SMART TEXTILE MATERIALS

INTRODUCTION

Smart textiles, also known as electronic textiles (e-textiles), smart garments, smart clothing or smart fabrics, are fabrics that enable digital technologies (components/electronics) to be embedded and interwoven in them, and provide added value to the wearer reacting to body and environmental stimuli (mechanical, thermal, chemical, biological, and magnetic).

Smart textile materials can entail materials such as electric sensors, shape memory polymers, phase change materials and conductive polymers: all able to interact with the stimuli in their environment according to the design and purpose of the material.

UNIT OUTLINE

The premise for this unit is to provide the students with an overview of smart textile materials and techniques, and covers topics such as conductive materials, basic sensors and principles, coatings and the integration and combination of textile materials and technology. The aim is to provide the students with an understanding of which materials and how give smart textiles their functionality to react to the body and environmental stimuli. Working independently, the students are guided through application sessions, by implementing workshops or laboratory/exercise sessions alongside theoretical sessions. By using a learning journal, the students are to constructively analyse and discuss their learning process, and reflect and demonstrate their awareness, determination and self-critical abilities. Based on the students' own conclusions and observations, they are expected to in groups write a technical essay or report based on the critical analysis of the investigation and experimentation of a proposed problem.

Though the use of methods such as workshops and problem-based learning, the students are expected to develop competences related to problem-formulation and solving, communication, teamwork, information literacy and interpersonal abilities. The unit builds on the knowledge acquired from the unit Textile electronics, by further investigating the various aspects related to functional and smart textiles. The subject expertise required for the unit is for example electrical engineering, textile material technology, textile engineering, or mechanical engineering majoring in textile technology. A teaching and laboratory assistant can provide you with focused assistance and guidance throughout the unit.

INDICATIVE CONTENT AND TEACHING AND LEARNING METHODS

In this unit, the students should be introduced to the fundamentals of smart textile materials:

- Definition and standardisation

Co-funded by the Erasmus+ Programme of the European Union

SMART TEXTILE MATERIALS

- Textile electronics: resistive networks, complex impedance and sheet resistance
- Basic sensors and principles: sensing principle, textile transducer, ordinary transducer, characterisation of resistive and capacitive sensors
- Conductive coatings and prints
- Electrical resistance measurements
- Impedance sensors

The contents should be delivered through theoretical and application sessions (e.g. lectures and workshops), where students are to work in interdisciplinary groups. Problem-based learning should be integrated into the unit to facilitate collaborative and hands-on experiences, along with the blended learning approach to facilitate knowledge and resource sharing between the teacher(s) and the students.

Also see Tool 1 Lectures, Tool 2 Workshops (Technology and Engineering), Tool 3 Interdisciplinary Group Work, Tool 5 Problem-based learning, and Tool 8 Blended Learning (available at http://www.e4ft.eu), together with the resource list below for further support.

LEARNING OUTCOMES

Upon successful completion of the unit the students will be able to:

1. Demonstrate in-depth knowledge of smart textiles materials and the broad range of uses in conductive textiles, textile sensors and textile electronics;
2. Produce and characterise conductive sensors, and measure the electrical properties of conductive textiles;
3. Critically analyse and explain the possibilities and limitations offered by electrically conductive textiles;
4. Verbally and in writing describe practical work, prototypes, critically analyse results and discuss conclusions based on relevant arguments, verbally and in writing, to peers, researchers and industry.

ASSESSMENT METHODS

The assessment of this unit involves written interpretation of findings and learnings:

1. Active participation in laboratory sessions, which is assessed through a learning journal, where students document, constructively analyse and discuss their learning process, and reflect and demonstrate their awareness, determination and self-critical abilities (see template in Tool 9

Self-Directed Learning)

2. Technical group written report of 2000 words outlining the problem to be resolved, critical analysis of the investigation and experimentation, and a critical reflection of the outcomes.

READING AND RESOURCE LIST

Essential Reading and Resources

McLoughlin, J. and Sabir, T. (2018) High-performance apparel: materials, development, and applications. Duxford, United Kingdom: Elsevier Ltd.

Further Reading and Resources

Anon (2019) Smart Textiles Production: Overview of Materials, Sensor and Production Technologies for Industrial Smart Textiles. MDPI - Multidisciplinary Digital Publishing Institute.

Kirstein, T. (2013) Multidisciplinary know-how for smart textiles developers. Oxford; Woodhead Pub.

Pailes-Friedman, R. (2016) Smart textiles for designers: inventing the future of fabrics. London: Laurence King Publishing.