Second Semester Examination
2023/2024 Academic Session

July/August 2024

# EPE 442 – Advanced Semiconductor Technology
***(Teknologi Pembuatan Semi Konduktor Termaju)***

Duration: 3 hours
*(Masa: 3 Jam)*

Please check that this examination paper consists of SIX (6) pages of printed material before you begin the examination.

*[Sila pastikan bahawa kertas peperiksaan ini mengandungi ENAM (6) muka surat yang bercetak sebelum anda memulakan peperiksaan ini.]*

**Instructions**: Answer ALL **FIVE (5)** questions.

*[**Arahan**: Jawab **LIMA (5)** soalan]*

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1. [a] Figure 1[a] show the Price vs Time chart for Bitcoin and Nvidia stock evaluated data from Jan 2020. Although the relationship between the price of Bitcoin and Nvdia's stock price is complex and multifaceted, the rise of cryptocurrency usage definitely increases the demand of high performance chips that are significantly produced by Nvdia.

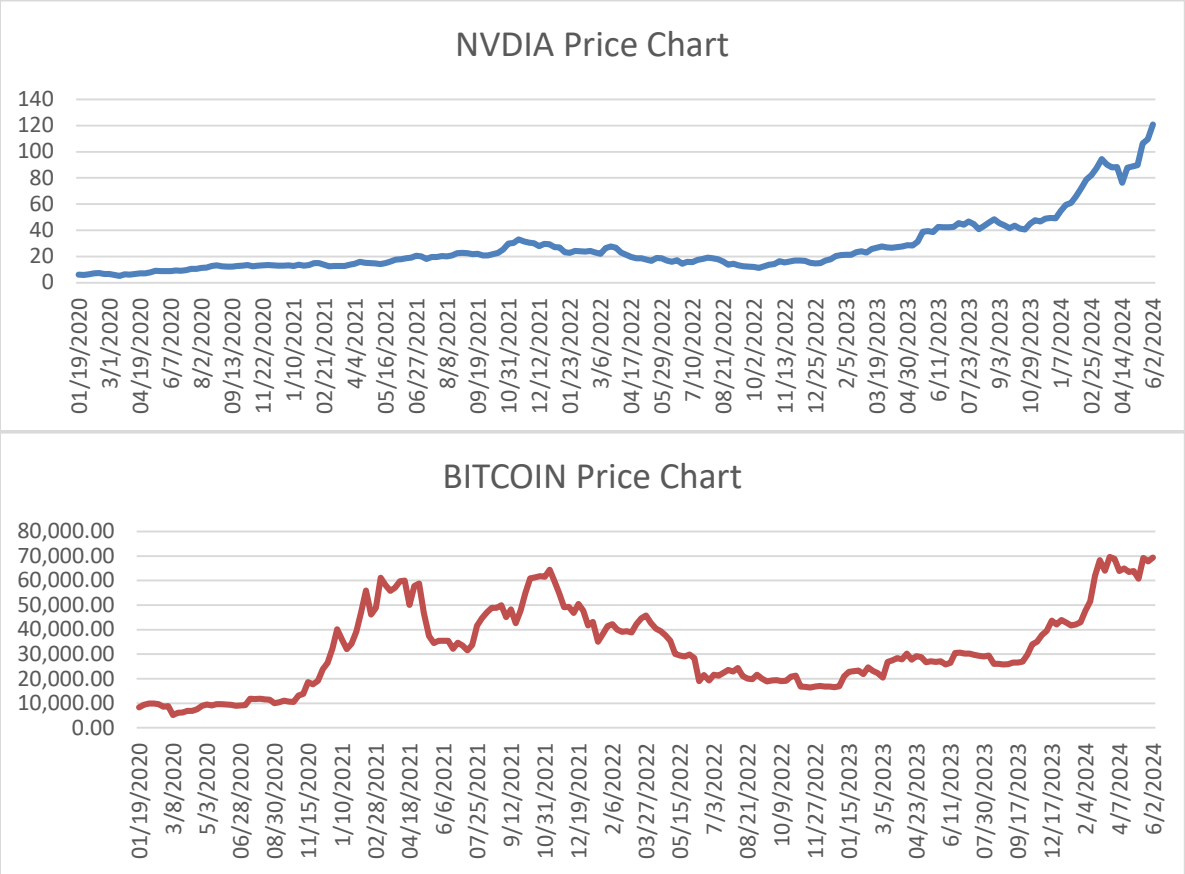


Figure 1[a]

(i) Explain how does the rising of cryptocurrency market increase the demand of semiconductor products especially high performing chips.

**(30 marks)**

(ii) Explain how Covid19 pandemic significantly increase the price of semiconductor companies.

