



www.3d-p.eu/

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Revision History

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1.0 INTRODUCTION

Curricula for 3D Printing courses were organized so that to allow personalization depending on the type of trainee:

- 3D-P Beginner user - a vocational student/trainer who is not knowledgeable on how to generate simple 3D virtual and physical models using CAD and 3D printing respectively, and whose intention is primarily to gain basic familiarisation with 3D CAD and 3D printing technology;
- 3D-P Intermediate user - a vocational student/trainer who is typically aware on how to create 3D virtual models in CAD using common basic commands (e.g. extrude), has an idea of 3D printing and whose intention is primarily to create 3D CAD models for 3D printing purposes, to use 3D printed physical models for visualising the 3D form geometry and for communicating the form ideas;
- 3D-P Advanced user - a vocational student/trainer who is typically aware on how to create 3D virtual models in CAD using advanced 3D modelling commands, knows the basic steps of 3D printing and whose intention is primarily to create 3D CAD models using advanced features for 3D printing purposes, to use 3D printed physical models for visualising the 3D form geometry, for communicating form ideas and and/or for testing functional aspects. Such a student/trainer is considered as an independent 3D-P user.

The number of hours allocated to each type of course is the following:

- Beginner course: 15h
- Intermediate course: 25h
- Advanced course: 40h

Practical applications are developed for each module for demonstrating the theoretical concepts. Also, the user can answer to tests/quizzes for each module.

2.0 BEGINNERS CURRICULUM

No. of hours – 15h

Introduction to 3D printing	
<i>Learning Outcomes</i>	<ul style="list-style-type: none"> - Knowledge on 3D Printing approach and basic terminology - Understanding the advantages and limitations of 3D Printing for different applications - Knowledge on the process steps for obtaining an object using 3D Printing technology
<i>Pre-requisites</i>	- Computers and Internet skills
<i>Sub-topics to be covered</i>	<ul style="list-style-type: none"> • Additive Manufacturing approach. 3D Printing technology definition and specific terms • 3D Printing advantages and limitations • Short history of 3D Printing • 3D Printing technology steps. Examples • 3D Printing applications fields. Examples
<i>Module Suitable for</i>	Beginners
<i>No. of hours (PPT slides)</i>	4 hours consisting of min. 25 slides

Available 3D printing technologies	
<i>Learning Outcomes</i>	<ul style="list-style-type: none"> - Knowledge on the main 3D Printing processes, their advantages and limitations - Knowledge on materials issues in 3D Printing - Knowledge on STL file format
<i>Pre-requisites</i>	<ul style="list-style-type: none"> - Knowledge on 3D Printing approach to build parts and assemblies - Knowledge on 3D Printing technology steps
<i>Sub-topics to be covered</i>	<ul style="list-style-type: none"> • Type of 3D Printing processes: main characteristics, materials, advantages and limitations, examples • STL file format
<i>Module Suitable for</i>	Beginners
<i>No. of hours (PPT slides)</i>	3 hours consisting of min. 20 slides

3D Printing equipment	
<i>Learning Outcomes</i>	<ul style="list-style-type: none"> - Understand the difference between industrial 3D printers, desktop 3D printers and home/hobbyists 3D printers - Understand the main components of a FDM 3D printer
<i>Pre-requisites</i>	<ul style="list-style-type: none"> - Knowledge on 3D Printing approach to build parts and assemblies - Knowledge 3D Printing technology steps

	- Knowledge on 3D Printing types of processes
<i>Sub-topics to be covered</i>	<ul style="list-style-type: none"> • RepRap Project • Fused Deposition Modelling /Fused Filament Fabrication process • FDM/FFF equipment
<i>Module Suitable for</i>	Beginners
<i>No. of hours (PPT slides)</i>	2 hours consisting of min.18 slides

Select a STL model from online repositories	
<i>Learning Outcomes</i>	- Knowledge on how to access STL models repositories on internet and download the desired model (theoretical and practical skills)
<i>Pre-requisites</i>	<ul style="list-style-type: none"> - Knowledge on 3D Printing: processes, working flow - Knowledge on STL file format - Computers and Internet skills
<i>Sub-topics to be covered</i>	<ul style="list-style-type: none"> • Access STL files repositories such as: Thingiverse, GrabCAD, Pinshape, Yeggi, etc. • Browse the repositories and download STL file • Examples
<i>Module Suitable for</i>	Beginners
<i>No. of hours (PPT slides)</i>	3 hours consisting of min.10 slides

