guide environmental assessments, including environmental protection laws, human rights considerations, and public |

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| | health regulations.<br>4.2. Explain the importance of complying with national and international environmental regulations, such as the Environmental Protection Act, National Environmental Policy Act (NEPA), and ISO 14001 standards.<br>4.3. Identify the legal frameworks and policies related to environmental assessments, such as Environmental Impact Assessments (EIA), and their role in ensuring compliance with environmental protection standards.<br>4.4. Discuss the ethical obligations of professionals conducting environmental assessments, including the responsibility to provide accurate, unbiased information and transparency in reporting findings.<br>4.5. Evaluate the significance of obtaining informed consent from stakeholders and communities affected by environmental assessments, ensuring that their rights and interests are respected throughout the process.<br>4.6. Discuss the concept of "due diligence" in environmental assessments and its application to prevent harm to both the environment and local populations.<br>4.7. Analyze the potential consequences of non-compliance with environmental laws and ethical standards, including legal penalties, project delays, and reputational damage.<br>4.8. Examine the role of environmental assessments in promoting sustainability, ensuring that the development of projects aligns with ethical obligations to protect future generations and the natural environment.<br>4.9. Demonstrate the ability to apply legal and ethical considerations in the planning and execution of environmental assessments, ensuring that all legal requirements and ethical guidelines are adhered to throughout the project. |

**ENE0004 -3: Water and Wastewater Treatment**

The aim of this unit is to provide learners with a comprehensive understanding of the principles and processes involved in water and wastewater treatment. Learners will explore the design of water treatment systems, identifying and selecting appropriate treatment technologies to address various water quality challenges. The unit will also focus on assessing the effectiveness and sustainability of wastewater treatment methods, ensuring learners can evaluate their long-term environmental impact.

| Learning Outcome: | Assessment Criteria: |
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| 1. **Understand the principles and processes involved in water and wastewater treatment.** | 1.1. Define the key principles involved in water and wastewater treatment, including physical, chemical, and biological processes.<br>1.2. Explain the importance of water treatment in ensuring safe drinking water and protecting public health, highlighting the role of filtration, disinfection, and chemical treatment.<br>1.3. Describe the stages of the water treatment process, such as coagulation, flocculation, sedimentation, filtration, and disinfection, and explain their purpose in removing contaminants.<br>1.4. Identify the various methods used for wastewater treatment, including primary, secondary, and tertiary treatments, and explain the function of each stage in treating domestic and industrial wastewater.<br>1.5. Discuss the role of biological treatment methods such as activated sludge, trickling filters, and constructed wetlands in removing organic matter and pollutants from wastewater.<br>1.6. Explain the principles of advanced treatment technologies, such as membrane filtration, reverse osmosis, and ultraviolet (UV) disinfection, and their applications in specific contexts.<br>1.7. Demonstrate knowledge of key water quality parameters, such as pH, turbidity, total dissolved solids (TDS), biochemical oxygen demand (BOD), and chemical oxygen demand (COD), and how they are monitored during the treatment process.<br>1.8. Analyze the environmental impact of water and wastewater treatment, including energy |

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| | consumption, sludge management, and the disposal of treatment by-products.<br>1.9. Discuss the importance of regulatory frameworks and standards, such as those set by the World Health Organization (WHO), Environmental Protection Agency (EPA), and local authorities, in guiding water and wastewater treatment practices. |
| **2. Design water treatment systems and identify appropriate treatment technologies.** | 2.1 Evaluate the water source characteristics, including water quality, flow rates, and seasonal variations, to determine the treatment requirements and challenges.<br>2.2 Implement coarse screening to remove large debris (e.g., leaves, twigs) and prevent clogging of downstream equipment.<br>2.3 Introduce chemicals such as alum or ferric chloride to destabilize suspended particles and promote clumping (floc formation) for easier removal.<br>2.4 Design sedimentation basins or clarifiers where the floc can settle and be removed from the water, typically through gravity-based processes.<br>2.5 Use multi-stage filtration systems, including sand, activated carbon, and advanced membrane technologies (e.g., microfiltration or ultrafiltration), to remove smaller particles and improve water clarity.<br>2.6 Choose an appropriate disinfection method, such as chlorination, ultraviolet (UV) light, or ozonation, to kill or inactivate harmful microorganisms and pathogens.<br>2.7 Consider using reverse osmosis, nanofiltration, or activated carbon filtration for water with high levels of dissolved solids, chemicals, or organic contaminants.<br>2.8 For wastewater treatment, implement biological treatment methods, such as activated sludge or biofilm reactors, to remove nutrients like nitrogen and phosphorus that can lead to eutrophication.<br>2.9 Design systems for the handling, treatment, and disposal of residual sludge, such as through anaerobic digestion, dewatering, or |

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| | incineration. |
| **3. Assess the effectiveness and sustainability of wastewater treatment methods.** | 3.1 Evaluate the efficiency of primary treatment methods (screening, sedimentation) in removing large solids, and their ability to reduce the load on subsequent treatment stages.<br>3.2 Assess the performance of secondary treatment methods such as activated sludge, trickling filters, or biofilm reactors, in reducing organic matter, biochemical oxygen demand (BOD), and suspended solids.<br>3.3 Examine the capability of tertiary treatment technologies like advanced filtration, reverse osmosis, or nutrient removal processes in further reducing contaminants, especially nitrogen and phosphorus.<br>3.4 Analyze the energy consumption of each treatment method, and assess the potential for energy recovery through biogas production in anaerobic digesters or other waste-to-energy technologies.<br>3.5 Assess the ability of wastewater treatment plants to meet regulatory standards for effluent quality, including limits on heavy metals, pathogens, and other hazardous substances.<br>3.6 Evaluate the cost-effectiveness of various treatment methods, considering both capital investment and long-term operational costs.<br>3.7 Assess the environmental impact of wastewater treatment methods, including the management of sludge, chemical use, and the risk of chemical byproducts.<br>3.8 Analyze the potential for water reuse and the sustainability of treated wastewater in non-potable applications (e.g., irrigation, industrial use, or cooling).<br>3.9 Review the capacity of the treatment system to handle increasing wastewater volumes due to population growth or urban expansion, ensuring its scalability and resilience. |
| **4. Apply environmental regulations in the management of water quality and wastewater** | 4.1 Identify and understand relevant local, national, and international environmental |

