

The Hong Kong University of Science and Technology

UG Course Syllabus Template

Title: Green Technology for Sustainable Development

Code: CIVL4100V

Credits: 3

Prerequisite: CIVL2410

Name: Prof. Dan Tsang

Email: cedan@ust.hk

Office Hours: Rm 5560, after lecture (11:50-12:50, Thursday)

Course Description

This course covers the recent applications of environmentally friendly and green technology for long-term decarbonization (e.g., carbon capture, utilization, and sequestration), green remediation, sustainable energy, sustainable construction materials, and value-added waste upcycling. The course covers examples of interfacial and catalytic reactions in industry that are environmentally sustainable, in terms of reducing material use, toxic by-product emission, and waste generation. The course will review the underlying principles and new concepts of environmental chemistry as well as material design and fabrication, followed by the discussion of performance and limitations in the context of scientific research and field applications in civil and environmental engineering.

This course equips students with the fundamental principles and concepts in green technologies, enabling them to better understand and evaluate emerging technologies in strategic areas such as long-term decarbonization, renewable energy, waste upcycling, and environmental remediation. These are multi-disciplinary by nature and require an understanding of engineering designs and fundamental science. This course will cover both theories and practical applications of these emerging topics in the era of carbon neutrality.

Intended Learning Outcomes (ILOs)

By the end of this course, students should be able to:

1. Recognize the role of green technologies in today's sustainability agenda from the national and global perspectives.
2. Explain the principles, properties, functions, limitations, and mechanisms of green technologies.
3. Communicate how green technologies work in diverse applications including environmental decontamination, biomass waste valorization, energy and chemical production, gas and water treatment, etc.
4. Critically evaluate chemical processes using green chemistry metrics and propose viable solutions for improvements.

Assessment and Grading

This course will be assessed using criterion-referencing and grades will not be assigned using a curve. The evaluation of student performance is strictly based on whether students have achieved the defined learning outcomes. Your grade will depend entirely on your own mastery of the material and fulfillment of the grading rubrics, regardless of how your peers perform.

Detailed rubrics for each assignment are provided below, outlining the criteria used for evaluation.

Assessments:

[List specific assessed tasks, exams, quizzes, their weightage, and due dates; perhaps, add a summary table as below, to precede the details for each assessment.]

Assessment Task	Contribution to Overall Course grade (%)	Due date
Mid-Term Exam	40%	22 October 2026
Critical Review Essay	20%	3 December 2026
Final Exam	40%	Exam Week

* Assessment marks for individual assessed tasks will be released within two weeks of the due date.

Mapping of Course ILOs to Assessment Tasks

Assessed Task	Mapped ILOs	Explanation
Mid-Term Exam	ILO1, ILO2, ILO3, and ILO4	This exam evaluates all four learning outcomes within the context of the environmental module. It assesses students' ability to recognize the role of green environmental technologies in the global sustainability agenda (ILO 1), explain their fundamental principles and mechanisms (ILO 2), communicate how they are applied in decontamination and treatment scenarios (ILO 3), and critically evaluate these environmental processes using green metrics under exam conditions (ILO 4).
Critical Review Essay	ILO2, ILO3, and ILO4	This essay comprehensively assesses the learning outcomes by requiring students to integrate complex principles (ILO 2) and effectively communicate how a selected green technology works in diverse applications (ILO 3). Furthermore, it requires students to critically evaluate chemical processes using green chemistry metrics (ILO 4) while synthesizing the technology's broader role.
Final Exam	ILO1, ILO2, ILO3, and ILO4	Mirroring the mid-term's level of rigor, this exam evaluates all four learning outcomes with a specific focus on construction materials. It tests students' ability to recognize the

	sustainability role of green construction materials (ILO 1), explain the principles and mechanisms of sustainable cementitious materials (ILO 2), communicate their applications in infrastructure (ILO 3), and critically evaluate these material processes and designs (ILO 4).
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Grading Rubrics

Rubric for Critical Review Essay (20%)

Criteria	Excellent (A-level)	Good (B-level)	Satisfactory (C-level)	Marginal/Fail (D/F-level)
Understanding of Green Tech (ILO 2)	Demonstrates deep, comprehensive understanding of the chosen green technology; integrates complex environmental/cement principles seamlessly.	Shows solid understanding of the main green tech concepts with accurate explanations of mechanisms.	Possesses adequate knowledge but explanations of mechanisms or principles are superficial.	Demonstrates insufficient understanding; major inaccuracies in describing the technology.
Critical Evaluation (ILO 4)	Highly insightful evaluation using green chemistry metrics; proposes highly viable, creative solutions.	Good analysis of the processes; identifies valid areas for improvement using green metrics.	Some capacity for analysis, but evaluation is largely descriptive rather than critical.	Lacks analytical depth; fails to apply green metrics or propose viable solutions.
Communication & Argumentation (ILO 3)	Exceptionally clear, well-structured, and persuasive. Writing is professional with flawless formatting and citation.	Clear and organized arguments. Writing is coherent with minor formatting or citation errors.	Basic organization. Arguments are sometimes hard to follow; several writing/citation errors.	Disorganized, unclear communication; missing citations or poor writing quality.

