



**DEDAN KIMATHI UNIVERSITY OF TECHNOLOGY**

**UNIVERSITY EXAMINATIONS 2021/2022**

**YEAR ONE SEMESTER TWO EXAMINATION FOR DEGREE OF MASTERS OF  
SCIENCE IN LEATHER TECHNOLOGY**

**SLT 6111 NANO TECHNOLOGY FOR LEATHER**

**DATE: FEBRUARY 2022**

**TIME:3 Hours**

**INSTRUCTIONS: Answer ALL Questions**

**Question One (15 Marks)**

- a) A bulk material has constant physical properties regardless of its size, but at the nanoscale level, dependent properties are observed. Give examples in which nanomaterials differ from the bulk material in terms of their properties [4 Marks]
- b) Using a flow chart and general equations explain how silica nanoparticles can be synthesized by Sol-Gel method using tetraethylorthosilicate (TEOS,  $\text{Si}(\text{OC}_2\text{H}_5)_4$ ). [7 Marks]
- c) Suggest a suitable mechanism for nanoparticle synthesis using the microemulsion method. [4 Marks]
- d) List two potential risks of nanotechnology [2 Marks]

**Question Two (15 Marks)**

- a) i. Explain the kind of information that can be obtained from Atomic Force Microscopy technique (AFM) [2 Marks]
- ii. Briefly describe with help of a suitable sketch Atomic Force Microscopy (AFM) microscopy and highlight basic principles of its operation. [7 Marks]
- b) Briefly highlight the differences between Scanning electron microscopy (SEM) and Transmission Electron Microscopy (TEM) techniques in terms of their working principles [6 Marks]

**Question Three (15 Marks)**

- a) Find the interplanar distance in a crystal in which a series of planes produce a first order reflection from a copper X-ray tube ( $\lambda = 1.539 \text{ \AA}$ ) at an angle of  $22.5^\circ$ . [5 Marks]
- b) List 5 important factors that need to be taken into consideration for self-assembly to occur [5 Marks]
- c) Explain the potential benefits of an emulsion polymer of poly(methyl methacrylate-co-butyl acrylate) prepared with in situ nano-silica when employed as a novel tanning agent [5 Marks]

**Question Four (15 Marks)**

- a) Explain the fact that charge carriers in a semiconductor can be negative, positive, or both. [4 Marks]
- b) With the help of equations explain why leather samples exhibit a self-cleaning effect when they are finished with nano  $\text{TiO}_2$  [7 Marks]
- c) Explain two ways in which nanotechnology can be used to treat tannery effluents [4 Marks]