

TECHNICAL ESSAY

THEME

Synergising Chemical Engineering and Sustainable Microelectronics for a Greener Future

THEME DESCRIPTION

The microelectronics industry is the foundation of modern technology, powering essential devices from smartphones to advanced computing systems. Nonetheless, this advancement has incurred considerable environmental expenses. As the demand for more powerful and efficient microelectronics increases, so too does the energy consumption, resource depletion, and development of electronic trash (e-waste) linked to their manufacturing.

Microelectronics manufacturing, particularly semiconductor fabrication and nanomaterial synthesis, is among the most resource-intensive industrial processes, consuming significantly more energy than conventional material processing. The business significantly relies on essential raw minerals like gallium and indium, which are at risk of supply constraints within the next two decades due to increased demand and limited natural reserves. The improper disposal of microelectronic components, including printed circuit boards and semiconductor chips, contributes to environmental pollution and potential emissions from hazardous substances, with global waste projections reaching 74.7 million metric tonnes by 2030.

The production of microelectronics has considerable environmental consequences, including resource extraction, high energy consumption, and toxic emissions. Semiconductor etching, an essential process, depends on fluorinated gases such as CF_4 and NF_3 , which possess significant global warming potentials. It also generates wastewater pollutants, including PFAS, which threaten water quality and public health. The escalating problem of e-waste underscores the necessity for more sustainable procedures in microelectronics industries.

The theme, "Synergising Chemical Engineering and Sustainable Microelectronics for a Greener Future," underscores the vital contribution of chemical engineering to promoting sustainability in the microelectronics sector. This theme promotes the integration of chemical engineering concepts with advanced green technologies, urging participants to create new, environmentally friendly solutions that mitigate environmental damage, enhance resource circularity, and foster a sustainable, low-carbon future. By addressing these challenges, this theme aligns with key Sustainable Development Goals (SDGs), including SDG 9 (Industry,

Innovation, and Infrastructure), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action), fostering a more sustainable and responsible future for the microelectronics industry.

Key focus areas include:

- Identifying and creating safer, sustainable alternatives to hazardous compounds in microelectronics manufacturing, thereby mitigating toxicity and environmental dangers.
- Developing and implementing energy-efficient and low-carbon manufacturing techniques that optimize resource utilization, minimize emissions, and enhance overall efficiency in microelectronics production..
- Implementing effective recycling and resource recovery systems to recover valuable materials, prolong the lifespan of microelectronic components, and advance towards a circular economy.

This theme utilises chemical engineering expertise to push participants to devise practical and significant ways that integrate sustainability with technological progress. By integrating chemical engineering with sustainable microelectronics, we can create a more environmentally responsible future for the microelectronics sector.

OBJECTIVES

- To give aspiring engineers a foundational understanding and creative thinking.
- To provide individuals a place to improve their research and technical writing abilities.
- To promote future research and development engineering concepts for impactful solutions.

COMPETITION DESCRIPTION

- This is an **INDIVIDUAL** competition which will be conducted **via ONLINE**.
- Each university/institution may enroll a maximum of **SEVEN (7)** participants in this competition.
- Each participant will be assigned to create an essay that demonstrates the topic relating to the competition's theme which will be provided during the participants' briefing session on the **18th of October 2025**.

ELIGIBILITY

- For an individual competition, participants must be **full-time undergraduate students** enrolled in the **Chemical Engineering Program** (or equivalent) offered by universities / institutions.
- Participants must submit an **APPROVED** original copy of their **student identity card (Matric Card)** together with the **LATEST module registration** file.
- Each participant is only allowed to participate in **ONE (1) physical mode competition** and **ALL online mode competitions**.