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| **discharge.** | regulations governing water quality and wastewater discharge, including standards set by organizations like the EPA, WHO, or EU directives.<br>4.2 Ensure wastewater treatment processes are designed to meet permissible effluent quality standards, including limits on parameters such as biochemical oxygen demand (BOD), chemical oxygen demand (COD), total suspended solids (TSS), and pathogen levels.<br>4.3 Apply best available technologies (BAT) to ensure that wastewater discharge meets regulatory requirements while minimizing environmental impact.<br>4.4 Develop monitoring programs to regularly assess water quality and wastewater discharges, including parameters such as pH, temperature, nutrients (nitrogen, phosphorus), and heavy metals, ensuring ongoing compliance with regulations.<br>4.5 Ensure that discharge permits are obtained and adhered to, detailing allowable limits for various pollutants, sampling protocols, and compliance reporting procedures.<br>4.6 Implement measures for the pre-treatment of wastewater in industries or municipalities where discharges exceed regulatory limits for specific pollutants.<br>4.7 Use advanced treatment technologies, such as reverse osmosis, membrane bioreactors (MBRs), or nutrient removal technologies, to reduce the impact of wastewater discharges on receiving water bodies, particularly in sensitive environments.<br>4.8 Comply with regulations related to sludge management, including appropriate disposal or beneficial reuse methods such as composting, landfilling, or biogas recovery.<br>4.9 Develop contingency plans for spill or overflows of untreated wastewater, ensuring emergency protocols are in place to protect public health and the environment. |

**ENE0004 -4: Air Quality and Pollution Control**

The aim of this unit is to equip learners with a thorough understanding of air quality management and pollution control strategies. Learners will explore the types of air pollutants and their sources, gaining insights into their effects on human health and the environment. The unit will focus on evaluating the impact of air pollution and understanding various air pollution control technologies and strategies.

| Learning Outcome: | Assessment Criteria: |
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| 1. **Identify the types of air pollutants and their sources.** | 1.1. Define the primary types of air pollutants, such as particulate matter (PM), nitrogen oxides (NOx), sulfur dioxide (SO2), carbon monoxide (CO), volatile organic compounds (VOCs), ozone (O3), and greenhouse gases (GHGs), explaining their chemical properties and behavior in the atmosphere.<br>1.2. Identify the major sources of air pollutants, including natural sources like wildfires, volcanic eruptions, and dust storms, as well as anthropogenic sources such as transportation, industrial emissions, power plants, and agricultural activities.<br>1.3. Explain the process by which anthropogenic activities contribute to the formation of secondary pollutants, such as ozone, through chemical reactions in the atmosphere.<br>1.4. Discuss the role of transportation, including vehicles and aircraft, in the emission of pollutants like carbon monoxide, nitrogen oxides, and particulate matter.<br>1.5. Analyze the impact of industrial activities on air quality, focusing on emissions from manufacturing, mining, and chemical production processes.<br>1.6. Examine the contribution of energy production, particularly fossil fuel combustion in power plants, to the release of air pollutants such as sulfur dioxide, nitrogen oxides, and carbon dioxide.<br>1.7. Explain how agricultural practices, including the use of fertilizers and pesticides, can contribute to air pollution through the release of ammonia and methane.<br>1.8. Identify the role of domestic and commercial heating systems in releasing air pollutants such as carbon monoxide and particulate |

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| | matter.<br>1.9. Discuss the influence of urbanization and population growth on air pollution levels, particularly in relation to increased vehicular emissions and industrialization in densely populated areas. |
| **2. Evaluate the impact of air pollution on human health and the environment.** | 2.1. Define air pollution and its primary sources, including industrial emissions, transportation, agriculture, and residential heating, and explain their contribution to environmental and health impacts.<br>2.2. Identify the different types of air pollutants (e.g., particulate matter, nitrogen oxides, sulfur dioxide, carbon monoxide, ozone) and their specific effects on human health and ecosystems.<br>2.3. Discuss the short-term and long-term health effects of air pollution on humans, including respiratory diseases, cardiovascular problems, and increased mortality rates.<br>2.4. Analyze the impact of air pollution on vulnerable populations, such as children, the elderly, and individuals with pre-existing health conditions, highlighting the disparities in exposure and risk.<br>2.5. Explain the role of air pollution in exacerbating climate change, including its contribution to global warming, ozone layer depletion, and the formation of smog.<br>2.6. Evaluate the environmental consequences of air pollution, including its effects on biodiversity, ecosystems, and natural resources such as water and soil quality.<br>2.7. Assess the economic costs of air pollution, including healthcare expenses, loss of productivity, and environmental remediation efforts.<br>2.8. Examine the effectiveness of regulatory measures and policies aimed at reducing air pollution, such as air quality standards, emission controls, and international agreements like the Paris Agreement.<br>2.9. Propose mitigation strategies to reduce air |

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| | pollution, including technological advancements, urban planning improvements, and public health initiatives. |
| **3. Understand and apply air pollution control technologies and strategies.** | 3.1. Define air pollution and explain its sources, including industrial, transportation, and agricultural emissions, and the impacts on public health and the environment.<br>3.2. Identify and describe key air pollution control technologies, such as scrubbers, electrostatic precipitators, and catalytic converters, and explain their operating principles.<br>3.3. Evaluate the effectiveness of different air pollution control strategies in reducing particulate matter, nitrogen oxides, sulfur dioxide, and volatile organic compounds.<br>3.4. Apply appropriate technologies to control emissions in various industries, such as power plants, manufacturing facilities, and transportation systems.<br>3.5. Demonstrate an understanding of regulatory frameworks, such as the Clean Air Act and ISO 14001, and how they influence the design and implementation of air pollution control measures.<br>3.6. Analyze the advantages and limitations of active versus passive control technologies, including cost considerations and maintenance requirements.<br>3.7. Discuss the role of air quality monitoring in assessing the performance of air pollution control systems and ensuring compliance with environmental standards.<br>3.8. Examine emerging technologies and innovative solutions for air pollution control, including green technologies and low-emission alternatives.<br>3.9. Assess the environmental, social, and economic impacts of implementing air pollution control technologies, considering factors such as energy consumption, cost-effectiveness, and public health benefits. |
| **4. Monitor and assess air quality and implement corrective measures where necessary.** | 4.1. Define air quality monitoring and its importance in ensuring compliance with |