Obtain the physical model using services offered by 3D Printing providers	
<i>Learning Outcomes</i>	- Knowledge on how to access online service bureaus or platforms for estimating printing costs and placing orders for manufacturing the desired object (theoretical and practical skills)
<i>Pre-requisites</i>	<ul style="list-style-type: none"> - Knowledge on 3D Printing: processes, working flow, materials - Knowledge on STL file format - Computers and Internet skills
<i>Sub-topics to be covered</i>	<ul style="list-style-type: none"> • Access 3D Printing online services providers such as: 3D Hubs, Shapeways, Sculpteo, i.Materialise, StratasysDirect, QuickParts, etc. • Upload STL model, select material, 3D Printing process, machine, etc. • Evaluate cost, delivery time and other information provided by producers/platforms • Place order • Examples
<i>Module Suitable for</i>	Beginners
<i>No. of hours (PPT slides)</i>	3 hours consisting of min.10 slides

3.0 INTERMEDIATE CURRICULUM

No. of hours – 25

Introduction to 3D printing	
<i>Learning Outcomes</i>	<ul style="list-style-type: none"> - Knowledge on 3D Printing approach and basic terminology - Understanding the advantages and limitations of 3D Printing for different applications - Knowledge on the process steps for obtaining an object using 3D Printing technology
<i>Pre-requisites</i>	- Computers and Internet skills
<i>Sub-topics to be covered</i>	<ul style="list-style-type: none"> • Additive Manufacturing approach. 3D Printing technology definition and specific terms • 3D Printing advantages and limitations • Short history of 3D Printing • 3D Printing technology steps. Examples • 3D Printing applications fields. Examples
<i>Module Suitable for</i>	Intermediate
<i>No. of hours (PPT slides)</i>	4 hours consisting of min.25 slides

Available 3D printing technologies	
<i>Learning Outcomes</i>	<ul style="list-style-type: none"> - Knowledge on the main 3D Printing processes, their advantages and limitations - Knowledge on materials issues in 3D Printing - Knowledge on STL file format
<i>Pre-requisites</i>	<ul style="list-style-type: none"> - Knowledge on 3D Printing approach to build parts and assemblies - Knowledge 3D Printing technology steps
<i>Sub-topics to be covered</i>	<ul style="list-style-type: none"> • Type of 3D Printing processes: main characteristics, materials, advantages and limitations, examples • STL file format
<i>Module Suitable for</i>	Intermediate
<i>No. of hours (PPT slides)</i>	3 hours consisting of min.20 slides

3D Printing equipment	
<i>Learning Outcomes</i>	<ul style="list-style-type: none"> - Understand the difference between industrial 3D printers, desktop 3D printers and home/hobbyists 3D printers - Understand the main components of a FDM 3D printer
<i>Pre-requisites</i>	<ul style="list-style-type: none"> - Knowledge on 3D Printing approach to build parts and assemblies - Knowledge 3D Printing technology steps

	- Knowledge 3D Printing types of processes
<i>Sub-topics to be covered</i>	<ul style="list-style-type: none"> • RepRap Project • Fused Deposition Modelling /Fused Filament Fabrication process • FDM/FFF equipment
<i>Module Suitable for</i>	Intermediate
<i>No. of hours (PPT slides)</i>	2 hours consisting of min.18 slides

Select a STL model from online repositories	
<i>Learning Outcomes</i>	- Knowledge on how to access STL models repositories on internet and download the desired model (theoretical and practical skills)
<i>Pre-requisites</i>	<ul style="list-style-type: none"> - Knowledge on 3D Printing: processes, working flow - Knowledge on STL file format - Knowledge of computers and Internet skills
<i>Sub-topics to be covered</i>	<ul style="list-style-type: none"> • Access STL files repositories such as: Thingiverse, GrabCAD, Pinshape, Yeggi, etc. • Browse the repositories and download STL file • Examples
<i>Module Suitable for</i>	Intermediate
<i>No. of hours (PPT slides)</i>	3 hours consisting of min.10 slides

