Annexe A: New/Revised Course Content in OBTL+ Format

Course Overview

The sections shown on this interface are based on the templates UG OBTL+ or PG OBTL+
If you are revising/duplicating an existing course and do not see the pre-filled contents you expect in the subsequent sections e.g. Course Aims, Intended Learning Outcomes etc. please refer to Data Transformation Status for more information.

Expected Implementation in Academic Year	AY2020-2021
Semester/Trimester/Others (specify approx. Start/End date)	Semester 1
Course Author * Faculty proposing/revising the course	Lee-Chua Lee Hong
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Course Title	Solid and Hazardous Waste Management
Course Code	EN3001
Academic Units	3
Contact Hours	39
Research Experience Components	Not Applicable

Course Requisites (if applicable)

Pre-requisites	Year 3 standing
Co-requisites	
Pre-requisite to	
Mutually exclusive to	
Replacement course to	
Remarks (if any)	

Course Aims

To provide an understanding of solid and hazardous waste engineering principles and management issues.

Municipal solid waste properties, generation, collection, management, recycling, treatment, disposal;
Hazardous waste properties, generation, management, containment, treatment.

Course's Intended Learning Outcomes (ILOs)

Upon the successful completion of this course, you (student) would be able to:

ILO 1	Explain integrated solid and hazardous waste management;
ILO 2	Assess and predict waste sources, characteristics, generation, collection, transfer and transport;
ILO 3	Assess and design waste recycling, reuse, recovery, treatment and disposal;
ILO 4	Explain industrial waste management issues and productivity;
ILO 5	Assess hazardous treatment and disposal.

Course Content

	Topic
1.	Integrated solid waste management
2.	Waste characteristics, generation, handling, collection, and transfer
3.	Waste minimization and processing
4.	Biochemical waste conversion
5.	Thermal waste transformation
6.	Solid waste disposal
7.	Hazardous waste management

Reading and References (if applicable)

Readings are revised year to year to keep up with the latest development in the subject. Other more classic readings are mostly from the following books:

1. Tchobanoglous, G., Theisen, H and Vigil, S., “Integrated Solid Waste Management”, McGraw-Hill, New York, 1993.
2. Vesilind, P.A., Worrell, W., and Reinhart, D., "Solid Waste Engineering", Brooks/Cole, 2002.
3. LaGrega, M, Buckingham, P. and Evants, J.C., “Hazardous Waste Management”. McGraw-Hill, New York, 2001.

Planned Schedule

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
1	Integrated solid waste management	1			Tutorials & Lectures
2	Integrated solid waste management & Waste characteristics, generation, handling, collection, and transfer	1, 2			Tutorials & Lectures
3	Waste characteristics, generation, handling, collection, and transfer	2, 3			Tutorials & Lectures
4	Waste minimization and processing	3			Tutorials & Lectures
5	Waste minimization and processing & Biochemical waste conversion	3, 4			Tutorials & Lectures
6	Biochemical waste conversion	4			Tutorials & Lectures
7	Thermal waste transformation	5			Tutorials & Lectures
8	Thermal waste transformation & Solid waste disposal	5, 6			Tutorials & Lectures

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
9	Solid waste disposal	6			Tutorials & Lectures
10	Hazardous waste management	7			Tutorials & Lectures
11	Hazardous waste management & Hazardous waste treatment	7, 8			Tutorials & Lectures
12	Hazardous waste treatment	8, 9			Tutorials & Lectures
13	Hazardous waste reutilization	9			Tutorials & Lectures

Learning and Teaching Approach

Approach	How does this approach support you in achieving the learning outcomes?
Lectures	Weekly lectures to provide you with the specific knowledge and techniques to achieve the learning outcome stated above.
Tutorials	Weekly tutorials to guide problem solving and provide face-to-face feedback.

Assessment Structure

Assessment Components (includes both continuous and summative assessment)

No.	Component	ILO	Related PLO or Accreditation	Weightage	Team/Individual	Rubrics	Level of Understanding
1	Continuous Assessment (CA): Project(Team Project)	1 to 5	ENE SLO* a b c d e f g h i j	40	Team	Analytic	Relational
2	Summative Assessment (EXAM): Final exam(Final Exam)	1 to 5	ENE SLO* a b c d f g k	60	Individual	Holistic	Relational

Description of Assessment Components (if applicable)

ENE SLOs: Student Learning Outcome for Environmental Engineer Programme

a. Engineering knowledge: Apply the knowledge of mathematics, natural science, engineering fundamentals, and environmental engineering specialisation to the solution of complex environmental engineering problems.

b. Problem Analysis: Identify, formulate, research literature, and analyse complex environmental engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design/development of Solutions: Design solutions for complex environmental engineering problems and design system components or processes with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

d. Investigation: Conduct investigations of complex problems using research-based knowledge and methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex environmental engineering activities with an understanding of the limitations.

f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and the need for the sustainable development.

h. Ethics: Apply ethical principles and commit to professional and moral responsibilities in the environmental engineering practice.

i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary settings.

j. Communication: Communicate effectively on complex environmental engineering activities with the engineering community and with society at large, be able to comprehend and write effective reports and design documentation, and make effective presentations.

k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and economic decision-making, and apply these to work, as a member and leader in a multidisciplinary team.

l. Life-long Learning: Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological evolution.

Formative Feedback

Instructors take questions during and at the end of lectures, and provide on-the-spot clarifications. You can also confer with the instructors via appointed consultations or email.

You are assessed on a final exam and a team project. You will be informed of the feedback and grade of the project.

NTU Graduate Attributes/Competency Mapping

This course intends to develop the following graduate attributes and competencies (maximum 5 most relevant)

Attributes/Competency	Level
Care for Environment	Advanced
Care for Society	Intermediate
Collaboration	Intermediate
Problem Solving	Intermediate
Critical Thinking	Intermediate

Course Policy

Policy (Academic Integrity)

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values. As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the academic integrity website for more information. On the use of technological tools (such as Generative AI tools), different courses / assignments have different intended learning outcomes. Students should refer to the specific assignment instructions on their use and requirements and/or consult your instructors on how you can use these tools to help your learning. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Policy (General)

You are expected to take responsibility to follow up with course notes, assignments and course related announcements. You are also expected to participate in class discussions.

Policy (Absenteeism)

Valid reasons include falling sick supported by a medical certificate and participation in NTU's approved activities supported by an excuse letter from the relevant bodies. There will be no make-up opportunities for in-class activities.

Policy (Others, if applicable)

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