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| | environmental regulations and public health standards.<br>4.2. Describe the key pollutants commonly monitored in air quality assessments, including particulate matter (PM), nitrogen oxides (NOx), sulfur dioxide (SO2), carbon monoxide (CO), and volatile organic compounds (VOCs).<br>4.3. Explain the various air quality monitoring techniques and tools, such as passive and active sampling, real-time monitoring systems, and remote sensing technologies.<br>4.4. Demonstrate how to interpret air quality data, identifying trends, patterns, and deviations from established air quality standards.<br>4.5. Evaluate the significance of air quality indices (AQI) in assessing and communicating air quality to stakeholders, including the public and regulatory bodies.<br>4.6. Identify the causes and sources of air pollution, including industrial emissions, traffic, construction activities, and natural sources, and assess their impact on local air quality.<br>4.7. Discuss the regulatory frameworks and guidelines, such as the WHO Air Quality Guidelines and national environmental standards, and their role in guiding air quality monitoring and corrective actions.<br>4.8. Implement corrective measures when air quality standards are exceeded, including recommending solutions such as emission control technologies, process modifications, or traffic management strategies.<br>4.9. Assess the effectiveness of corrective measures through continuous monitoring and adjust strategies as necessary to maintain compliance and improve air quality. |

**ENE0004 -5: Solid Waste Management and Recycling**

The aim of this unit is to provide learners with a comprehensive understanding of sustainable solid waste management practices and their role in minimizing environmental impacts. Learners will explore the principles of effective waste management and various disposal methods, critically analyzing their environmental implications. The unit will focus on evaluating and applying recycling and waste minimization strategies across different sectors, helping learners design and manage waste management systems that align with environmental regulations.

| Learning Outcome: | Assessment Criteria: |
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| **1. Analyze the principles of sustainable solid waste management and disposal methods.** | 1.1. Evaluate the core principles of sustainable solid waste management, including waste minimization, recycling, and recovery strategies.<br>1.2. Assess the environmental, economic, and social impacts of various solid waste management practices.<br>1.3. Examine the effectiveness of modern disposal methods such as landfilling, incineration, and composting in achieving sustainability goals.<br>1.4. Analyze regulatory frameworks and policies influencing solid waste management at local, national, and international levels.<br>1.5. Develop recommendations for optimizing solid waste management practices in alignment with sustainability principles.<br>1.6. Critically appraise the role of technology and innovation in improving waste disposal methods and reducing environmental harm.<br>1.7. Demonstrate the application of sustainable waste management strategies in real-world scenarios through case studies or simulations. |
| **2. Evaluate and apply recycling and waste minimization strategies in various sectors.** | 2.1 Identify and analyze current recycling and waste minimization practices across different sectors.<br>2.2 Evaluate the environmental and economic benefits of implementing recycling strategies in specific industries.<br>2.3 Apply waste minimization techniques tailored to the operational needs of diverse sectors.<br>2.4 Critically assess the challenges and barriers to effective recycling and waste minimization in industrial, commercial, and residential |

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| | contexts.<br>2.5 Design sustainable waste management plans, incorporating innovative recycling approaches and minimizing environmental impact.<br>2.6 Demonstrate the integration of recycling and waste minimization strategies into sector-specific regulatory and policy frameworks.<br>2.7 Utilize data-driven methods to measure the effectiveness of implemented recycling and waste minimization strategies.<br>2.8 Propose improvements to existing waste management systems based on best practices and technological advancements.<br>2.9 Reflect on global trends and case studies to identify transferable recycling and waste reduction solutions. |
| **3. Design and manage waste management systems that comply with environmental regulations.** | 3.1 Evaluate the principles and practices of waste management in compliance with environmental regulations and sustainability goals.<br>3.2 Identify key environmental regulations and standards relevant to waste management systems.<br>3.3 Analyze the environmental impact of different waste management approaches and recommend sustainable solutions.<br>3.4 Develop comprehensive waste management plans that address collection, transportation, treatment, and disposal methods.<br>3.5 Demonstrate the application of innovative technologies and methods in waste management to enhance efficiency and compliance.<br>3.6 Assess the effectiveness of existing waste management systems and propose improvements to meet regulatory standards.<br>3.7 Monitor and evaluate waste management system operations to ensure ongoing compliance with environmental policies.<br>3.8 Integrate stakeholder engagement strategies to promote environmental awareness and effective waste management practices.<br>3.9 Prepare and present detailed reports on |

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| | waste management strategies, ensuring alignment with environmental goals and legal requirements. |
| **4. Understand the environmental benefits of circular economy principles and their application in waste management.** | 4.1 Explain the core principles of the circular economy and their relevance to environmental sustainability.<br>4.2 Analyze the environmental impacts of traditional linear economic models in waste management.<br>4.3 Evaluate the potential benefits of adopting circular economy principles for reducing resource depletion and waste generation.<br>4.4 Assess how circular economy practices contribute to minimizing carbon emissions and ecological footprints.<br>4.5 Identify successful case studies where circular economy principles have been implemented in waste management systems.<br>4.6 Compare the efficiency of circular economy models with traditional waste disposal methods.<br>4.7 Demonstrate understanding of the role of recycling, reusing, and repurposing in circular economy frameworks.<br>4.8 Propose strategies for integrating circular economy principles into existing waste management policies and practices.<br>4.9 Critically reflect on the challenges and opportunities associated with the implementation of circular economy principles in waste management. |

**ENE0004 -6: Renewable Energy Systems**

The aim of this unit is to provide learners with a comprehensive understanding of renewable energy sources and their role in promoting environmental sustainability. Learners will explore different types of renewable energy sources, such as solar, wind, and bioenergy, and assess their potential environmental impact. The unit will focus on evaluating the feasibility of renewable energy systems and designing appropriate solutions for various applications.

