

## BENT305 Engineering Materials 2

ECTS Value: 5 ECTS  
Self-Study Hours: 60

Contact Hours: 25  
Assessment Hours: 40

### Overall Objectives and Outcomes

This unit will continue the study of materials from the previous unit. This unit will start by looking at the chemistry of carbon and hydrocarbon monomers. It will then continue by looking at the polymerisation process including how simple monomers can react together to form complex hydrocarbon molecules known as polymers. The student will also learn about the different types of polymers that are available to the engineering communities including Thermoplastic and thermosetting polymers. The module will then proceed to look at the structure of organic materials which are derived from natural sources such as plant matter. The focus will be specifically on wood which is a very important material source. Two principal types of woods will be looked at namely Hardwoods and Softwoods. The final part of the module will be concerned with advanced and future materials which will propel engineering to be able to design and construct more advanced and ambitious engineering components.

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

### Competences

- Demonstrate an understanding of the physical and chemical properties of hydrocarbon molecules based on a knowledge of organic chemistry;
- evaluate the best polymers for particular tasks from various Thermoplastic and Thermosetting Polymers based on the evaluation of the chemistry and structure of Hydrocarbon Molecules;
- demonstrate the polymerization process through which these molecules can form more complex molecules called Polymers;
- critically evaluate the properties of organic materials with a focus on plant matter, specifically wood, based on the knowledge of the basic chemistry and structure of natural Organic Materials;
- review and select different types of advanced materials which are gradually being introduced and understand how such materials can be used to revolutionise the future of engineering;
- engage with research literature on current developments in future materials such as smart materials, and nano engineered materials.

### Knowledge

- define the chemistry underpinning the chemical and physical behaviour of hydrocarbon molecules;
- understanding of the polymerised chains structure of complex carbon polymers which are formed by the monomer molecules' reaction together;
- review the basic chemistry and physical structure of Organic materials which are naturally occurring including plant materials specifically wood;
- explain characteristics and properties of the two principal types of woods used by carpenters namely Hardwoods and Softwoods;

- e. define smart materials and know about the different types of smart materials which are in existence. Also be aware of the developments currently underway in the area of smart materials;
- f. understand the basic principles of Nano engineering and how such engineering techniques produce the materials of the future;
- g. describe polymeric structures, including molecular shape and Structure of polymeric chains.

### Skills

- a. apply knowledge of organic chemistry to be able to select the best types of polymers to use for particular applications;
- b. employ thermoplastics and thermosetting plastics as necessary;
- c. relate particular characteristics (chemical and physical) to differences in carbon chain structure and composition.

### Assessment Methods

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

### Suggested Readings

#### Core Reading List:

1. Callister Jr, W. D. (2013), *Materials Science and Engineering*. (9<sup>th</sup> Ed.) UK: John Wiley and Sons.
2. Smallman R. E., and Ngan A. H. W., (2014) *Modern Physical Metallurgy*, (8<sup>th</sup> Ed.). UK: Butterworth-Heinemann.
3. Ashby, M.F. and Shercliff, H. (2013). *Materials: Engineering, Science, Processing and Design* (Materials 3e with Online Testing). Butterworth-Heinemann Inc.
4. Sharma, C.P. (2004) *Engineering Materials: Properties and Applications of Metals and Alloys*. PHI Learning.

#### Supplementary Reading List:

1. *Engineering Materials 1: An Introduction to Properties, Applications and Design* by DRH Jones
2. Sidney Boone R., Christensen Donna and Squire Debra. *Wood Species Guide*. Retrieved from <http://www.esf.edu/wus/documents/woodspeciesguide.pdf>
3. *Structure and properties of wood*- Canadian Wood Council and Forintek Canada Corporation. Retrieved from [http://www.tboake.com/2014/172-Structure\\_and\\_prop-2016.pdf](http://www.tboake.com/2014/172-Structure_and_prop-2016.pdf)