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BENT 204 Engineering Materials 1

ECTS Value: 5 ECTS
Self-Study Hours: 60

Contact Hours: 25
Assessment Hours: 40

Overall Objectives and Outcomes

The study of materials is an important component of any engineering course. This module will start by looking at the structure atom, which is the basic building block of matter. Various elements will be studied as well as the general structure of the periodic table in which the elements are categorised with each grouping showing common properties both chemical and physical extent. The participant will also learn about the different primary types of interatomic bonding as well relevant secondary bonding types. This will lead to an overview of various crystal structures including the fundamental concepts underpinning such structures. The module will then proceed to discuss ferrous and non-ferrous alloys and the alloying process in detail. The properties of such alloys will be discussed. The module concludes with a brief outlook of ceramic materials including basic structure and properties.

By the end of this module, the learner will be able to:

Competences

a. illustrate the key features of the basic atomic structure including the schematic representation of the Bohr atomic model;
b. predict properties of materials based on principles such as their position in the Periodic Table and their basic atomic structure;
c. develop knowledge on the properties of the resultant chemical structure in the case of reactions involving the three primary types of Interatomic Bonds including Ionic, Covalent and Metallic bonding;
d. develop understanding of the physical and chemical properties of materials based on their crystal structures including the Face Centred Cubic, Body centred Cubic, and Hexagonal Close Packed structures;
e. determine the properties of ferrous metal alloys to use for particular tasks including the best steels and cast irons to use for different tasks and environments;
f. evaluate the best non-ferrous alloys such as copper, aluminium, magnesium and titanium alloys for particular engineering tasks and their applications;
g. review how basic ceramic materials can be used based on their structure and properties.

Knowledge

a. define the key features of the basic atomic structure including the schematic representation of the Bohr atomic model;
b. explain important terms such as the atomic number, isotopes, valence electron, and mole;
c. identify the different groups forming the periodic table and outline the properties of each individual group;
d. describe the meaning of secondary bonding (Van der Waals);
e. outline how the different bonding types discussed can form molecules;
f. describe how impurities can form solutions or alloys;

g. explain the composition and properties of various ferrous metal alloys including steels and cast irons;
h. describe the different defect types such as vacancies and explain how self-interstitials are formed;
i. detail how the different bonding types discussed can form molecules;
j. state the structure and properties of basic ceramic materials.

Skills

a. recognise different defect types such as Vacancies;
b. show how different non-ferrous metals such as copper, aluminium, magnesium and titanium can form alloys;
c. show how ferrous metal can form alloys, including particular grades of steel and cast irons;
d. understand the concept of a phase in the context of material science;
e. define phase equilibrium.

Assessment Methods

This module will be assessed through: Research Assignment (50%), Presentation (20%), Practical assignment (30%)

Suggested Readings

Core Reading List:

1. Callister Jr, William D., (2013), Materials Science and Engineering. (9th Ed.) John Wiley and Sons.
2. Smallman R. E., Ngan A. H. W., (2014) Modern Physical Metallurgy, Eighth Edition. Butterworth-Heinemann.
3. Somiya Shigeyuki, (2013) Handbook of Advanced Ceramics: Materials, Applications, Processing, and Properties, Second Edition. Academic Press.

Supplementary Reading List:

1. Mouritz Adrian P., (2012), Introduction to Aerospace Materials. Amer Inst of Aeronautics.