| Learning Outcome: | Assessment Criteria: |
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| **1. Understand different types of renewable energy sources and their potential environmental impact.** | 1.1. Explain the various types of renewable energy sources, including solar, wind, hydro, geothermal, and biomass.<br>1.2. Compare and contrast the efficiency, availability, and scalability of different renewable energy sources.<br>1.3. Analyze the life-cycle environmental impact of renewable energy systems, including resource extraction, manufacturing, and disposal.<br>1.4. Evaluate the potential for renewable energy sources to mitigate greenhouse gas emissions and reduce reliance on fossil fuels.<br>1.5. Discuss the economic and social implications of adopting renewable energy technologies.<br>1.6. Assess the land, water, and ecosystem impacts associated with the development and operation of renewable energy facilities.<br>1.7. Explore case studies demonstrating successful implementation of renewable energy projects and their environmental benefits.<br>1.8. Identify and discuss challenges and barriers to integrating renewable energy into existing energy grids.<br>1.9. Propose strategies for optimizing the environmental benefits of renewable energy systems while minimizing adverse impacts. |
| **2. Evaluate the feasibility and design renewable energy systems for various applications.** | 2.1 Analyze the energy demands and requirements for various applications to identify suitable renewable energy systems.<br>2.2 Assess the availability and sustainability of renewable energy resources, including solar, wind, hydro, and biomass, for different scenarios. |

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| | 2.3 Evaluate the technical and economic feasibility of implementing renewable energy systems, considering factors such as efficiency, cost, and environmental impact.<br>2.4 Design renewable energy systems tailored to specific applications, incorporating best practices and industry standards.<br>2.5 Perform simulations or calculations to optimize the design of renewable energy systems for maximum performance and efficiency.<br>2.6 Evaluate the potential risks, limitations, and challenges associated with renewable energy system implementation.<br>2.7 Develop implementation strategies that address logistical, regulatory, and financial considerations for renewable energy projects.<br>2.8 Present a comprehensive report or proposal outlining the feasibility, design, and expected outcomes of the renewable energy system.<br>2.9 Critically analyze feedback and refine the renewable energy system design to meet stakeholder requirements effectively. |
| **3. Analyze the integration of renewable energy systems into existing infrastructure.** | 3.1 Evaluate the compatibility of renewable energy technologies with existing infrastructure systems, including power grids, transportation, and industrial setups.<br>3.2 Assess the technical requirements for integrating renewable energy systems into current infrastructure, such as voltage regulation, load management, and energy storage solutions.<br>3.3 Analyze the environmental, economic, and social impacts of incorporating renewable energy systems into existing structures.<br>3.4 Examine case studies of successful integration projects to identify best practices and challenges encountered.<br>3.5 Develop strategies for addressing potential technical, regulatory, and financial barriers to renewable energy integration.<br>3.6 Evaluate the role of smart grid technologies and digital tools in enhancing the efficiency of renewable energy systems within established |

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| | infrastructure.<br>3.7 Conduct a risk assessment to identify potential failures and mitigation strategies when implementing renewable systems into existing networks.<br>3.8 Propose innovative solutions for optimizing the synergy between renewable energy systems and traditional infrastructure components.<br>3.9 Critically analyze policies and regulatory frameworks that influence the integration of renewable energy technologies into national and international infrastructure projects. |
| **4. Identify the environmental benefits and challenges of renewable energy technologies.** | 4.1 Analyze the potential environmental benefits of renewable energy technologies, such as reduced greenhouse gas emissions and decreased reliance on fossil fuels.<br>4.2 Evaluate the challenges associated with the implementation of renewable energy technologies, including resource availability, intermittency, and geographic limitations.<br>4.3 Discuss the role of renewable energy in mitigating climate change and supporting sustainable development.<br>4.4 Investigate the environmental impact of manufacturing, deploying, and decommissioning renewable energy systems.<br>4.5 Compare the environmental trade-offs between renewable energy technologies and traditional energy sources.<br>4.6 Assess the effectiveness of renewable energy technologies in reducing environmental pollution, including air, water, and soil contamination.<br>4.7 Examine case studies showcasing successful applications of renewable energy technologies and their environmental outcomes.<br>4.8 Propose strategies to address environmental challenges in the adoption and scaling of renewable energy solutions.<br>4.9 Critically review policies and practices that influence the environmental benefits and challenges of renewable energy deployment. |

**ENE0004 -7: Sustainable Engineering Practices**

The aim of this unit is to provide learners with a deep understanding of sustainable engineering principles and their application in real-world projects. Learners will explore and apply the core principles of sustainable engineering design, focusing on minimizing environmental impacts throughout the project lifecycle. The unit will enable learners to evaluate the environmental impacts of engineering projects and implement sustainable practices to mitigate these effects.

| Learning Outcome: | Assessment Criteria: |
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| **1. Understand and apply the principles of sustainable engineering design.** | 1.1. Analyze the fundamental principles of sustainable engineering design and their relevance to modern engineering practices.<br>1.2. Evaluate the environmental, economic, and social impacts of engineering projects to ensure alignment with sustainability objectives.<br>1.3. Demonstrate the application of life cycle assessment (LCA) methods to identify and mitigate environmental impacts in design processes.<br>1.4. Integrate renewable and efficient energy technologies into engineering solutions to optimize sustainability.<br>1.5. Develop engineering solutions that minimize resource consumption and waste generation.<br>1.6. Apply systems thinking to design projects, ensuring balanced trade-offs between functionality, sustainability, and cost.<br>1.7. Critically assess the regulatory and ethical implications of sustainable engineering design practices.<br>1.8. Propose innovative strategies for incorporating sustainability into design processes, considering emerging trends and technologies.<br>1.9. Implement monitoring and evaluation frameworks to assess the sustainability performance of engineering designs over time. |
| **2. Evaluate the environmental impacts of engineering projects and apply sustainable practices to mitigate those impacts.** | 2.1 Analyze the potential environmental impacts associated with engineering projects, including ecological, social, and economic effects.<br>2.2 Assess the significance of environmental risks |

