UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2015/2016

COURSE NAME	:	MATERIAL CHARACTERIZATION
COURSE CODE	:	BED 41303
PROGRAMME	:	BEJ
EXAMINATION DATE	:	JUNE / JULY 2016
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

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

Q1 (a) The correction factor, F can be independently calculated with given a condition samples are thinner than probe spacing, s and uniformly doped.

(i) Formulate the resistivity, ρ of the thin sample as given condition.
(4 marks)

(ii) Determine the sheet resistance, R_{sh} of the sample obtained from the answer in part **Q1(a)(i)**.
(4 marks)

(iii) Explain the strength and weakness of four – point probe technique.
(2 marks)

(b) (i) Evaluate the sheet resistance concept between two ends that can be obtained by referring to **Figure Q1(b)(i)**. Hint: relates to the resistance equation.
(6 marks)

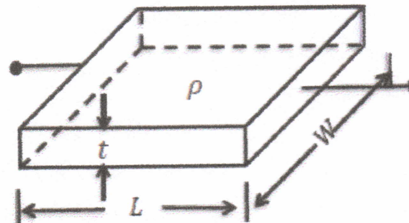

Figure Q1(b)(i)

(ii) Sketch and label clearly the shapes of wafer flat for n- and p- type in {100} and {111} directions.
(9 marks)

Q2 (a) Surface charging can also be produced without using any traditionally device fabrication.

(i) Describe and briefly explain other method that can produce surface charging.
(4 marks)

(ii) Distinguish **THREE (3)** steps of chemical treatment that can be done on n-type silicon wafer.
(6 marks)

(iii) List the advantage of chemical treatment.
(2 marks)

(iv) As an IC fabrication engineer, classify **THREE (3)** main semiconductor characterization techniques.
(3 marks)

(b) Atomic force microscopy (AFM) have three operation modes.

(i) Categorize **THREE (3)** operation modes of AFM technique.
(6 marks)

(ii) Compare type of sample that suitable to be inspected by Atomic Force Microscopy (AFM) and Scanning Tunneling Microscopy (STM).
(4 marks)

Q3 (a) (i) Identify **THREE (3)** X-ray and **ONE (1)** Gamma-Ray techniques used for sample characterization, respectively.
(4 marks)

(ii) Briefly explain the Scanning Electron Microscopy (SEM).
(2 marks)

(iii) Analyse the operation of SEM technique in producing an image.
(4 marks)

(b) (i) Outline the Ellipsometry technique in characterize the sample measurement.
(4 marks)

(ii) Gives **TWO (2)** examples of measurement from answer given in part **Q3(b)(i).**
(4 marks)

(iii) Determine the application of Raman spectroscopy. Support your answer with aid of diagram and label clearly.
(7 marks)

Q4 (a) (i) Failure rate sometimes represented as bathtub curve that divided into **THREE (3)** sections. Explain about these **THREE (3)** sections, respectively.
(6 marks)

(ii) Sketch the bathtub curve that contain failure rate versus time and also the **THREE (3)** sections.
(4 marks)

(b) (i) Further failure analysis of a device can to be inspected using Focus Ion Beam (FIB). List **THREE (3)** basic components use for FIB measurement. Hint: Similar to Scanning Electron Microscopy (SEM).
(5 marks)

(ii) As an Engineer, propose **TWO (2)** procedures to characterize the lifetime and integrity of gate oxides can be inspected.
(4 marks)