Check and correct STL file using dedicated software	
<i>Learning Outcomes</i>	- Knowledge on using specific software (Netfabb Basic or Magics) for checking and correcting the STL downloaded model
<i>Pre-requisites</i>	<ul style="list-style-type: none"> - Knowledge on STL file format - Computers and Internet skills
<i>Sub-topics to be covered</i>	<ul style="list-style-type: none"> • Download and install dedicated software for STL files errors checking and correction: Magics, Netfabb Basic • Use automated tools/commands for checking STL file • Use automated tools/commands for correcting STL file • Examples
<i>Module Suitable for</i>	Intermediate
<i>No. of hours (PPT slides)</i>	3 hours consisting of min.15 slides

Obtain the physical model using services offered by 3D Printing providers	
<i>Learning Outcomes</i>	- Knowledge on how to access online service bureaus or platforms for estimating printing costs and placing orders for manufacturing the desired object (theoretical and practical skills)
<i>Pre-requisites</i>	- Knowledge on 3D Printing: processes, working flow, materials - Knowledge on STL file format - Knowledge of computers and Internet skills
<i>Sub-topics to be covered</i>	<ul style="list-style-type: none"> • Access 3D Printing online services providers such as: 3D Hubs, Shapeways, Sculpteo, i.Materialise, StratasysDirect, QuickParts, etc. • Upload STL model, select material, 3D Printing process, machine, etc. • Evaluate cost, delivery time and other information provided by producers/platforms • Place order • Examples
<i>Module Suitable for</i>	Intermediate
<i>No. of hours (PPT slides)</i>	3 hours consisting of min.10 slides

3D Printing an object on a low-cost filament deposition based printer	
<i>Learning Outcomes</i>	- Knowledge on 3D Printing an object using low-cost 3D printer based on filament deposition: process steps, parameters, building orientation
<i>Pre-requisites</i>	- Knowledge on 3D Printing: processes, working flow
<i>Sub-topics to be covered</i>	<ul style="list-style-type: none"> • Basic parameters for 3D Printing process based on filament deposition (layer thickness, road width, air gap, platform temperature, extruder temperature etc.). Materials issues • Main mechanical components of a low-cost 3D printer based on filament deposition. Examples. • Understand the influence of building orientation over aspects such as: support structure position and volume, surface quality, time and cost, mechanical properties
<i>Module Suitable for</i>	Intermediate
<i>No. of hours (PPT slides)</i>	3 hours consisting of min.20 slides

3D Printing an object on a low-cost filament deposition based printer – hands on sessions	
<i>Learning Outcomes</i>	- Knowledge on setting building orientation, process parameters and build an object on a low-cost 3D printer - Knowledge on 3D printer software
<i>Pre-requisites</i>	- Knowledge on FDM process, process steps and parameters, building orientation

<i>Sub-topics to be covered</i>	<ul style="list-style-type: none"> • Import the STL file in 3D printer software, scale and position object within building envelope, set process parameters, slice the model • Apply 3D Printing process steps for 3D printing an object • Apply post-processing operations for 3D printed objects
<i>Module Suitable for</i>	Intermediate
<i>No. of hours (PPT slides)</i>	4 hours consisting of min.25 slides

4.0 ADVANCED CURRICULUM

No. of hours – 40

Introduction to 3D printing	
<i>Learning Outcomes</i>	<ul style="list-style-type: none"> - Knowledge on 3D Printing approach and basic terminology - Understanding the advantages and limitations of 3D Printing for different applications - Knowledge on the process steps for obtaining an object using 3D Printing technology
<i>Pre-requisites</i>	- Computers and Internet skills
<i>Sub-topics to be covered</i>	<ul style="list-style-type: none"> • Additive Manufacturing approach. 3D Printing technology definition and specific terms • 3D Printing advantages and limitations • Short history of 3D Printing • 3D Printing technology steps. Examples • 3D Printing applications fields. Examples
<i>Module Suitable for</i>	Advanced
<i>No. of hours (PPT slides)</i>	4 hours consisting of min.25 slides