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| | and their short- and long-term implications.<br>2.3 Apply environmental impact assessment (EIA) methodologies to identify and evaluate potential adverse outcomes.<br>2.4 Propose strategies to minimize negative environmental effects through sustainable design and engineering practices.<br>2.5 Evaluate the effectiveness of alternative sustainable solutions in reducing environmental harm.<br>2.6 Integrate principles of sustainability into the planning, design, and execution of engineering projects.<br>2.7 Demonstrate the ability to implement mitigation measures in compliance with environmental regulations and standards.<br>2.8 Critically review case studies to identify best practices for sustainable engineering.<br>2.9 Develop a comprehensive plan that balances environmental, economic, and social considerations in an engineering context. |
| **3. Implement strategies for energy efficiency, resource conservation, and eco-friendly design.** | 3.1 Identify and analyze the key principles of energy efficiency, resource conservation, and eco-friendly design in the context of environmental sustainability.<br>3.2 Evaluate the impact of different strategies for reducing energy consumption and promoting sustainability within building designs and industrial systems.<br>3.3 Develop a comprehensive strategy for improving energy efficiency in a specific project, considering both short-term and long-term environmental impacts.<br>3.4 Demonstrate the application of resource conservation techniques in the design and implementation of projects to reduce material waste and optimize resource use.<br>3.5 Apply eco-friendly design principles, such as renewable energy integration, passive design, and low environmental impact materials, to a practical case study.<br>3.6 Calculate and assess the energy performance of buildings or systems using recognized standards and tools for energy audits and |

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| | simulations.<br>3.7 Assess the potential economic benefits of implementing energy-efficient and resource-conserving strategies, including cost savings and return on investment.<br>3.8 Communicate the benefits and challenges of eco-friendly design strategies effectively to stakeholders, including clients, contractors, and regulatory bodies.<br>3.9 Ensure compliance with relevant environmental laws, regulations, and standards while implementing energy-efficient, resource-conserving, and eco-friendly designs. |
| **4. Utilize life cycle assessments to support sustainable decision-making in engineering projects.** | 4.1 Understand the principles and stages of life cycle assessment (LCA) in the context of engineering projects.<br>4.2 Identify the key components and phases of life cycle assessment, including goal and scope definition, inventory analysis, impact assessment, and interpretation.<br>4.3 Demonstrate the ability to apply LCA tools and methodologies in evaluating the environmental impact of engineering projects.<br>4.4 Analyze and interpret LCA results to inform sustainable decision-making in engineering design and project development.<br>4.5 Assess the potential trade-offs between environmental, economic, and social factors during the LCA process.<br>4.6 Evaluate the effectiveness of life cycle assessment in identifying areas for improvement in sustainability practices within engineering projects.<br>4.7 Develop strategies for integrating LCA findings into engineering project management and decision-making processes.<br>4.8 Communicate the outcomes of LCA studies clearly and effectively to stakeholders, including recommendations for sustainable practices.<br>4.9 Critically review and assess existing LCA studies to determine their applicability to specific engineering projects. |

**ENE0004 -8: Environmental Regulations and Policies**

The aim of this unit is to provide learners with a thorough understanding of the role of environmental policies and regulations in shaping environmental engineering practices. Learners will explore global, regional, and local environmental laws and standards, gaining the ability to identify and analyze their implications for engineering projects.

| Learning Outcome: | Assessment Criteria: |
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| **1. Understand the role of environmental policies and regulations in guiding environmental engineering practices.** | 1.1. Demonstrate knowledge of key environmental policies and regulations that influence environmental engineering practices at the national and international levels.<br>1.2. Explain the historical development of environmental policies and how they have shaped current environmental engineering standards and practices.<br>1.3. Identify and describe the main environmental regulations governing water, air, waste, and land management, and their impact on engineering projects.<br>1.4. Assess the role of government agencies, non-governmental organizations, and international bodies in formulating and enforcing environmental policies.<br>1.5. Evaluate the effectiveness of existing environmental policies and regulations in addressing contemporary environmental challenges.<br>1.6. Discuss the ethical considerations for environmental engineers when working within the framework of policies and regulations.<br>1.7. Analyze case studies of environmental engineering projects to identify how policies and regulations have influenced project outcomes.<br>1.8. Examine the role of environmental regulations in promoting sustainable engineering practices and reducing ecological footprints.<br>1.9. Propose recommendations for improving existing policies and regulations to better support environmentally responsible |

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| | engineering practices. |
| **2. Identify and analyze global, regional, and local environmental laws and standards.** | 2.1 Identify key global environmental laws and regulations, including international agreements and treaties.<br>2.2 Analyze the impact of regional environmental laws and policies on local ecosystems and industries.<br>2.3 Explain the role of local environmental standards in addressing specific environmental issues within a community.<br>2.4 Evaluate the effectiveness of global, regional, and local environmental laws in promoting sustainable practices.<br>2.5 Compare and contrast environmental laws across different regions and their influence on international trade and development.<br>2.6 Examine how environmental laws contribute to achieving global sustainability goals such as the United Nations SDGs.<br>2.7 Assess the challenges in enforcing environmental laws at the local, regional, and global levels.<br>2.8 Investigate the role of government, non-governmental organizations (NGOs), and the private sector in shaping environmental laws.<br>2.9 Critically review recent developments or changes in environmental legislation and their implications for various stakeholders. |
| **3. Evaluate the impact of compliance with environmental regulations on engineering projects.** | 3.1 Assess the role of environmental regulations in the planning and execution of engineering projects.<br>3.2 Analyze the potential positive and negative effects of compliance on project costs, timelines, and resource allocation.<br>3.3 Examine how adherence to environmental regulations can influence project sustainability and long-term viability.<br>3.4 Identify key environmental regulations relevant to engineering projects across various sectors.<br>3.5 Evaluate the challenges engineering teams face in ensuring compliance with |

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| | environmental regulations.<br>3.6 Investigate the relationship between environmental regulations and risk management in engineering projects.<br>3.7 Assess how non-compliance with environmental regulations can impact the reputation and financial stability of a project or organization.<br>3.8 Review case studies where compliance with environmental regulations led to project success or failure.<br>3.9 Propose strategies for integrating environmental regulations into the project management process to enhance compliance and minimize negative impacts. |
| **4. Apply environmental regulations in the design, implementation, and monitoring of engineering solutions.** | 4.1 Demonstrate knowledge of key environmental regulations relevant to engineering practices.<br>4.2 Identify applicable local, national, and international environmental laws and standards.<br>4.3 Analyze engineering solutions to ensure compliance with environmental regulations during design and implementation.<br>4.4 Apply best practices for sustainability and environmental protection in engineering projects.<br>4.5 Assess environmental risks and impacts related to engineering designs and activities.<br>4.6 Develop strategies to minimize adverse environmental effects in engineering projects.<br>4.7 Evaluate the effectiveness of environmental regulations in the implementation and monitoring phases of engineering solutions.<br>4.8 Integrate environmental regulatory requirements into project planning and decision-making processes.<br>4.9 Communicate environmental compliance requirements and their significance to stakeholders. |

