First Semester Examination
2022/2023 Academic Session

February 2023

EPP 351 – Advanced Manufacturing Process
(Proses Pembuatan Termaju)

Duration: 3 hours
(Masa: 3 jam)

Please check that this examination paper consists of FIVE (5) pages of printed material before you begin the examination.

[Sila pastikan bahawa kertas peperiksaan ini mengandungi LIMA (5) muka surat yang bercetak sebelum anda memulakan peperiksaan ini].

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

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

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1. [a] Define the following terms; plastic, polymer, thermoset and thermoplastic. Differentiate between plastic and polymer, thermoset and thermoplastic.

(20 marks)

[b] CERMITECH Sdn. Bhd. is a company specializing in production of ceramic products ranging from small size dinnerware to large product such as flower pot. The company needs to increase production and at the same time maintain lower cost of production. Select the appropriate process for production of dinnerware and flower pot. Justify your choice.

(40 marks)

[c] Using diagram, illustrate the complete process of powder metallurgy starting from the metal powder preparation until finished product is obtained. Justify why each stage in the process is crucial for good quality product.

(40 marks)

2. [a] As Malaysia strives to achieve developed nation status, the dependent on manufacturing based economy remain relevant but must adapt to new competitive environment in a highly connected world. Give your justification and analysis on why sustainable manufacturing should be adopted in the future as part of strategy to become developed nation

(50 marks)

[b] As a result of foreign direct investment (FDI) initiative, a multi-national company has decided to invest and begin its manufacturing of glass material in Malaysia. Sand, being the raw material for silica which is needed for glass manufacturing, need to be extracted from a remote area along a river which is an important source of livelihood for the nearby villagers.

(i) State THREE (3) major manufacturing sustainability performances that must be considered in this case?

(ii) What would be your suggestion in order to achieve balance among the sustainability performance mentioned in [b](i)? Justify your answer

(50 marks)

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3. [a] Component failure in high speed machinery often associated with tiny cracks which propagate into larger cracks. Surface treatment of component may be used in order to minimize the risk of premature failure. Identify, explain the process and justify an appropriate treatment method that can be used to treat the component.

(40 marks)

[b] A small beaker made of ABS plastic need to be coated with uniform thin layer of Nickel to make it water proof. Two alternatives for coating the beaker are electroplating and electroless plating. Judge the suitability of the processes and justify which one should be used.

(40 marks)

[c] Estimate the plating thickness in electroplating a (4-mm diameter x 8-mm height) solid-metal cylinder using a current of 3A, and a plating time of 1.0 hour. Assume that c = 0.08.

(20 marks)

4. [a] Figure 4[a] shown above is the two-level metal interconnect structure in which a layer of silicon dioxide (SiO_2) has been placed in between a first-level metal and a silicon substrate.

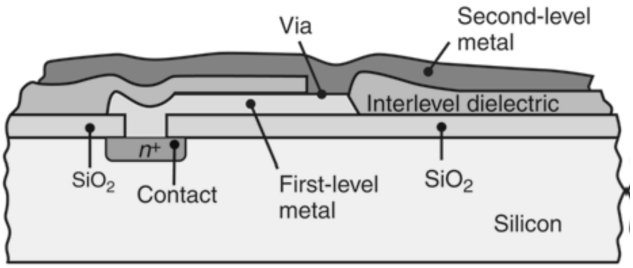

Figure 4[a]

(i) Explain TWO (2) functions of silicon dioxide (SiO_2) in the microelectronic structure above.

(20 marks)

(ii) Identify TWO (2) most suitable techniques to deposit a layer of silicon dioxide (SiO_2) on top of a silicon substrate and justify your answers.

(20 marks)

[b] (i) Describe the differences between isotropic and anisotropic etching process in semiconductor manufacturing.

(20 marks)

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(ii) Based on Figure 4[b], sketch the holes that will be generated from a square mask on a <100> silicon wafer using isotropic and anisotropic etching respectively.

(20 marks)

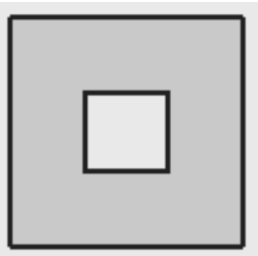

Figure 4[b]

(iii) Explain ONE (1) difference between n-type and p-type dopant and why it is very important in semiconductor manufacturing.

(20 marks)

5. [a] Figure 5[a] shows a MEMS RF switch which is one of the applications of a metal microcantilever. A microcantilever has been used as a switch due to its sensitivity to a miniscule amount of external force or stimuli.

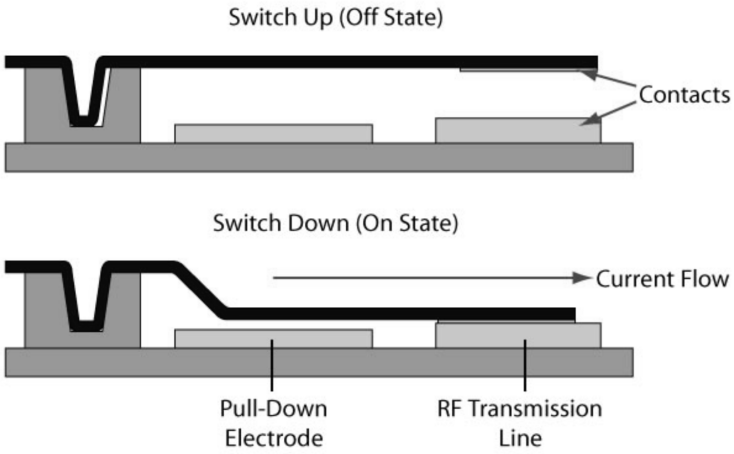

Figure 5[a]

(i) Identify ONE (1) appropriate technique to fabricate the above microcantilever and justify your selection.

(20 marks)

(ii) Based on your selection of technique in question (b)(i), describe the prior steps before the above structure is produced using sketches.

(40 marks)

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[b] Figure 5[b] shown a schematic diagram of failure in the fabrication process of microcantilever polysilicon structures.

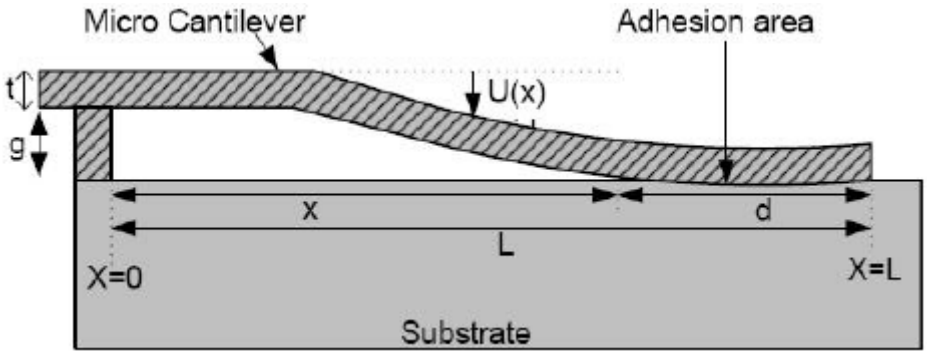

Figure 5[b]

(i) Describe about the failure and how will it affect the overall function of microcantilever.

(30 marks)

(ii) Suggest ONE (1) solution to avoid repetition of that failure during fabrication process.

(10 marks)

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