**(20 marks)**

[b] In Malaysia, the semiconductor industry is primarily centred around OSAT (Outsourced Semiconductor Assembly and Test). Companies such as Inari, UNISEM, and KESM are among the publicly listed leaders in Malaysia's semiconductor sector.

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(i) Explain the semiconductor industrial ecosystem in Malaysia and how our semiconductor industry contributing in global semiconductor supply chain?

**(20 marks)**

(ii) In order to complement back-end semiconductor manufacturing in Malaysia, the government has facilitated the development of front-end semiconductor manufacturing companies. Companies such as Silterra are strategic assets for the national interest in the semiconductor industry. However, after 23 years since Silterra officially commenced operations, front-end manufacturing has not fully taken off, and Malaysia is still dominated by back-end manufacturing. Give your opinion on initiatives that the government could adopt to increase the presence of front-end manufacturing in Malaysia, and how can the private sector help facilitate this transition?

**(30 marks)**

2. [a] Semiconductor level typically refers to a specific stage or level of production within the semiconductor manufacturing process. It denotes the various steps involved in the fabrication of semiconductor devices, such as integrated circuits (ICs) or chips. Explain and describe Level 0, Level 1 and Level 2.

**(30 marks)**

[b] Oxidation plays a vital role in chip technology by enabling the formation of insulating layers, isolation between components, and many more processes. Figure 2 (b) show an illustrations of silicon with oxide layer. Suggest the steps and process to produce such configuration.

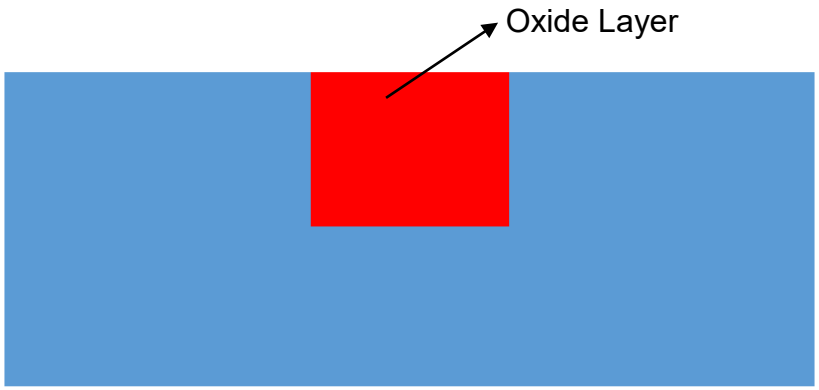


Figure 2[b]

**(30 marks)**

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[c] Figure 2[c] show the process of converting sand to silicon wafer. For each step, describe and explain all processes. You may use flow diagram to help illustrate the process.

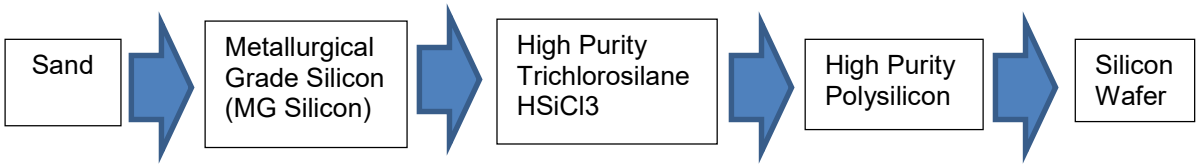


Figure 2[c]

**(40 marks)**

3. [a] Figure 3[a] depicts the delamination of the chip pad from encapsulating epoxy resin. Delamination in advanced electronic packaging can result from various factors that affect the integrity of the package during manufacturing, assembly, and operation. **"Material selection and thermal management are considered as the main critical factors that need to be controlled to avoid delamination".** Do you agree with this statement? Justify your answer.