**ENE0004 -9: Climate Change and Environmental Risk Management**

The aim of this unit is to provide learners with a comprehensive understanding of climate change science and its wide-ranging impacts on the environment, society, and economy. Learners will explore strategies for mitigating the effects of climate change, with a focus on their application within the engineering context. The unit will emphasize the use of environmental risk management techniques to assess and minimize the impact of climate change on infrastructure.

| Learning Outcome: | Assessment Criteria: |
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| **1. Understand the science of climate change and its environmental, social, and economic impacts.** | 1.1. Explain the scientific principles of climate change, including the greenhouse effect, global warming, and carbon cycle.<br>1.2. Identify and describe the primary greenhouse gases and their role in climate change.<br>1.3. Evaluate the physical evidence supporting the occurrence of climate change, including temperature trends, ice melt, and sea-level rise.<br>1.4. Assess the impacts of climate change on global weather patterns, including extreme weather events and shifting climate zones.<br>1.5. Analyze the environmental consequences of climate change, such as biodiversity loss, ecosystem disruption, and ocean acidification.<br>1.6. Discuss the social implications of climate change, including its effects on human health, migration, and inequality.<br>1.7. Examine the economic effects of climate change on various sectors, including agriculture, industry, and infrastructure.<br>1.8. Investigate the interrelationship between environmental, social, and economic factors in climate change adaptation and mitigation strategies.<br>1.9. Propose solutions to mitigate climate change impacts, highlighting global and local initiatives for sustainable development. |
| **2. Evaluate strategies for mitigating climate change impacts within the engineering context.** | 2.1 Analyze various engineering strategies aimed at mitigating climate change impacts.<br>2.2 Assess the effectiveness of different mitigation techniques within specific engineering sectors. |

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| | 2.3 Investigate the role of sustainable technologies in reducing environmental harm.<br>2.4 Critically evaluate the long-term environmental, social, and economic impacts of climate change mitigation strategies.<br>2.5 Compare the benefits and challenges of implementing mitigation strategies in different geographical and economic contexts.<br>2.6 Examine the integration of climate change mitigation strategies into engineering project planning and execution.<br>2.7 Assess the role of policy, regulation, and innovation in promoting climate change mitigation within engineering.<br>2.8 Evaluate case studies of successful and unsuccessful mitigation efforts in engineering projects.<br>2.9 Recommend improvements or new approaches to existing mitigation strategies based on engineering principles and sustainability goals. |
| **3. Apply environmental risk management techniques to assess and minimize the impact of climate change on infrastructure.** | 3.1 Evaluate various environmental risk management techniques and their application in climate change scenarios.<br>3.2 Analyze the impact of climate change on different types of infrastructure, considering factors such as extreme weather events and long-term environmental changes.<br>3.3 Identify key environmental risks associated with infrastructure projects in climate-sensitive areas.<br>3.4 Assess the vulnerability of infrastructure systems to climate-related hazards and propose risk mitigation strategies.<br>3.5 Apply environmental risk assessment tools to predict the potential effects of climate change on infrastructure.<br>3.6 Propose strategies to minimize the environmental impact of infrastructure through sustainable design and construction practices.<br>3.7 Review regulatory frameworks and standards |

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| | relevant to climate change and infrastructure risk management.<br>3.8 Develop contingency plans and recommend adaptive measures for infrastructure to withstand climate-induced risks.<br>3.9 Evaluate the effectiveness of environmental risk management techniques in reducing the impact of climate change on infrastructure. |
| **4. Develop and implement adaptation strategies for climate change resilience in environmental engineering projects.** | 4.1 Identify key climate change impacts on environmental systems and infrastructure.<br>4.2 Analyze potential vulnerabilities in environmental engineering projects related to climate change.<br>4.3 Evaluate existing adaptation strategies and their effectiveness in enhancing climate resilience.<br>4.4 Design adaptive engineering solutions that address both current and projected climate change scenarios.<br>4.5 Implement climate change adaptation strategies through integration into project planning and execution phases.<br>4.6 Assess the potential socio-economic and environmental implications of proposed adaptation strategies.<br>4.7 Monitor and review the performance of adaptation measures over time, ensuring sustainability.<br>4.8 Collaborate with stakeholders, including policymakers and local communities, to ensure the relevance and feasibility of adaptation strategies.<br>4.9 Ensure compliance with relevant environmental regulations, standards, and best practices when implementing climate change adaptation strategies. |

**ENE0004 -10: Soil and Groundwater Contamination**

The aim of this unit is to provide learners with a thorough understanding of the causes, types, and effects of soil and groundwater contamination, along with the associated risks. Learners will explore the impact of soil and water pollution on human health and the environment, assessing the severity of contamination and its long-term consequences. The unit will focus on applying remediation techniques to manage and clean up contaminated sites, ensuring safe and sustainable recovery of affected areas.

| Learning Outcome: | Assessment Criteria: |
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| **1. Understand the causes, types, and effects of soil and groundwater contamination.** | 1.1. Identify the key causes of soil and groundwater contamination, including industrial, agricultural, and domestic activities.<br>1.2. Describe the various types of soil and groundwater contamination, such as chemical, biological, and radiological pollutants.<br>1.3. Explain the mechanisms through which contaminants spread in soil and groundwater, including leaching, runoff, and infiltration.<br>1.4. Assess the environmental, health, and socio-economic impacts of soil and groundwater contamination.<br>1.5. Discuss the role of human activities, such as improper waste disposal, in contributing to contamination.<br>1.6. Examine the effects of soil contamination on ecosystems, biodiversity, and agricultural productivity.<br>1.7. Analyze the long-term effects of groundwater contamination on water quality and public health.<br>1.8. Evaluate the challenges and risks associated with remediating contaminated soil and groundwater.<br>1.9. Propose preventive measures and policies to minimize soil and groundwater contamination. |
| **2. Assess the risks associated with soil and water pollution and their impact on human health and the environment.** | 2.1 Identify and evaluate the different types of soil and water pollutants, including their sources and pathways.<br>2.2 Analyze the potential short-term and long-term effects of soil and water pollution on human health. |

