

Waste management and circular economy systems

Description
<p>This course focuses on the science, engineering, and policy behind sustainable waste practices. Topics include sustainable water management, wastewater management (including water reuse). The purpose of this course is for students to become familiar with and well versed in sustainable concepts and designs for waste management. Consideration of technical, environmental, economic, and social aspects of these concepts is emphasized.</p>
Learning objectives
<p>At the conclusion of this course, students will be able to:</p> <ul style="list-style-type: none"> ● Knowledgeable on multiple technologies and concepts for sustainable water and waste management. ● Proficient in applying methodologies to develop sustainable wastewater and waste management alternative solutions. ● Able to identify environmental, social, and economic issues associated with various wastewater and waste management concepts. ● Able to apply sustainability considerations (environmental, social and economic) including multicriteria decision analysis tools (MCDA) to provide recommendations on most appropriate solutions for a design option or problem.

WEEK	Lectures
1 ST -2 ND	<p>Overview of Wastewater Composition:</p> <ul style="list-style-type: none"> ● Understanding the sources and components of wastes and wastewater. ● Introduction to different types of wastes and wastewater (domestic, industrial, agricultural). <p>Importance of Effective Waster Management:</p> <ul style="list-style-type: none"> ● Exploring the environmental and public health consequences of inadequate waste management. ● Case studies highlighting the impact of poor wastewater management practices. <p>Regulatory Frameworks and Environmental Impact Assessments:</p> <ul style="list-style-type: none"> ● Examination of local and international regulations governing waste management. ● Introduction to environmental impact assessment methodologies.
3 RD -4 TH	<p>Collection Systems and Infrastructure:</p> <ul style="list-style-type: none"> ● Study of various wastewater collection systems (sewer systems, decentralized systems). ● Design considerations and challenges in implementing effective collection systems. <p>Transportation Methods and Considerations:</p> <ul style="list-style-type: none"> ● Overview of transportation methods (collection, pumping, gravity, etc.). ● Case studies on successful transportation systems in urban and rural settings. <p>Case Studies on Successful Collection and Transportation Systems:</p>

	<ul style="list-style-type: none"> ● Guest speakers from municipalities and organizations with effective collection and transportation practices. ● Group discussions on replicable models.
5 TH -6 TH	<p>Methods for Wastewater Characterization:</p> <ul style="list-style-type: none"> ● Techniques for physical, chemical, and biological characterization. ● Techniques for wastewater sampling and analysis. <p>Analytical Techniques for Assessing Wastewater Quality:</p> <ul style="list-style-type: none"> ● Exploration of laboratory techniques and instruments. ● Interpretation of results and their implications for management. <p>Field Demonstrations and case study experience</p> <ul style="list-style-type: none"> ● Visits to waste and wastewater treatment plants and laboratories. ● Hands-on experience in waste facilities.
7 TH -8 TH	<p>Development of Waste Management Plans:</p> <ul style="list-style-type: none"> ● Steps involved in creating comprehensive management plans. ● Group projects to develop sample plans for hypothetical scenarios. <p>Policy Considerations and Implementation Strategies:</p> <ul style="list-style-type: none"> ● Examination of local, national, and international wastewater management policies. ● Role-playing exercises for policy implementation challenges. <p>Guest Lectures from Experts in Policy Development:</p> <ul style="list-style-type: none"> ● Invited experts sharing experiences in developing and implementing wastewater management policies. ● Q&A sessions with the experts.
9 TH -10 TH	<p>Introduction to Wastewater Reuse:</p> <ul style="list-style-type: none"> ● Understanding the concept of wastewater reuse and its potential benefits. ● Differentiating between direct and indirect reuse. <p>Types of Waster Reuse:</p> <ul style="list-style-type: none"> ● Exploration of various applications such as agricultural, industrial, and environmental reuse. ● Case studies on successful waste reuse projects. <p>Benefits and Challenges of Waste Reuse:</p> <ul style="list-style-type: none"> ● Discussion on economic, environmental, and societal benefits. ● Addressing concerns and challenges associated with public perception.
11 TH -12 TH	<p>Specifics of Agricultural Wastewater:</p> <ul style="list-style-type: none"> ● Understanding the unique characteristics of wastewater generated from agricultural activities. ● Identification of common contaminants in agricultural wastewater. <p>Contaminants in Agricultural Wastewater:</p> <ul style="list-style-type: none"> ● Analysis of contaminants, including nutrients, pesticides, and pathogens. ● Implications for soil and water quality. <p>Case Studies of Successful Agricultural Wastewater Management:</p> <ul style="list-style-type: none"> ● Exploration of innovative and sustainable agricultural wastewater management practices. ● Guest speakers from the agriculture industry.
13 TH -14 TH	<p>Techniques for Treating and Reusing Agricultural Wastewater:</p> <ul style="list-style-type: none"> ● Overview of treatment methods suitable for agricultural wastewater. ● Practical demonstrations of treatment technologies. <p>Integrated Approaches for Sustainable Agriculture:</p>

	<ul style="list-style-type: none"> ● Examining holistic approaches that integrate waste and wastewater management with sustainable agricultural practices. ● Field trips to farms implementing successful integrated approaches. <p>Field Trips to Sites Implementing Wastewater Reuse:</p> <ul style="list-style-type: none"> ● Visits to agricultural facilities to observe real-world applications of wastewater reuse. ● Student presentations on observations and learnings.
15 TH	<p>Innovations in Waste and Wastewater Management:</p> <ul style="list-style-type: none"> ● Exploration of cutting-edge technologies and innovations in the field. ● Group discussions on potential future developments. <p>Advances in Monitoring and Control Systems:</p> <ul style="list-style-type: none"> ● Introduction to smart monitoring and control systems for efficient waste management. ● Case studies on successful implementation of advanced systems. <p>Future Prospects and Research Opportunities:</p> <ul style="list-style-type: none"> ● Discussion on ongoing research and potential areas for future exploration. ● Student presentations on proposed research projects (final exam).

Assignments – project

1. Group Projects on Waste and Wastewater Management Plans: Groups will develop a practical wastewater management plan for a given scenario.
2. Case Study Analysis: Individual or group analysis of a real-world case study related to waste and wastewater management.

Exams, marking and student assessment

Project(s) 70%, Written exam(s): 30%