FORMAT

Essay Guidelines

- Language: **English**
- Length: Between **700 to 1000** words (Excluding abstract and references)
- Abstract: Not more than **250** words
- Include **SPECIFIC ESSAY TITLE, NAME, IC NUMBER, CONTACT NUMBER** and **E-MAIL ADDRESS** of participants in the cover page of the participating entry.
- Cover page template will be given during the briefing session held on the 18th of October 2025.
- An essay must consist of:
 - **Specific essay title**
 - **Abstracts**
 - **Significance of finding**
 - **Content**
 - **Conclusion**
 - **References**
 - **Appendix**

Essay Format

All submission must follow the following format:

- Font type: **Times New Roman**
- Font size: **12 pt.**
- Spacing: **1.5 pt.**
- Page Layout: **Standard A4 size (210mm × 297 mm)**

- Margin: Left to Right: 2.54 cm
Top to Bottom: 2.54 cm
- The text must be justified and the paragraphs are separated by 6 pt. with indentation of 12 mm from the left.
- References should appear in a reference list at the end of the essay and should follow the APA 7th referencing style format.
- Page numbers should be included except for the cover page.
- The title of the essay needs to be at the centre of the page and the writing needs to be typed in **UPPERCASE (BOLD 14 PT)**.

RULES AND REGULATIONS

- Each university/institution is entitled to send a maximum of **SEVEN (7)** participants.
- For an online competition, each participant is entitled to **ONE (1)** submission only.
- The submitted work must be of original work. Plagiarism is **STRICTLY PROHIBITED**.
- Any essay that has been sent after **SUBMISSION DEADLINES** will be **IGNORED**.
- Political and '3R' (Race, Religion and Royalty) contents are **NOT ALLOWED**.
- Decisions by judges are **FINAL** and **NOT** open to appeal.
- Late submissions will not be entertained under any circumstances.
- Entries that do not comply with any of the above rules will be **AUTOMATICALLY DISQUALIFIED**.
- Upon submission, any modification on the contents is not allowed. Evaluators have the right to penalise the participating team for the change of contents.

SUBMISSION GUIDELINES

- Submission deadline: **15 November 2025**
- A submission can only be made **SIX (6) days** before the submission deadline: **10 November 2025 - 15 November 2025**.

Submission Format

- Email: regnaces.usm@gmail.com
- Email Subject: [TEW]_Name of University/Institution_Individual Name
- Example: [TEW]_USM_LUQMAN BIN AHMAD

- All receipts of successful submissions will be notified via the provided email within 3 business days. If the participants do not receive any replies from us, please do not hesitate to contact the organizer.

JUDGEMENT CRITERIA

Content (60%)

- **Critical Analysis:**
 - Depth of knowledge
 - Relevance to the topic
 - Originality and innovation
 - Accuracy of the information
 - Problem-solving and practical application
 - Use of evidence and example
 - Scope research
 - Conclusion and impact
 - Complexity handling
 - Comprehensive information
 - Economics

Format (20%)

- Structure of essay
- APA format citation
- Template
- Page layout

Language (20%)

- Grammar
- Sentence structure
- Choice of words (Tone and formality)

RESULT

The winners of the competition will be announced during the NACES 2025 Closing Ceremony on 14 December 2025.

PRIZES

1st Prize - RM 170

2nd Prize - RM 140

3st Prize - RM 120

All prizes were subjected to increment based on decisions from the organizer.

IMPORTANT NOTES

- Each participant must agree to be bound by the official contest rules. The organizer has all the rights to eliminate or disqualify any participants that violate the guidelines as stated above. Such actions may be taken by the host without any prior notice.
- The judges' decisions are final and any appeals to the decisions will not be entertained.
- Participants must complete the registration form by the **10th of October 2025** to be eligible for participation.
- Any changes on the confirmed participants' list must be informed before the **17th of October 2025**. Any changes after the date will not be entertained.
- Organisers will hold the right to publish submitted presentations for future publications without prior notice to the participants. Kindly notify the organiser if you have a patent or a copyright reserved.
- Registration fees are non-refundable.
- The contents of this booklet are subjected to amendment and improvisation. Participants will be notified when the amendments are made.

CONTACT INFORMATION

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