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| | 2.3 Assess the environmental consequences of soil and water contamination, including effects on ecosystems and biodiversity.<br>2.4 Determine the vulnerability of various populations to the health risks posed by polluted soil and water, with a focus on vulnerable groups.<br>2.5 Review national and international regulations and standards regarding soil and water pollution and their enforcement.<br>2.6 Evaluate risk assessment methods used to quantify the impact of pollutants on public health and the environment.<br>2.7 Investigate the effectiveness of pollution control measures and mitigation strategies for soil and water contamination.<br>2.8 Propose risk management strategies to prevent or reduce soil and water pollution in various contexts (e.g., urban, agricultural, industrial).<br>2.9 Recommend appropriate public health interventions based on the assessed risks of soil and water pollution. |
| **3. Apply remediation techniques to manage and clean up contaminated sites.** | 3.1 Identify and assess the types and sources of contamination at a site.<br>3.2 Evaluate the environmental and health risks associated with the contamination.<br>3.3 Select appropriate remediation methods based on site conditions, contaminants, and regulatory requirements.<br>3.4 Design a site remediation plan that includes a timeline, required resources, and risk management strategies.<br>3.5 Implement the selected remediation techniques, ensuring compliance with environmental standards.<br>3.6 Monitor the effectiveness of remediation efforts through appropriate sampling and analysis.<br>3.7 Adapt remediation strategies as necessary based on monitoring results and changing conditions.<br>3.8 Ensure proper disposal or treatment of |

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| | hazardous materials in line with legal and safety regulations.<br>3.9 Document and report the remediation process, results, and compliance with regulatory standards. |
| **4. Evaluate the effectiveness of contamination control measures and monitor soil and groundwater quality.** | 4.1 Critically assess various contamination control measures for their effectiveness in preventing and mitigating contamination in different environments.<br>4.2 Analyze the methodologies and technologies used for monitoring soil and groundwater quality, identifying strengths and weaknesses.<br>4.3 Conduct a comparative analysis of different control strategies and their impact on soil and groundwater health.<br>4.4 Evaluate the environmental and economic costs of implementing contamination control measures in various settings.<br>4.5 Develop and apply appropriate criteria to assess the quality of soil and groundwater in different contamination scenarios.<br>4.6 Examine the role of legislation and regulations in shaping contamination control measures and monitoring practices.<br>4.7 Review case studies or real-world examples of contamination control to identify best practices and lessons learned.<br>4.8 Propose improvements to existing contamination control measures based on the findings of evaluations and monitoring data.<br>4.9 Demonstrate the ability to interpret and present monitoring data, making recommendations for future actions based on assessment results. |

**ENE0004 -11: Environmental Project Management**

The aim of this unit is to equip learners with the knowledge and skills to manage environmental engineering projects effectively, ensuring alignment with regulatory, sustainability, and environmental goals. Learners will explore project management principles specific to environmental projects, focusing on planning, execution, and evaluation while adhering to regulatory and sustainability requirements. The unit will emphasize managing project risks, timelines, budgets, and stakeholder relationships to ensure successful project outcomes.

| Learning Outcome: | Assessment Criteria: |
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| **1. Demonstrate knowledge of project management principles in the context of environmental engineering projects.** | 1.1. Explain the key principles of project management, including scope, time, cost, quality, human resources, and risk management, within the context of environmental engineering.<br>1.2. Identify and describe the different stages of an environmental engineering project lifecycle, from initiation to completion.<br>1.3. Evaluate the roles and responsibilities of project stakeholders, including clients, contractors, and regulatory bodies, in environmental engineering projects.<br>1.4. Demonstrate an understanding of project planning tools and techniques, such as Gantt charts, Work Breakdown Structures (WBS), and project scheduling software, as they apply to environmental engineering.<br>1.5. Analyze the importance of resource allocation and budgeting in managing environmental engineering projects.<br>1.6. Assess the impact of environmental, social, and economic factors on project planning and decision-making in environmental engineering.<br>1.7. Discuss the application of sustainability principles in project management for environmental engineering.<br>1.8. Explain how to manage risks and uncertainties in environmental engineering projects, including strategies for mitigating potential project delays or cost overruns.<br>1.9. Review the ethical considerations in managing environmental engineering projects, ensuring compliance with industry standards and regulations. |
| **2. Plan, execute, and evaluate environmental engineering projects in compliance with regulatory and sustainability requirements.** | 2.1 Demonstrate the ability to develop comprehensive project plans that align with environmental engineering objectives and |

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| | regulatory standards.<br>2.2 Identify and interpret relevant local, national, and international environmental regulations applicable to the project.<br>2.3 Conduct thorough risk assessments, ensuring environmental impacts are evaluated and mitigated throughout the project lifecycle.<br>2.4 Apply principles of sustainable development to ensure projects contribute to long-term environmental health and resource efficiency.<br>2.5 Select and integrate appropriate environmental technologies and methodologies in the planning and execution stages.<br>2.6 Develop and implement procedures for monitoring project progress, ensuring compliance with environmental, safety, and quality standards.<br>2.7 Evaluate the effectiveness of environmental engineering solutions, using both quantitative and qualitative performance metrics.<br>2.8 Assess project outcomes against initial sustainability goals, proposing improvements where necessary.<br>2.9 Communicate project results and recommendations effectively to stakeholders, ensuring clarity on compliance and sustainability aspects. |
| **3. Manage project risks, timelines, budgets, and stakeholders to ensure successful project outcomes.** | 3.1 Identify and assess potential project risks through comprehensive risk analysis techniques, including risk identification, evaluation, and mitigation strategies.<br>3.2 Develop a detailed project timeline, setting clear milestones and deliverables to ensure timely project completion.<br>3.3 Create and manage a project budget, monitoring expenditures and making necessary adjustments to ensure alignment with the project's financial goals.<br>3.4 Implement stakeholder management strategies, ensuring effective communication and addressing stakeholder concerns throughout the project lifecycle.<br>3.5 Establish a project governance framework, defining roles, responsibilities, and decision- |

