



**UNIVERSITI KUALA LUMPUR
MALAYSIAN INSTITUTE OF CHEMICAL & BIOENGINEERING
TECHNOLOGY**

**FINAL EXAMINATION
OCTOBER 2025 SEMESTER**

COURSE CODE	: CCB 40702
COURSE NAME	: SOLID AND HAZARDOUS WASTE MANAGEMENT
PROGRAMME NAME	: BACHELOR OF CHEMICAL ENGINEERING WITH HONOURS
DATE	: 29 JANUARY 2026
TIME	: 09.00 AM - 12.00 PM
DURATION	: 3 HOURS

INSTRUCTIONS TO CANDIDATES

1. Please read **CAREFULLY** the instructions given in the question paper.
2. This question paper has information printed on both sides of the paper.
3. This question paper contains a total of **FIVE (5)** questions. Answer **ALL** questions.
4. Answer **ALL** questions in English language only.
5. Please write your answers on the answer booklet provided.

THERE ARE 4 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

INSTRUCTION: Answer ALL questions (100 marks)**Question 1**

- (a) Neutralization Underflow Residue (NUF) from Lynas Malaysia is a by-product of rare earth processing at the Gebeng plant in Kuantan. It is a synthetic gypsum material, non-radioactive and non-toxic, that has been proposed for use in construction and soil conditioning, offering both economic and environmental benefits. Define the following stages in a waste management system and explain how each is applied in the Lynas NUF secure landfill project:

- Waste identification
- Waste characterization
- Waste collection and storage
- Waste treatment and disposal

(10 marks)

- (b) Environmental Impact Assessment (EIA) is a systematic process used to evaluate the potential environmental, social, and economic consequences of proposed projects, plans, or policies before they are implemented. It serves as a decision-making tool to ensure that development activities are sustainable, environmentally responsible, and socially acceptable. Determine **FIVE (5)** possible stakeholders in the EIA (Environmental Impact Assessment) study.

(5 marks)

- (c) Thermal treatment systems are engineered facilities designed to manage hazardous waste by applying high-temperature processes that destroy, neutralize, or reduce the toxicity and volume of waste materials. These systems are widely used when hazardous waste cannot be safely recycled, reused, or landfilled due to their chemical or biological risks. Determine **FIVE (5)** advantages of pyrolysis and gasification over incineration.

(5 marks)

Question 2

- (a) Field investigation helps in creating a comprehensive understanding of the site's conditions, guiding the design and implementation of remediation strategies if necessary. Determine **FIVE (5)** most common field investigation techniques used to characterize a potentially impacted or contaminated site.

(10 marks)

- (b) Compare the waste minimization strategies adopted by Lynas with standard practices in hazardous waste management and evaluate how the potential commercialization of NUF (Neutralization Underflow Residue) aligns with the principles of the waste hierarchy.

(10 marks)

Question 3

- (a) Hazardous waste management refers to the systematic process of handling, treating, and disposing of wastes that pose significant risks to human health, ecosystems, and the environment due to their toxic, corrosive, flammable, or reactive properties. It involves a structured framework of policies, technologies, and practices designed to minimize harm while ensuring compliance with regulatory standards. Determine **FIVE (5)** hazardous waste management techniques.

(5 marks)

- (b) Solid waste management ensures that waste materials are handled responsibly throughout their lifecycle, reducing risks to human health and the environment while fostering efficiency, sustainability, and circular economy principles. Determine the **FIVE (5)** criteria of *green technology* to improve solid waste management.

(5 marks)

- (c) The hierarchy of solid waste management is a structured framework that prioritizes waste handling methods according to their environmental impact, economic efficiency, and sustainability. It serves as a guiding principle for governments, industries, and communities to manage waste responsibly. Determine **FIVE (5)** steps in hierarchy of solid waste management.

(5 marks)

- (d) 193 members of the United Nations signed the 2030 Agenda for Sustainable Development Goals (SDGs) in 2015. The 17 Sustainable Development Goals (SDGs) that underpin this agenda that assists as a roadmap of the sustainable world. Determine the **FIVE (5)** SDGs targets by DOE.

(5 marks)

Question 4

- (a) Waste management and contaminated land remediation can generate significant economic value. Discuss **FIVE (5)** economic opportunities arising from the assessment, treatment, and remediation of contaminated sites in Malaysia. Use examples relevant to the guideline's processes (Phase I ESA (Environmental Site Assessment), Phase II ESA, risk assessment, remediation).

(10 marks)

- (b) Malaysia has previously used the cradle-to-grave approach. This technique begins with the extraction of raw materials, then moves on to the manufacturing process, product consumption, and ultimately product disposal. Priority is given to disposal over resource recovery. It has given rise to environmental issues such as illicit dumping. In a linear economy, raw natural resources are extracted, processed into goods, and then discarded. A circular economy model, on the other hand, seeks to bridge the gap between the cycles of production and natural ecosystems. Identify **FIVE (5)** gaps a circular economy model is seeking.

(10 marks)

Question 5

- (a) The principles of radioactive waste management are vital for ensuring the safety of people and the environment from the harmful effects of radioactive materials. Apply **FIVE (5)** principles of Radioactive Waste Management to guide the design, operation, and regulation of radioactive waste management facilities to ensure safety and sustainability.

(10 marks)

- (b) Contaminated land refers to areas of soil, groundwater, or surface environments that have been polluted by hazardous substances due to human activity or natural processes. These contaminants may include heavy metals, hydrocarbons, pesticides, industrial chemicals, or waste residues, and they pose risks to human health, ecosystems, and economic development if not properly managed. Explain the purpose of conducting an Initial Assessment (Phase I ESA: Environmental Site Assessment) according to the Malaysian contaminated land guidelines.

(5 marks)

- (c) Describe how the findings of Phase I ESA (Environmental Site Assessment) influence the selection of suitable remediation or waste treatment methods.

(5 marks)

END OF EXAMINATION PAPER

