Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2021/2022

COURSE NAME	:	MATERIAL CHARACTERIZATION
COURSE CODE	:	BEJ 43603 / BED 41303
PROGRAMME CODE	:	BEJ
EXAMINATION DATE	:	JULY 2022
DURATION	:	3 HOURS

INSTRUCTION

1. ANSWER **ALL** QUESTIONS
2. THIS FINAL EXAMINATION IS AN **ONLINE** ASSESSMENT AND CONDUCTED VIA **OPEN BOOK.**

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

Q1 (a) As your project task, you need to measure the sample thickness of silicon dioxide (SiO_2) on silicon wafer substrate sample. You need to carry out the measurement using simple, non-vacuum, non-destructive and optical characterisation technique.

(i) Propose the technique.

(3 marks)

(ii) Explain step-by-step of your experiment flow.

(5 marks)

(b) Identify the concept of optical characterization technique used in part **Q1(a)**. Explain **THREE (3)** main measurement categories for the optical characterisation technique stated in your answer.

(5 marks)

(c) (i) List **THREE (3)** features of Raman Spectroscopy.

(3 marks)

(ii) From answer in **Q1(c)**, describe **ONE (1)** strength and weakness of the measurement technique. Summarise your answer in a table.

(4 marks)

(iii) With the help on band diagram, explain and analyse the optical characterisation technique in direct band gap material mechanism.

(5 marks)

Q2 (a) As a research student, you need to investigate the morphological properties of Cuprous oxide (Cu_2O) thin film. The objective is to analyse the homogeneity of the surface.

(i) Select the most suitable apparatus for the measurement and explain how the image can be produced.

(6 marks)

(ii) Based on your answer in **Q2(a)(i)**, sketch and label clearly your prediction result.

(3 marks)

(iii) Analyse the strength of the proposed method in **Q2(a)(i)** over the optical microscope.

(3 marks)

(b) You received a task from your supervisor to analyse the most suitable technique to investigate the cross-sectional of a very thin sample (less than 50 nm).

(i) Propose the appropriate technique for the measurement.

(2 marks)

(ii) Analyse **THREE (3)** major differences with the apparatus in **Q2(a)(i)**.

(6 marks)

(c) (i) Give **ONE (1)** disadvantage of X-Rays Fluorescence (XRF) technique.

(2 marks)

(ii) Examine **ONE (1)** situation in which constituent of mixed conductor can be determined using technique answer in **Q2(c)(i)**.

(3 marks)

Q3 (a) (i) Formulate Mean time to failure (MTTF)

(2 marks)

(ii) Explain **TWO (2)** reasons and **TWO (2)** advantages to perform the Failure Analysis. Summarise in the table.

(4 marks)

(b) (i) Propose the steps or processes for having a cross-section image that will be measured by Focus Ion Beam (FIB).

(2 marks)

(ii) List **THREE (3)** advantages of FIB measurement.

(3 marks)

(c) Oxide breakdown on Metal-oxide semiconductor (MOS) devices can be categorised into **THREE (3)** modes or regions.

(i) Determine **THREE (3)** modes stated in **Q3(c).**

(3 marks)

(ii) Clearly explain the difference of the modes stated in **Q3(c)(i)** by the aid of the oxide failure mode versus oxide electric field graph.

(6 marks)

(iii) Choose **ONE (1)** of the mode in **Q3(c)(i)** and analyse the defects that contributed to the mode. Sketch the defects and label clearly.

(5 marks)

Q4 (a) (i) Name **THREE (3)** simple and **TWO (2)** complex adhesion tests.

(5 marks)

(ii) As a student, you need to set-up a scratch test for your thin film sample. Sketch the diagram of your experiment apparatus and explain briefly.

(5 marks)

(iii) From your opinion, evaluate why test in part **Q4(a)(ii)** must be carried out.
(4 marks)

(iv) Other than scratch test, identify **ONE (1)** familiar test used in industrial site.
(2 marks)

(b) State **FOUR (4)** typical failure characterization technique used to detect electromigration and stress mitigation in conductors and contacts in Integrated Circuit.
(4 marks)

– END OF QUESTIONS –