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| | making processes to maintain project alignment with organizational objectives.<br>3.6 Monitor and evaluate project progress regularly, adjusting strategies to mitigate risks and resolve issues promptly.<br>3.7 Use project management tools and techniques (e.g., Gantt charts, project management software) to track progress and ensure accountability.<br>3.8 Ensure compliance with industry standards and regulations, addressing any legal or ethical concerns that may arise during the project.<br>3.9 Conduct post-project evaluations, identifying lessons learned and applying them to future projects for continuous improvement. |
| **4. Communicate effectively with project teams, clients, and regulatory bodies.** | 4.1 Demonstrate the ability to communicate project details and progress clearly and concisely with project teams, clients, and stakeholders.<br>4.2 Use appropriate verbal, written, and digital communication tools to convey project information to diverse audiences.<br>4.3 Adapt communication style and tone according to the needs of different stakeholders, including regulatory bodies, clients, and team members.<br>4.4 Provide accurate and timely updates on project status, addressing any issues or concerns effectively.<br>4.5 Employ active listening skills to ensure understanding and foster productive discussions with all parties.<br>4.6 Prepare and deliver professional presentations, reports, and documentation to clients and regulatory bodies.<br>4.7 Engage in constructive feedback processes, incorporating input from clients and stakeholders into project planning and execution.<br>4.8 Ensure compliance with communication protocols and regulatory requirements when interacting with regulatory bodies.<br>4.9 Resolve communication barriers promptly to maintain smooth project operations and client satisfaction. |

**ENE0004 -12: Advanced Topics in Environmental Engineering**

The aim of this unit is to provide learners with an in-depth understanding of emerging trends and advanced technologies in environmental engineering, enabling them to apply these innovations to address contemporary environmental challenges. Learners will analyze case studies of complex environmental engineering issues, examining the solutions implemented and their effectiveness. The unit will focus on evaluating the integration of new technologies, such as smart cities and sustainable infrastructure, in addressing modern environmental concerns.

| Learning Outcome: | Assessment Criteria: |
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| **1. Understand and apply emerging trends and advanced technologies in environmental engineering..** | 1.1. Explain the key emerging trends in environmental engineering, including sustainable practices, green technologies, and advancements in waste management and renewable energy.<br>1.2. Identify and evaluate advanced technologies that contribute to environmental protection and sustainability, such as water treatment innovations, carbon capture systems, and smart grid solutions.<br>1.3. Analyze the impact of emerging environmental technologies on urban planning, infrastructure, and policy-making.<br>1.4. Assess the effectiveness of new technologies in mitigating environmental challenges, including climate change, pollution, and resource depletion.<br>1.5. Investigate the role of data analytics, automation, and artificial intelligence in advancing environmental engineering solutions.<br>1.6. Evaluate the integration of interdisciplinary approaches, combining environmental engineering with fields such as biotechnology, chemistry, and information technology.<br>1.7. Apply emerging technologies to real-world environmental engineering projects, demonstrating their practical benefits and challenges.<br>1.8. Reflect on the ethical considerations and societal implications of adopting new technologies in environmental engineering. |
| **2. Analyze case studies of complex environmental engineering challenges and** | 2.1 Identify and describe the key environmental engineering challenges presented in the case |

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| **solutions.** | studies.<br>2.2 Assess the scope and complexity of the issues involved in the case studies.<br>2.3 Examine the various solutions implemented in each case study to address environmental engineering challenges.<br>2.4 Critically evaluate the effectiveness of the solutions in resolving the identified challenges.<br>2.5 Analyze the environmental, social, and economic impacts of the solutions applied in each case study.<br>2.6 Compare and contrast different approaches to solving similar environmental engineering problems.<br>2.7 Investigate the role of innovation, technology, and sustainability in the proposed solutions.<br>2.8 Provide recommendations for improvement or alternative solutions based on the analysis of case studies.<br>2.9 Communicate findings and conclusions in a structured and clear manner, with supporting evidence. |
| **3. Evaluate the integration of new technologies in addressing modern environmental issues, such as smart cities and sustainable infrastructure.** | 3.1 Critically analyze the role of emerging technologies in environmental sustainability, focusing on smart cities and sustainable infrastructure.<br>3.2 Evaluate the potential benefits and challenges associated with the implementation of smart city technologies in various urban settings.<br>3.3 Assess the impact of new technologies on environmental conservation and resource management within urban infrastructure.<br>3.4 Investigate the integration of renewable energy solutions in smart city designs, such as solar power, wind energy, and energy-efficient buildings.<br>3.5 Examine the role of data analytics, Internet of Things (IoT), and artificial intelligence (AI) in improving environmental monitoring and management in urban areas.<br>3.6 Assess the economic, social, and environmental trade-offs involved in adopting |

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| | cutting-edge technologies in city planning and infrastructure.<br>3.7 Investigate case studies where new technologies have been successfully integrated into environmental solutions within urban environments.<br>3.8 Evaluate policy frameworks and regulations that support or hinder the adoption of new technologies in the context of sustainable development.<br>3.9 Propose strategies for overcoming technological, financial, and political barriers to the effective integration of smart technologies in addressing environmental issues. |
| **4. Research and explore innovative solutions to tackle ongoing environmental challenges.** | 4.1 Identify key environmental challenges currently faced globally, regionally, or locally.<br>4.2 Review and evaluate existing approaches and solutions to address these challenges.<br>4.3 Conduct independent research on emerging technologies, strategies, and practices that offer innovative solutions to environmental problems.<br>4.4 Critically assess the feasibility, sustainability, and impact of innovative solutions on environmental, economic, and social factors.<br>4.5 Investigate case studies or best practices where innovative environmental solutions have been successfully implemented.<br>4.6 Engage with experts, stakeholders, or academic sources to gather diverse perspectives on potential solutions.<br>4.7 Propose new or adapted solutions based on research findings, supporting them with data and evidence.<br>4.8 Communicate the advantages, limitations, and potential outcomes of proposed solutions to relevant audiences or stakeholders.<br>4.9 Continuously monitor developments in the field to ensure proposed solutions remain relevant and effective in addressing evolving environmental challenges. |

## ICTQual AB

Yew Tree Avenue, Dagenham,

London East,United Kingdom RM10 7FN

+44 744 139 8083

Support@ictqualab.co.uk | www.ictqualab.co.uk

**Visit Official Web page**