

FACULTY OF **ENGINEERING**

DEGREE COURSE: **CIVIL AND ENVIRONMENTAL
ENGINEERING BS**

SUBJECT: FUNDAMENTALS OF CHEMISTRY AND MATERIAL
SCIENCE

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OBJECTIVES

The overall goal of this course is to introduce the students to the properties and behavior of the macroscopic world in terms of the structure and arrangement of the constituent molecules and atoms. Emphasis will also be given to the study of materials for engineering applications.

CONTENTS

The course is divided in two parts. The first one is related to the general chemistry arguments and constitutes a basic requirement in order to be introduced to the materials science part (2nd part).

1. The basic structures of atoms and ions, periodic properties.
2. Covalent bonds and ionic bonds.
3. Molecular shape and structure.
4. Properties of gases.
5. Condensed phases, intermolecular forces, metallic solids, ceramic solids.
6. Thermodynamics: First and Second Law.
7. Gibbs energy. Criteria for spontaneity and equilibria.
8. Chemical kinetics.
9. Physical equilibria.
10. Chemical equilibria.
11. Aqueous solution equilibria. Acids and bases. Solubility equilibria.
12. Electrochemistry and corrosion.
13. Crystalline imperfections.
14. Phase diagrams.
15. Engineering alloys.
16. Mechanical properties of metals.
17. Ceramics.
18. Polymeric materials.

LEARNING OUTCOMES

The student is expected to be able to:

- understand the molecular nature of all phases of matter,

- to understand the various ways of depicting chemical compounds and chemical reactions,
 - to develop an ability to solve basic quantitative problems regarding the properties of atoms and molecules, chemical equilibria and electrochemistry.
 - Moreover, the student will be introduced to the study of the typical materials used in the engineering field with particular interest paid to metals and alloys, ceramic solids, cements and polymeric materials.
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ASSESSMENT

Written exam: multiple choice and open questions

RECOMMENDED TEXTBOOKS

The different topics are fully covered by the course notes provided.

Support for the first part (from 1 to 12) can be found in the following textbooks:

- P. Atkins, L. Jones, L. Laverman, Chemical Principles: the quest for insight. W. H. Freeman Publisher, Sixth Edition (2012), ISBN-10: 1429288973.
- J. C. Kotz, P. M. Treichel, J. Townsend, Chemistry and Chemical Reactivity. Thomson Brooks/Cole Publisher, Seventh Edition (2009), ISBN-10: 0495387037.

For the second part (13 to 18), the students can fruitful use the following textbook:

- W. F. Smith, J. Hashemi, Foundations of Materials Science and Engineering, McGraw-Hill Publisher, Third Edition (2004), ISBN-0-07-240233-4.
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