Available 3D printing technologies	
<i>Learning Outcomes</i>	<ul style="list-style-type: none"> - Knowledge on the main 3D Printing processes, their advantages and limitations - Knowledge on materials issues in 3D Printing - Knowledge on STL file format
<i>Pre-requisites</i>	<ul style="list-style-type: none"> - Knowledge on 3D Printing approach to build parts and assemblies - Knowledge 3D Printing technology steps
<i>Sub-topics to be covered</i>	<ul style="list-style-type: none"> • Type of 3D Printing processes: main characteristics, materials, advantages and limitations, examples • STL file format

<i>Module Suitable for</i>	Advanced
<i>No. of hours (PPT slides)</i>	3 hours consisting of min.20 slides

3D Printing equipment	
<i>Learning Outcomes</i>	<ul style="list-style-type: none"> - Understand the difference between industrial 3D printers, desktop 3D printers and home/hobbyists 3D printers - Understand the main components of a FDM 3D printer
<i>Pre-requisites</i>	<ul style="list-style-type: none"> - Knowledge on 3D Printing approach to build parts and assemblies - Knowledge 3D Printing technology steps - Knowledge 3D Printing types of processes
<i>Sub-topics to be covered</i>	<ul style="list-style-type: none"> • RepRap Project • Fused Deposition Modeling /Fused Filament Fabrication process • FDM/FFF equipment
<i>Module Suitable for</i>	Advanced
<i>No. of hours (PPT slides)</i>	2 hours consisting of min.18 slides

3D CAD modelling software applications	
<i>Learning Outcomes</i>	<ul style="list-style-type: none"> - Understand the basic of 3D CAD modelling - Knowledge on different free 3D CAD applications. A360 Fusion
<i>Pre-requisites</i>	Knowledge of computers and Internet skills
<i>Sub-topics to be covered</i>	<ul style="list-style-type: none"> • Fundamentals of 3D CAD modelling • Free 3D CAD software applications • A360 Fusion software - general aspects
<i>Module Suitable for</i>	Advanced
<i>No. of hours (PPT slides)</i>	2 hours consisting of min.20 slides

3D CAD modelling using A360 Fusion	
<i>Learning Outcomes</i>	<ul style="list-style-type: none"> - Knowledge on modelling a 3D object from scratch using a 3D CAD software - Knowledge on how to generate STL files from 3D CAD software
<i>Pre-requisites</i>	<ul style="list-style-type: none"> - Fundamentals of 3D CAD modelling - A360Fusion software - general aspects
<i>Sub-topics to be covered</i>	<ul style="list-style-type: none"> • Open or create new object, save model as STL file • Set or customize working environment (units, grids etc.) • Create 2D sketches • 3D modelling using primitives and/or commands (extrusions, revolutions etc.) for generating solids using 2D sketches

	<ul style="list-style-type: none"> • Select and manipulate 3D geometry (zoom, rotate/orbit, pan etc.) • Apply Boolean operations • Apply colour, material, textures • Apply chamfer, fillets
<i>Module Suitable for</i>	Advanced
<i>No. of hours (PPT slides)</i>	11 hours consisting of min.50 slides

Select a STL model from online repositories	
<i>Learning Outcomes</i>	- Knowledge on how to access STL models repositories on internet and download the desired model (theoretical and practical skills)
<i>Pre-requisites</i>	- Knowledge on 3D Printing: processes, working flow - Knowledge on STL file format - Computers and Internet skills
<i>Sub-topics to be covered</i>	<ul style="list-style-type: none"> • Access STL files repositories such as: Thingiverse, GrabCAD, Pinshape, Yeggi, etc. • Browse the repositories and download STL file • Examples
<i>Module Suitable for</i>	Advanced
<i>No. of hours (PPT slides)</i>	3 hours consisting of min.10 slides

Check and correct STL file using dedicated software	
<i>Learning Outcomes</i>	- Knowledge on using specific software (Netfabb Basic or Magics) for checking and correcting the STL downloaded model (theoretical and practical skills)
<i>Pre-requisites</i>	- Knowledge on STL file format - Computers and Internet skills
<i>Sub-topics to be covered</i>	<ul style="list-style-type: none"> • Download and install dedicated software for STL files errors checking and correction: Magics, Netfabb Basic • Use automated tools/commands for checking STL file • Use automated tools/commands for correcting STL file • Examples
<i>Module Suitable for</i>	Advanced
<i>No. of hours (PPT slides)</i>	3 hours consisting of min.15 slides

