Contract Number: 2016-1-PL01-KA202-026335

Project Title: Specialist in 3D printing - specialized training in application of 3D printing and practical use of acquired knowledge

Acronym: 3DSPEC

CURRICULUM OF THE 3DSPEC COURSE

Contents

1. Introduction

The 3DSPEC course is an on-line, **freely** available **course on 3D printing** for **four target groups** - users who work professionally in one or more of the following areas: **education**, **design**, **health care** and **SMEs**. For each of these areas of professional operation there are **specific needs and expectations** regarding knowledge and skills in 3D printing, which is strictly related with activities done in work practice.

The 3DSPEC course is an e-learning course run on a Moodle platform and it:
1. provides **theoretical content** regarding 3D printing technology,
2. presents **examples** of use of 3D printing in the abovementioned areas of professional operation.

The course curriculum has been established based on survey with representatives of the course target groups.

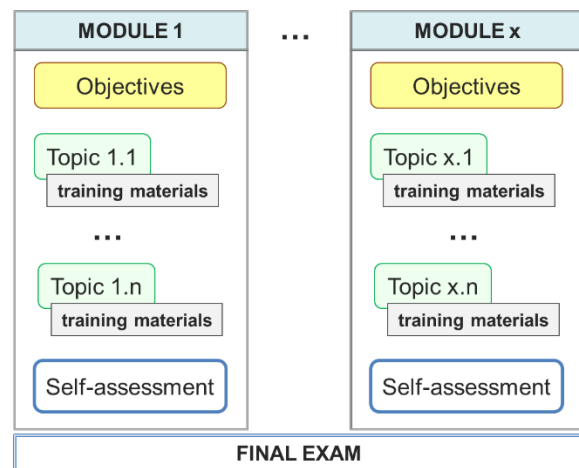## 2. Structure of the 3DSPEC course

The 3DSPEC **course consists of**:
- modules – they are the main units in the course
- final exam.

Each **module includes** the following **parts**:
- objectives – a short description regarding knowledge and/or skills to be acquired
  by a trainee who has completed the module
- topics – to each topic there are training materials linked,
- self-assessment – a test that enables a trainee to assess how well they assimilated knowledge/skills.

Structure of the course is presented in the figure.

Structure of the 3DSPEC course

As it was mentioned before, the course is addressed to trainees who work professionally in at least one of the following areas: education, health care, design and SMEs. To properly meet their needs there are **two types of topics** in the course:
- **general topics** – they are addressed for all trainees regardless area of professional activity declared by them
- **profiled topics** – their content covers only one area of professional activity, but they still can be browsed by other enrolled trainees, but are not mandatory for them (not covered by the final test).

A number of activities related with use of different types of software is presented. The **procedures to apply** are **demonstrated** among others **by films,** and **input files are provided** as well - to enable trainees to exercise those procedures. The files are provided as **Complementary materials**.

3. The 3DSPEC course curriculum

The 3DSPEC course includes the following **thematic modules**:

Module 1. Introduction: general view of the 3D printing technology.

Module 2. Making input file for 3D printer.

Module 3. Materials used in 3D printing

Module 4. Examples of use of 3D printing in activities conducted in your profession

Module 5. Self-designing and assembling of 3D printer.

During enrolment for the course, each **trainee declares belonging to one or more target group, i.e.**: education, design, healthcare, SMEs. **Optionally** a trainee can declare **interest in topics regarding building of 3D printers** instead of indication of a target group.

A part of the course content is **obligatory for all trainees** and **a part is optional** – depending on the target group declared.

Structure of the whole curriculum is presented in the figure below entitled 'Structure of 3DSPEC course curriculum'. Mark "X" means topic obligatory for a given group of trainees and mark "O" means topic optional for a given target group (their content will not be included in final exam).

Contents	Target group				
	Education	Design	Healthcare	SMEs	3D Printer Assembly & Development
Module 1. Introduction: General view of the 3D printing technology	X	X	X	X	X
1.1. How the additive technologies work	X	X	X	X	X
1.2. Topic 1.2. 3D printing methods - examples, overview - part 1	X	X	X	X	X
1.2. Topic 1.2. 3D printing methods - examples, overview - part 2	X	X	X	X	X
1.2. Topic 1.2. 3D printing methods - examples, overview - part 3	X	X	X	X	X
1.2. Topic 1.2. 3D printing methods - examples, overview - part 4	X	X	X	X	X
1.3. Possibilities and limitations of application - Main advantages and disadvantages	X	X	X	X	X
Module 2. Preparing of input file for 3D printer	X	X	X	X	X
2.1. Introduction to 3D modelling	X	X	X	X	X
2.2. Review of software for 3D modelling	X	X	X	X	X
2.3. 3D modelling for 3D printing - design recommendations	X	X	X	X	X
2.4 Preparing data from 3D scanning for 3D printing purposes	X	X	X	X	X
2.5. Conversion of patient's body-data into a three - dimensional model	X	X	X	X	X
2.6. Free repositories of 3D models for 3D printing	X	X	X	X	X
2.7. Work in slicer software - transforming of 3D model for a 3D printer	X	X	X	X	X
Module 3. Materials used in 3D printing	X	X	X	X	X
3.1. Description of the most often used materials.	X	X	X	X	X
3.2. Mechanical properties of 3D printed objects	X	X	X	X	X
Complementary materials	X	X	X	X	X
Module 4. Examples of use of 3D printing in activities conducted in your profession	X	X	X	X	O
4.1. Additive 3D printing applications in the healtcare area	O	O	X	O	O
4.1.1. 3D printouts for informing a patient about their disease, pathological changes of organs, therapy/surgery	O	O	X	O	O
4.1.2. 3D printouts for preparing a patient for surgery	O	O	X	O	O
4.1.3. 3D printouts to help the surgeon in the surgery	O	O	X	O	O
4.1.4. 3D printouts as custom made implants and prototypes of standard implants	O	O	X	O	O
4.2. Additive 3D printing applications in the SMEs area	O	O	O	X	O
4.2.1. Making large-size 3D printouts	O	O	O	X	O
4.2.2. Application of 3D printing in usability tests of new solutions	O	O	O	X	O
4.2.3. 3D printouts for marketing of new solutions	O	O	O	X	O
4.2.4. Development of 3D printed company promotional gadgets and accessories	O	O	O	X	O
4.3. Additive 3D printing applications in the Education area	X	O	O	O	O
4.3.1. 3D printing of teaching aids for improvement of teaching process	X	O	O	O	O
4.3.2. Parametric 3D models for self-adaptation by students	X	O	O	O	O
4.3.3. Curricula of lessons including 3D printouts as part of the teaching process	X	O	O	O	O
4.4. Additive 3D printing applications in the Design area	O	X	O	O	O
4.4.1. Methods for adjustment of 3D models of technical objects for 3D printing	O	X	O	O	O
4.4.2. Fast prototyping for design assessment	O	X	O	O	O
4.5. 3D Printing in FDM Technology – Typical Problems	O	X	O	O	O
Complementary materials	O	O	O	O	O
Module 5. Self designing and assembling of 3D printers	O	O	O	O	X
5.1. 3D printers – properties and usability	O	O	O	O	X
5.2. Design of 3D printer - case study 1	O	O	O	O	X
5.3. Design of 3D printer - case study 2	O	O	O	O	X
5.4. Design of 3D printer - review of available solutions	O	O	O	O	X
5.5. Modding 3D Printer	O	O	O	O	X
Complementary materials	O	O	O	O	X

