



# MERU UNIVERSITY OF SCIENCE AND TECHNOLOGY

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## University Examinations 2024/2025

FIRST YEAR SECOND SEMESTER EXAMINATION FOR THE DEGREE MASTER OF SCIENCE IN CHEMISTRY AND MASTER OF SCIENCE IN CEMENT AND CONCRETE

### SCT 7123: MODELLING TECHNIQUES

DATE: JANUARY 2025

TIME: 3 HOURS

INSTRUCTIONS: Answer question *one* and any other *two* questions

#### QUESTION ONE (30 MARKS)

- a) Define the terms below: (3 marks)
- Pitting corrosion
  - Biocementation
  - Biodegradation
- b) Outline two limitations of Hic model in the study of cement microstructure. (2 marks)
- c) Discuss the role aluminate phase in cement in corrosion prevention by using relevant chemical equation. (2 marks)
- d) By use of a convectional rotary kiln, show all the chemical transformations that occurs within it to give us cement powder. (5 marks)
- e) External gypsum into cement microstructure in undesirable. Explain. (2 marks)
- f) Discuss the hydration kinetics of tricalcium silicate (5 marks)
- g) Explain the mechanism of volume increase in hydrated microstructure of concrete (3 marks)
- h) Discuss two transport mechanism of ions within the cement microstructure. (4 marks)

- i) DuCOM model on concrete has contributed immensely to durability prediction. Justify this statement (4 marks)

**QUESTION TWO (15 MARKS)**

- a) Hydraulic cements gain its strength upon reactions with water. Justify using appropriate chronological chemical equations and the chemical kinetics involved in each case. (7 marks)
- b) Discuss the Dijon Numerical model for boundary nucleation. (8 marks)

**QUESTION THREE (15 MARKS)**

- a) Discuss  $\mu ic$  model as used to simulate hydrating cement microstructure. (8 marks)
- b) Detail a study of integrated particle kinetics model as developed by Navi and Pignat showing the role of the Aviram equation. (7 marks)

**QUESTION FOUR (15 MARKS)**

- a) By Using appropriate equations show how Hic model has been used to investigate hydration kinetics of alite. (7 marks)
- b) Discuss Jennings and Johnson model of hydrated cement microstructure showing clearly their contribution to improving older 3-D models. (8 marks)