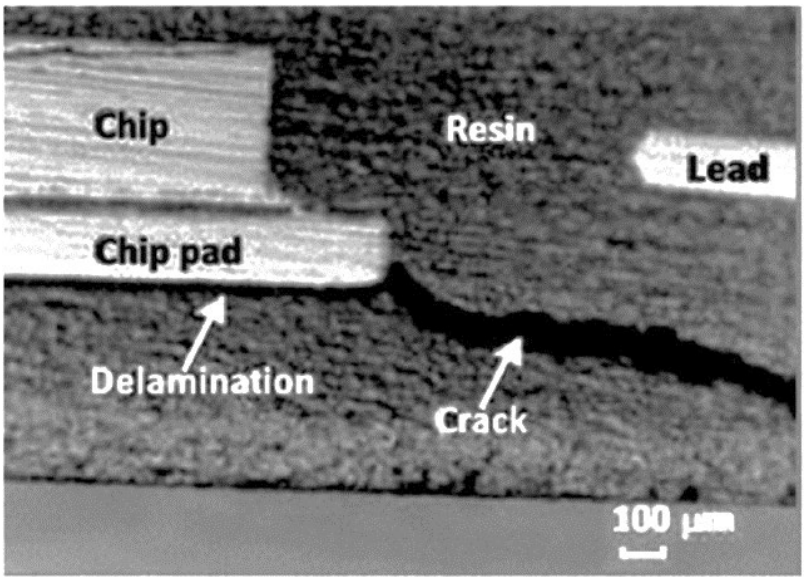


Figure 3[a]

**(30 marks)**

[b] Heat management and dissipation are crucial aspects of electronic packaging due to several important reasons.

(i) Explain TWO (2) reasons why heat management and dissipation are considered important in electronic packaging.

**(20 marks)**

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(ii) Heat spreader and heat sink are used for heat dissipation. Compare the heat spreader and heat sink by completing the information in Table 3. (Please copy the table provided and complete it in your answer script.)

Table 3

| | Heat Spreader | Heat Sink |
|---|---|---|
| Purpose | | |
| Operation | | |
| Effectiveness | | |

**(30 marks)**

(iii) Can we combine both the heat spreader and heat sink in the same application? Justify your answer.

**(20 marks)**

4. [a] You are an engineer working in a Surface Mount Technology (SMT) manufacturing facility, and you have encountered multiple instances of bridging issues (Figure 4(a)) during the assembly process. Bridging occurs when solder runs from one component contact to another, resulting in a short circuit.

(i) Suggest TWO (2) potential causes of the bridging issue mentioned above. Your answer must include a description of the potential cause.

**(20 marks)**

(ii) Provide ONE (1) solution and its justification for each of the potential causes mentioned in (i).

**(30 marks)**

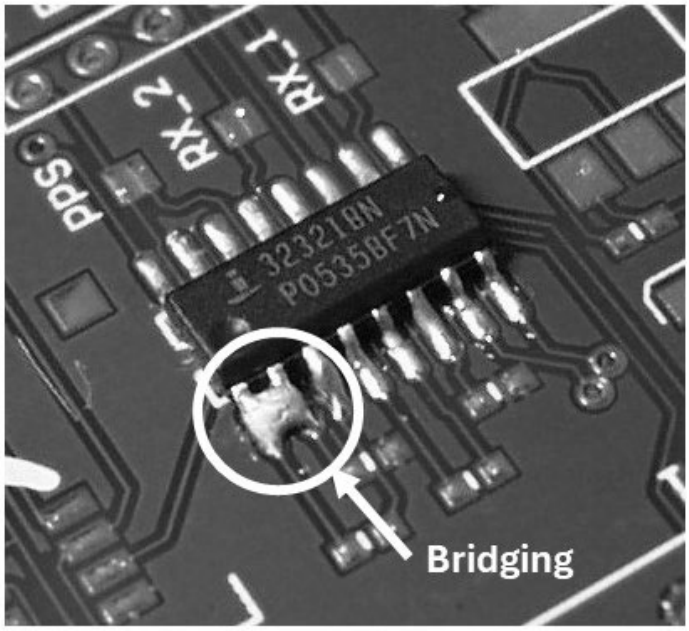


Figure 4[a]

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[b] Low melting point solder paste is a type of solder paste designed to melt at a lower temperature compared to conventional solder pastes. It typically contains alloys such as bismuth-tin (Bi-Sn), indium-based, or other low-melting compositions.

(i) List and explain TWO (2) applications where low melting points solder paste are desired in Surface Mount Technology.

**(20 marks)**

(ii) Describe THREE (3) common challenges using a low melting point solder paste in Surface Mount Technology.

**(30 marks)**

5. [a] "Flexible electronics devices have enormous potential for use on and in the human body, not only because they enable stretch ability, flexibility, and mechanical softness that cannot be achieved with silicon-based technologies, but also because organic electronics devices are more compatible with biological systems than silicon-based alternatives". Discuss about this quote by providing TWO (2) examples.

**(30 marks)**

[b] "Chip sales look to bounce back in 2024, led by generative AI (Artificial Intelligence), but could be complicated by geopolitics". Analyse this quote by elaborating FIVE (5) big topics of semiconductor industry for the year ahead.

**(40 marks)**

[c] Future semiconductor industry would be affected by major issues such as chip war, energy demand and sources, and global water crisis. Review ONE (1) of the topics, then elaborate on the issue and potential remedies.

**(30 marks)**

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