**TECHNICAL CASE STUDY & PRESENTATION**

## 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 enhance understanding and generate awareness about incorporating contemporary technology into manufacturing processes and optimizing operational efficiency.
- To enhance and develop critical and multi-dimensional logical thinking skills.
- To foster the development of problem-solving abilities and the practical application of engineering knowledge.

**COMPETITION DESCRIPTION**

- This is a **GROUP** competition, with **THREE (3) participants per team**, and will be conducted **PHYSICALLY**.
- Each university/institution may enroll a maximum of **THREE (3)** teams in this competition.
- Each team will be assigned a task to prepare a presentation according to the issues that will be provided during the participant briefing session on **18 October 2025**.
- Participants should use their creativity to come up with an original solution or solutions to the problems presented, considering both the financial and environmental implications.
- Each team is required to search, study, and select realistic and practical solutions for the given issues and should be able to explain the process in detail to showcase teamwork and research skills.
- The presentation will be done in **FACE TO FACE mode** on **13th December 2025**. A **Q&A SESSION** follows afterwards.

**ELIGIBILITY**

- For group competition, **ALL** participants must be **full-time undergraduate students**. At least **TWO (2)** participants must be **full-time undergraduate students** enrolled in the **Chemical Engineering Program** (or equivalent) offered by one of the participating universities / institutions.
- In case of any emergency, the team may approach the organisers regarding any changes on the participants presenting during the physical competition. The organiser will have the final decision regarding the changes.
- 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** are allowed to participate.
- Each participant in a team must be from the **SAME** university / institution.
- Each participant is only allowed to join **ONE (1)** team.

**FORMAT**

- Dress code: **Formal / Smart Casual**

- Venue: **Lecture Hall Complex, USMKKJ**
- The competition is carried out in **English**.
- Each team must submit a presentation slide in both **pptx** and **pdf**.
- Every participant is **compulsory to present**.
- All presentation slides must be created in **Microsoft Office PowerPoint**, with a maximum limit of **SEVENTEEN (17) SLIDES**.
- Citation needs to be included as footnotes if any form of references is used in the presentation slides production according to APA 7th reference style. The citation must include the following details: author, year, title, journal title, and volume page number (if any).
- The sequence of each team's presentations will be determined by lot.
- Each team will be given **5 MINUTES** for technical set up, **15 MINUTES** for presentation of their case study and followed by a **10-MINUTE** Q&A session with the judges, where the judges can ask questions or provide comments.
- During the presentation, each team will be alerted twice during the **12th** minute with a bell ring, indicating that the presentation should end in three minutes. The last notification on the **15th** minute will indicate that the time allocated is up and participants shall stop.
- Teams exceeding the time limit may be imposed with mark deduction.

**RULES AND REGULATIONS**

- Each university/institution is entitled to send a maximum of **THREE (3) teams**.
- Each team must consist of **THREE (3) members**.
- The competition will be done **PHYSICALLY** at **Lecture Hall Complex, USMKKJ**.
- For physical competition, the use of electronic external aids is strictly prohibited. If an objection with evidence is received, the team's participation will be **DISQUALIFIED** immediately.
- The competition should not have appeared in any publications other than in school publications. Participants need to ensure that they have acquired permission to use any resources having the copyright.
- Rude, abusive or aggressive behaviour in both instances, will lead to deduction of marks.
- 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 one 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.

**SOFT COPY POWERPOINT SLIDES SUBMISSION**

- Submission deadline: **5 December 2025**
- Submissions can only be made **ONE week** before the submission deadline (**29 November 2025 - 5 December 2025**). Any soft copy materials that are not submitted online shall not be displayed during the physical presentation.
- All the soft copy materials must be submitted in both **pptx** and **pdf** format together and reached the organiser (via email) before the submission deadline.

**Submission Format**

- Email: regnaces.usm@gmail.com
- Email Subject: **[TCS&P]_Name of University/Institution_Team Name**
- Example: **[TCS&P]_USM_Team01**
- All successful receipt of submissions will be notified via the provided email within 3 working days. If the participants do not receive any reply from us, please do not hesitate to contact the organizer.

**JUDGEMENT CRITERIA**

- **CONTENT**
  - Definition of the term.
  - Problem statement - Address the issue(s).
  - Suggest solution(s).
  - Challenges Conclusion and Recommendation.
  - Participants are required to do research and give practical solution(s) based on the given issues in the case study.
  - The way(s) to solve the issues are based on their own creativity while considering the environmental effect and economic worth.
- **PRESENTATION SKILLS**
  - Loud voice and usage of clear language.

- Attractiveness and well organised slide presentation.
- Context of the presentation has to be very clear and justified with reference.

- **QUESTION-AND-ANSWER SESSION**
  - Clarity of responses.
  - Displays ingenuity and ability to answer questions.
  - Justifications of every argument made by the judges.
  - The justification must be supported with the fundamental knowledge of chemical engineering.
  - Effectiveness of the team and teamwork.

**RESULT**

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

**PRIZES**

1st Prize: RM 830

2nd Prize: RM 720

3rd Prize: RM 550

*All prizes are 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 **10 October 2025** to be eligible for participation.
- Any changes on the confirmed participants' list must be informed before **17 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 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**


Phone : Bernice Chew Ching Siew (+6017-8947708)
Tee Jia Lin (+6012-4459108)

Email : regnaces.usm@gmail.com

Website : https://naces.eng.usm.my

Instagram : NACES USM

Facebook : usmnaces_2025

LinkedIn : NACES USM