

## AEN 2207 MATERIALS SCIENCE

Course Credits (CU): 4 CU i.e. 90 Contact Hours per semester

Course Duration : 15 weeks (90hours) i.e. 45 LH, 45 PH

Course Type : CORE (BSC Agric Engineering III)

Lecturer : Assoc.Prof J K Byaruhanga,PhD,Permanent Employment.  
Mr. Martin Mugonyi,Msc Part time Employment

### 1. Course Description

This course introduces the student to the science of engineering materials. It covers atomic structure, solidification and crystal formation, solid solutions, alloys as well as the science of polymers, ceramics and composites.

### 2. Course Objectives

The objectives of this course are:

- To give a broad introduction into the principles of atoms and the forces holding them together.
- To introduce the students to the concepts of solidification and crystal formation in engineering materials.
- To equip the students with the knowledge on strengthening mechanisms, structure and formulation of engineering materials
- To prepare the students for the advanced courses in Materials Science and Engineering

### 3. Recommended Texts

- William D. Callister Jr., Materials Science and Engineering, 2<sup>nd</sup> Edition, John Wiley and sons 2004.
- Anderson et al, Materials science, 4th Edition, Chapman and Hall, 1990.

### 4. COURSE CONTENT, METHODS OF INSTRUCTION, TOOLS AND EQUIPMENT REQUIRED

TOPIC	CONTENT	METHOD OF INSTRUCTION / Time allocated	TOOLS / EQUIPMENT NEEDED
INTRODUCTION	<ul style="list-style-type: none"><li>• Classification of Materials.</li><li>• Requirements for modern engineering materials</li></ul>	Interactive lectures (2hrs)	Chalk / BB LCD and computer
ATOMIC STRUCTURE AND INTERATOMIC BONDING	<ul style="list-style-type: none"><li>• Atomic Structure.</li><li>• Atomic Bonding In solids.</li></ul>	Interactive lectures (4 hrs)	Chalk / BB or Markers / Flip charts
SOLIDIFICATION AND STRUCTURAL CRYSTALLINITY OF MATERIALS	<ul style="list-style-type: none"><li>• Crystal Structures</li><li>• Crystallographic directions and planes</li><li>• Crystalline and Non-Crystalline Materials, Interplanar Spacing</li></ul>	Interactive lectures (4 hrs)	Chalk / BB LCD and computer
IMPERFECTIONS IN SOLIDS:	<ul style="list-style-type: none"><li>• Point Defects.</li></ul>	Interactive lectures (4 hrs)	Chalk / BB LCD and

	<ul style="list-style-type: none"> <li>• Line defects.</li> <li>• Interfacial Defects.</li> <li>• Volume Defects</li> </ul>		computer
<b>SOLID SOLUTIONS AND PHASE DIAGRAMS:</b>	<ul style="list-style-type: none"> <li>• Solid Solutions.</li> <li>• Equilibrium Phase Diagrams of Unary.</li> <li>• Binary, Peritectics.</li> <li>• Eutectics, Eutectoids.</li> <li>• Non-equilibrium Phase Diagrams.</li> <li>• Coring, Application and Examples of Phase Diagrams.</li> </ul>	Interactive lectures (8 hr)	Chalk / BB or Markers / Flip charts
<b>DIFFUSION IN SOLIDS:</b>	<ul style="list-style-type: none"> <li>• Mechanism of solidification.</li> <li>• Steady state diffusion.</li> <li>• Fick's Laws.</li> <li>• Dislocation Motion.</li> <li>• Non-steady state diffusion.</li> <li>• Factors influencing diffusion.</li> <li>• Nucleation and growth</li> </ul>	Interactive lectures (12hr)	Chalk / BB or Markers / Flip charts
<b>STRENGTHENING MECHANISMS</b>	<ul style="list-style-type: none"> <li>• Grains and Grains Boundaries,</li> <li>• Dislocations and phase deformations, strengthening by grain refinement.</li> <li>• Solid solution hardening.</li> <li>• Strain hardening.</li> <li>• Strain Ageing.</li> <li>• Cold work.</li> <li>• Recovery and Recrystallisation.</li> <li>• Precipitation Hardening</li> </ul>	Interactive lectures (4hr)	Chalk / BB or Markers / Flip charts
<b>STRUCTURES AND CHARACTERISTICS</b>	<ul style="list-style-type: none"> <li>• Polymers and Plastics</li> <li>• Ceramics</li> <li>• Composites</li> </ul>	Interactive lectures with (8 hrs)	Chalk / BB or Markers / Flip charts
<b>PRACTICALS</b>	<ul style="list-style-type: none"> <li>▪</li> </ul>	45hrs	Equipped materials science lab

## 5. SUMMARY OF TIME NEEDED

Interactive lectures,	45 hrs
practicals	45 hrs

## 6. OVERALL COURSE EVALUATION

Continuous Assessment Test and	30-50%
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Class practicals

Final examination

50-70%