Structure of 3DSPEC course curriculum

Detailed description of the course modules is below.

Module 1. Introduction: General view of the 3D printing technology.

Objectives

In this module a trainee is provided with structured knowledge that describes the basics of 3D printing technology, how the whole process works in general, what are 3D printing methods, they work, and what are their applications, the advantages and disadvantages of different solutions.

Topics

- How the additive technologies work
- 3D printing methods – examples, overview
- Possibilities and limitations of application - main advantages and disadvantages

Module 2. Preparing of input file for 3D printer.

Objectives

In this part of the course a trainee learns how to prepare an input file for a 3D printer. Different ways of preparing a computer 3D model of an object are presented. Also examples how to adjust models obtained e.g. from 3D scanning process to make 3D printouts are shown. Work in specialist software dedicated for preparing input files for 3D printers (files in GCODE format) is described.

Topics

- Introduction to 3D modelling
- Review of software for 3D modelling (Free Software, Commercial Software, Examples of commonly used software and its application – functionality and application)
- 3D modelling for 3D printing - design recommendations
- Preparing data from 3D scanning for 3D printing purposes
- Conversion of patient's body-data into a three - dimensional model
- Free repositories of 3D models for 3D printing
- Work in slicer software - transforming of 3D model for a 3D printer

Module 3. Materials used in 3D printing.

Objectives

Use of proper material for 3D printing is very important in terms of future use of a 3D printed object. In this module physical properties of most often used materials are presented. Results of research that characterize the strength properties of 3D printouts are also shown.

Topics

- Description of the most often used materials.
- Mechanical properties of 3D printed objects

> In the next module - MODULE 4 the topics are classified/grouped taking into account their assignment for particular 3DSPEC target groups BUT most of the topics might be useful, applicable for all the trainees. So the recommendation for a trainee is not to limit browsing to the topics that are assigned to the target group declared by the trainee during the enrolment for the course.

Module 4. Examples of use of 3D printing in activities conducted in your profession

Objectives

Examples of application of 3D printing in a trainee's area/s of operation and relevant theory (if necessary) is presented in the module. Procedures to be followed to produce a given, sample 3D printout are presented. In each topic a trainee gains access to downloadable additional materials – 3D models of an object. Additionally typical problems that are encountered by FDM method users are presented and some tips how to avoid them are provided.

Topics

- Additive 3D printing applications in the healthcare area
  o 3D printouts for informing a patient about their disease, pathological changes of organs, therapy/surgery
  o 3D printouts for preparing a patient for surgery
  o 3D printouts to help the surgeon in the surgery
  o 3D printouts as custom made implants and prototypes of standard implants
- Additive 3D printing applications in the SMEs area
  o Making large-size 3D printouts
  o Application of 3D printing in usability tests of new solutions
  o 3D printouts for marketing of new solutions
  o Development of 3D printed company promotional gadgets and accessories
- Additive 3D printing applications in the Education area
  o 3D printing of teaching aids for improvement of teaching process
  o Parametric 3D models for self-adaptation by students
  o Curricula of lessons including 3D printouts as part of the teaching process
- Additive 3D printing applications in the Design area
  o Methods for adjustment of 3D models of technical objects for 3D printing
  o Fast prototyping for design assessment
- 3D Printing in FDM Technology – Typical Problems

Module 5: Self designing and assembling of 3D printers.

Objectives

The content is focused on FDM 3D printers. Characteristics of 3D printers as manufacturing machines is provided as well as examples how they can be assembled. Additionally a detailed procedure of modding a 3D printer is provided, i.e. adding a functionality of controlling a 3D printer via Internet..

Topics

- 3D printers – properties and usability
- Design of 3D printer - case study 1
- Design of 3D printer - case study 2
- Design of 3D printer - review of available solutions
- Modding 3D Printer