Obtain the physical model using services offered by 3D Printing providers	
<i>Learning Outcomes</i>	- Knowledge on how to access online service bureaus or platforms for estimating printing costs and placing orders for manufacturing the desired object (theoretical and practical skills)
<i>Pre-requisites</i>	- Knowledge on 3D Printing: processes, working flow, materials - Knowledge on STL file format - Knowledge of computers and Internet skills
<i>Sub-topics to be covered</i>	<ul style="list-style-type: none"> • Access 3D Printing online services providers such as: 3D Hubs, Shapeways, Sculpteo, i.Materialise, StratasysDirect, QuickParts, etc. • Upload STL model, select material, 3D Printing process, machine, etc. • Evaluate cost, delivery time and other information provided by producers/platforms • Place order • Examples
<i>Module Suitable for</i>	Advanced
<i>No. of hours (PPT slides)</i>	3 hours consisting of min.10 slides

3D Printing an object on a low-cost filament deposition based printer	
<i>Learning Outcomes</i>	- Knowledge on 3D Printing an object using low-cost 3D printer based on filament deposition: process steps, parameters, building orientation
<i>Pre-requisites</i>	- Knowledge on 3D Printing: processes, working flow
<i>Sub-topics to be covered</i>	<ul style="list-style-type: none"> • Basic parameters for 3D Printing process based on filament deposition (layer thickness, road width, air gap, platform temperature, extruder temperature etc.). Materials issues • Main mechanical components of a low-cost 3D printer based on filament deposition. Examples. • Understand the influence of building orientation over aspects such as: support structure position and volume, surface quality, time and cost, mechanical properties
<i>Module Suitable for</i>	Advanced
<i>No. of hours (PPT slides)</i>	3 hours consisting of min.18 slides

3D Printing an object on a low-cost filament deposition based printer – hands on sessions	
<i>Learning Outcomes</i>	- Knowledge on setting building orientation, process parameters and build an object on a low-cost 3D printer - Knowledge on 3D printer software
<i>Pre-requisites</i>	- Knowledge on FDM process, process steps and parameters, building orientation

<i>Sub-topics to be covered</i>	<ul style="list-style-type: none"> • Import the STL file in 3D printer software, scale and position object within building envelope, set process parameters, slice the model • Apply 3D Printing process steps for 3D printing an object • Apply post-processing operations for 3D printed objects • Examples. Hands-on sessions
<i>Module Suitable for</i>	Advanced
<i>No. of hours (PPT slides)</i>	4 hours consisting of min.20 slides

Design with 3D printing in mind	
<i>Learning Outcomes</i>	<ul style="list-style-type: none"> - Knowledge on 3D printed parts' defects - Understand the influence of building orientation over parts' quality and mechanical properties - Knowledge on 3D Printing design rules for parts and assemblies
<i>Pre-requisites</i>	<ul style="list-style-type: none"> - Knowledge on FDM process and process parameters - Knowledge on 3D printer software
<i>Sub-topics to be covered</i>	<ul style="list-style-type: none"> • Building orientation in 3D Printing • Type of defects in parts manufactured using filament deposition process (FDM) • FDM process parameters' influence over parts' quality and mechanical properties • Design rules for 3D Printing parts and assemblies • Examples
<i>Module Suitable for</i>	Advanced
<i>No. of hours (PPT slides)</i>	2 hours consisting of min.15 slides

Future of 3D printing technologies	
<i>Sub-topics to be covered</i>	<ul style="list-style-type: none"> • Myths and reality in 3D Printing • 3D Printing risks and regulations • 3D Printing trends and developments: new materials, new applications fields • Examples

Case studies in the industry to show the potential for boosting entrepreneurial spirit, creativity and innovation	
<i>Sub-topics to be covered</i>	<ul style="list-style-type: none"> • 3D Printing case studies for training and education • 3D Printing case studies in architecture and art • 3D Printing case studies for the medical field • 3D Printing case studies in engineering/industry • 3D Printing technology as support for innovation and creativity. Examples. Success stories.

3DP and entrepreneurship	
<i>Sub-topics to be covered</i>	<ul style="list-style-type: none">• Examples of businesses based on 3D Printing: online platform and repositories of parts for printing, service providers, hubs, training providers etc.• Examples of start-ups• Sources of founding• Skills required for the field• Opportunities for freelancers

- End -