Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2015/2016

COURSE NAME	:	MICROFABRICATION
COURSE CODE	:	BED 40603
PROGRAMME	:	BACHELOR OF ELECTRONIC ENGINEERING WITH HONOURS
EXAMINATION DATE	:	DECEMBER 2015/JANUARY 2016
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **FOUR (4)** PAGES

Q1 (a) (i) Give a definition of NMOS and PMOS.

(4 marks)

(ii) Define **TWO (2)** advantages and disadvantages of NMOS. Summarize in a table.

(4 marks)

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

(5 marks)

(b) 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 apprioprate diagram.

(12 marks)

Q2 (a) A silicon wafer is oxidized at 1000°C. The initial thickness of oxide layer is 100 nm. Using the Deal and Grove model of oxidation with related to **EQUATION (Q2)**, **TABLE 1** and **TABLE 2**, calculate the oxidation time to obtain 0.5μm thickness of the oxide prepared by:

(i) Wet oxidation.

(6 marks)

(ii) Dry oxidation.

(6 marks)

(b) Analyze the effect of deposition technique on deposited SiO_2 thickness from answer in part **Q2 (a) (i)** and **(ii)**.

(3 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

(c) There are two types of photo resists, positive and negative photo resists. Explain the differences between positive and negative resists by drawing an appropriate process flow. Which type of photo resist has better pattern transfer resolution?

(10 marks)

Q3 (a) Diffusion is a process where an exact amount of impurities/dopant atoms is introduced into the semiconductor (Si) material under specific process conditions.

(i) Analyse **TWO (2)** atomic diffusion mechanism in a two-dimensional lattice and explain clearly using approriate diagram.

(10 marks)

(ii) Explain **THREE (3)** factors that influence diffusion.

(6 marks)

(b) Polysilicon etched depth in chlorine plasma is given in the **TABLE 3**. Predict the etch rate based on the data given.

(9 marks)

TABLE 3: Etching depth as a function of time

Time (s)	Depth (nm)
10	20
30	50
50	100
70	130

Q4 (a) As a researcher, you have to decide the lab equipment to investigate the topological and morphological properties of your thin film. Select the equipment needed and explain the properties of the equipment briefly.

(10 marks)

(b) Silicon is the most important semiconductor for the microelectronics industry.

(i) Examine **THREE (3)** advantages of Silicon compared to Germanium.

(6 marks)

(ii) As a postgraduate student, you need to find suitable technique to fabricate silicon homoepitaxial growth. By the aid of the figure, select **ONE (1)** of the technique and explain briefly.

(9 marks)

- END OF QUESTIONS -