Rubric for Mid-Term and Final Exams (40% each)

Criteria	Excellent (A-level)	Good (B-level)	Satisfactory (C-level)	Marginal/Fail (D/F-level)
ILO 1: Role of Green Technology	Demonstrates a comprehensive and highly insightful recognition of how specific technologies (environmental or construction) drive global and national sustainability goals.	Shows a solid understanding and good recognition of the broader sustainability context, with mostly accurate connections to national and global agendas.	Possesses a basic recognition of sustainability goals, but connections to the specific technologies are vague or superficial.	Fails to recognize or accurately connect the technologies to broader national or global sustainability agendas.
Recognize the role of green technologies in today's sustainability agenda from the				

national and global perspectives.				
ILO 2: Principles & Mechanisms	Provides flawless, in-depth explanations of complex chemical and physical mechanisms, properties, and limitations of the covered technologies.	Explains the fundamental principles, properties, and mechanisms well, with only minor gaps or inaccuracies in understanding.	Provides basic definitions, but mechanistic reasoning and explanations of limitations are flawed, incomplete, or superficial.	Exhibits incorrect, insufficient, or entirely missing explanations of core principles, properties, and mechanisms.
Explain the principles, properties, functions, limitations, and mechanisms of green technologies.				
ILO 3: Diverse Applications	Exceptionally clear and accurate communication of how the technologies are applied in complex, real-world decontamination, treatment, or infrastructure scenarios.	Clear communication of technological applications with mostly accurate details and solid contextual understanding.	Basic description of applications provided, but struggles to clearly communicate exactly how the technology functions in a real-world scenario.	Unclear, disorganized, or incorrect communication of how the technologies are practically applied.
Communicate how green technologies work in diverse applications.				
ILO 4: Critical Evaluation	Highly insightful evaluation under exam conditions. Accurately applies green metrics and proposes highly viable, well-reasoned solutions to complex problems.	Good analytical evaluation. Competently applies green metrics and proposes valid solutions for standard problems.	Demonstrates some capacity for evaluation, but struggles to correctly apply green metrics or proposes unviable solutions.	Lacks analytical depth; fails to apply green chemistry metrics or cannot propose solutions for improvements.
Critically evaluate chemical processes using the green chemistry metrics and propose viable solutions for improvements.				

Final Grade Descriptors:

Grades	Short Description	Elaboration on subject grading description
A	Excellent Performance	Demonstrates a comprehensive and profound grasp of green technologies and sustainable development. Exhibits expertise in applying principles of environmental chemistry and material science to solve complex decontamination and infrastructure challenges. Shows significant analytical capability in using green metrics to critically evaluate and propose innovative, sustainable solutions. Goes beyond core requirements, showing deep insight into both national and global sustainability agendas.
B	Good Performance	Shows good knowledge and understanding of the core concepts in green technologies across both environmental and cementitious applications. Demonstrates competence in applying fundamental mechanisms to familiar problems and possesses a

		strong ability to analyze and evaluate chemical processes using green metrics. Displays consistent effort and the ability to clearly communicate diverse technological applications.
C	Satisfactory Performance	Possesses adequate knowledge of the core principles of green technologies. Shows competence in dealing with familiar environmental and construction material problems but has limited capacity for deep critical evaluation or advanced application of green metrics. Demonstrates sufficient effort to communicate basic applications and achieve the broadly defined course learning outcomes.
D	Marginal Pass	Has threshold knowledge of green technology concepts and sustainable engineering principles. Shows the potential to achieve key analytical skills but struggles to independently evaluate chemical processes or propose viable solutions using green metrics. Can make basic judgments regarding sustainability but exhibit significant gaps in mechanistic understanding.
F	Fail	Demonstrates insufficient understanding of green technologies and lacks the necessary scientific and engineering problem-solving skills. Shows limited ability to apply green metrics, think critically about environmental or cementitious processes, and exhibits minimal effort towards achieving the course learning outcomes. Does not meet the threshold requirements for further development in the discipline.

Course AI Policy

The use of Generative AI tools is permitted for language editing of the Critical Review Essay, provided that their use is completely transparent. If you use AI tools to assist in your writing or research, you must include an "AI Acknowledgment Statement" at the end of your essay detailing exactly which tools were used and how.

Communication and Feedback

Assessment marks for individual assessed tasks will be communicated via Canvas within two weeks of submission. Feedback on assignments will include strengths and areas for improvement. Students who have further questions about the feedback, including marks, should consult the instructor within five working days after receiving the feedback.

Required Texts and Materials

Lecture notes will be provided.

Academic Integrity

Students are expected to adhere to the university's academic integrity policy. Students are expected to uphold HKUST's Academic Honor Code and to maintain the highest standards of academic integrity. The University has zero tolerance for academic misconduct. Please refer to [Academic Integrity | HKUST – Academic Registry](#) for the University's definition of plagiarism and ways to avoid cheating and plagiarism.

Additional Resources

Course Content

Week	Lecture Topics (Linked to Green Technologies)
1	Redox: Basic principles of redox reactions in green technologies and sustainable engineering
2	Precipitation/Crystallization: Basic principles of mineral formation and transformation in green technologies and sustainable engineering
3	AOPs (Advanced Oxidation Processes): Eco-friendly approaches to green remediation and biorefinery
4	Microwave: Energy-efficient microwave applications in sustainable engineering and green technology
5	Electrochemistry: Green electrochemical methods for decontamination and sustainable energy
6	Mechanochemical Activation: Solvent-free green chemistry applications for sustainable engineering and green technology
7	Mid-Term Examination (40%)
8	S/S (Stabilization/Solidification): Green technologies for waste containment
9	SCMs (Supplementary Cementitious Materials): Waste upcycling for sustainable construction
10	Low-Carbon Cement: Emerging paradigms for decarbonization in infrastructure
11	Durability: Enhancing the lifecycle and sustainability of green cementitious materials
12	CO₂ Curing: Carbon capture, utilization, and sequestration within building materials
13	Sensing/Storage: Smart technologies for sustainable energy storage and structural health
TBD	Final Examination (40%)