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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2016/2017

COURSE NAME	:	MICROFABRICATION
COURSE CODE	:	BED 40603
PROGRAMME	:	BEJ
EXAMINATION DATE	:	DECEMBER 2016/ JANUARY 2017
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

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THIS QUESTION PAPER CONSISTS OF **FIVE (5)** PAGES

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Q1 (a) (i) Define cleanroom.

(2 marks)

(ii) List **FOUR (4)** types of contamination produced by people.

(2 marks)

(iii) Analyse the countermeasure to reduce the problem stated in part **Q1(a)(ii)** and explain briefly.

(2 marks)

(b) (i) Give a definition of NMOS and PMOS.

(3 marks)

(ii) Illustrate the structure of NMOS transistor and label clearly.

(4 marks)

(iii) In general, there are more than 10 steps involves during the fabrication of transistor. Briefly explain the basic procedure and processes to fabricate a single layer NMOS transistor on p-type silicon wafer substrate using appropriate diagram.

(12 marks)

Q2 (a) (i) By the aid of diagrams, explain the differences between silicon epitaxial and polysiliconfilm growth.

(6 marks)

(ii) There are two types of epitaxy growth. List both of them and explain.

(3 marks)

(iii) As a researcher, you need to analyse the important parameter prior to the epitaxial fabrication process. Briefly explain regarding to that parameter.

(4 marks)

(b) As a postgraduate student, you need to design by your own way to fabricate silicon dioxide on silicon wafer. Below is the important points that you have to consider to implement your experiment.

(i) The oxidation temperature should be not more than at 1000°C.

(ii) Choose the higher growth rate method.

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(iii) The initial silicon oxide thickness, t_o is 1000Å. Moreover, deposition time given is 60 minutes.

Use Deal and Grove model of oxidation, which is related to **EQUATION Q2**, **TABLE 1** and **TABLE 2** for your calculation.

(12 marks)

$$t_{oxide}(t) = \frac{1}{2}A\left[-1+\sqrt{1+4\left(\frac{B(t+\tau)}{A^2}\right)}\right]$$

EQUATION Q2

TABLE 1: Rate constants for wet oxidation of silicon.

Oxidation temperature (°C)	A (μm)	Parabolic rate constant B (μm²/h)	Linear rate constant B/A (μm/h)
1200	0.05	0.720	14.40
1100	0.11	0.510	4.64
1000	0.226	0.287	1.27
920	0.50	0.203	0.406

TABLE 2: Rate constants for dry oxidation of silicon.

Oxidation temperature (°C)	A (μm)	Parabolic rate constant B (μm²/h)	Linear rate constant B/A (μm/h)
1200	0.040	0.045	1.12
1100	0.090	0.027	0.30
1000	0.165	0.0117	0.071
920	0.235	0.0049	0.0208
800	0.370	0.0011	0.0030

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Q3 (a) (i) Briefly explain photolithography process.

(2 marks)

(ii) Analyse **TWO (2)** elements that can contribute to the photoresist thickness during the coating process as shown in **Figure Q3(a)**.

(4 marks)

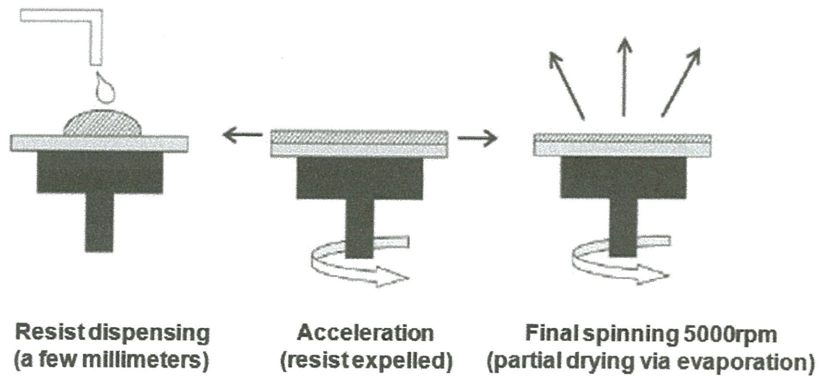

Figure Q3(a)

(iii) Formulate a thickness equation from the answers obtained in part **Q3(a)(ii).**

(3 marks)

(b) (i) Photosensitive material was commonly used in lithography process. Compare **THREE (3)** differences between positive resist and negative resist. Please compare your answers in a table.

(6 marks)

(ii) Photolithography is the centre of the wafer fabrication process. As a research student classify **FIVE (5)** basic steps of lithography process.

(5 marks)

(iii) As a researcher, you have to decide the lab equipment to investigate the topological properties of your thin film. Select the equipment needed and explain the properties of the equipment briefly.

(5 marks)

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Q4 (a) (i) Identify **TWO (2)** techniques for doping process.

(2 marks)

(ii) From answers in part **Q4(a)(i)**, compare **THREE (3)** differences between both doping technicques. Support your answers with aid of diagram.

(7 marks)

(iii) As a reseach student, examine **THREE (3)** methods that can minimise ion channeling effect.

(3 marks)

(b) (i) Briefly explain dry etching process.

(3 marks)

(ii) Discuss **TWO (2)** dry etching methods.

(4 marks)

(iii) From answers given in **Q4(b)(ii),** sketch and label clearly the etching profiles of each method.

(6 marks)

- END OF QUESTIONS -

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