

## Syllabus

### 1. Information about the **Module 2**

1.1 University	Transilvania University of Braşov
1.2 Team	UTBV_Team
1.3 Trainer_Name	Lecturer.dr.eng. Corneliu DRUGĂ Lecturer.dr.eng. Ionel ŞERBAN
1.3 Degree level	Postuniversity degree

### 2. Information about the course

Module title	<b>Types of Additive Manufacturing Technologies</b>
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### 3. Time budget

3.1 Number of hours	<b>3 h</b>	divided in:	Lecture	<b>100 mins</b>	Laboratory/ Project	<b>80 mins</b>
3.2 Time budget distribution (hours) for individual activity:						
(a) Individual study (course, obligatory bibliography, etc.)						2
(b) Additional documentation (recommended bibliography, etc.)						0.5
(c) Preparation for seminary/laboratory/project activities						0.5
(d) Peer learning						0
(e) Exam preparation						0
(f) Other activities						0
3.3 Total individual study (sum (3.7(a)...3.7(f)))				<b>3 h</b>		
3.4 ECTS credits				<b>0.6</b>		

### 4. Preconditions

4.1 curriculum	Librarian
4.2 competences	Space vision, technical skills, computer using knowledge

### 5. Course requirement

5.1. for lecture	Lecture room with video projector, laptop
5.2. for seminary/ laboratory/ project	Laboratory room with video projector, laptop, 3D printers

## 6. Gained competences

Professional competences	<ol style="list-style-type: none"> <li>1. Competences in organizing new services in libraries</li> <li>2. Competences in managing a Makerspaces in libraries</li> <li>3. Competences in selecting types of additive manufacturing technologies adapted to libraries</li> </ol>
Transversal competences	<ol style="list-style-type: none"> <li>1. Familiarity with existing additive manufacturing technologies on market</li> <li>2. Familiarity with new business models in libraries</li> </ol>

## 7. Course objective

7.1 General objective	Additive manufacturing technologies. State of the art.
7.2 Specific objectives	<p>Learners should be able to:</p> <ul style="list-style-type: none"> <li>- understand how additive manufacturing works: processes and exemplification of machines used in this type of manufacturing</li> <li>- understand and identify the classification, advantages, and limitations of additive manufacturing</li> <li>- identifying new library services</li> </ul>

## 8. Contents

8.1 Lecture	Hours	Teaching methods	Observation
<b>Types of Additive Manufacturing Technologies</b>			
2.1 Material Extrusion 2.1.1 Fused Deposition Modelling 2.2 Material and Binder Jetting 2.2.1 Material Jetting 2.2.2 Nano-Particle Jetting (NPJ) 2.2.3 Drop a Demand 2.2.4 Binder Jetting	20 mins	Video projector exposure methods, whiteboard explanations, and discussions	
2.3 VAT Polymerization 2.3.1 Stereolithography 2.3.2 Digital Light Projection 2.3.3 Continuous Digital Light Processing	40 mins		

2.4 Powder Bed Fusion 2.4.1 Selective Laser Sintering 2.4.2. Direct Metal Laser Sintering 2.4.3. Selective Laser Melting 2.4.4. Electron Beam Melting 2.4.5. Multi Jet Fusion			
2.5. Sheet Lamination Process 2.5.1. Laminated Object Manufacturing 2.5.2. Ultrasonic Additive Manufacturing 2.5.3. Selective Deposition Lamination	20 mins		
2.6. Direct Energy Deposition 2.6.1. Laser engineered net shaping 2.6.2. Electron Beam Additive Manufacturing	20 mins		
8.2 Seminary / Laboratory / Project	Hours	Teaching methods	Observation
<b>Types of Additive Manufacturing Technologies</b>			
Additive manufacturing processes- explained	20 mins	Video projector exposure methods, whiteboard explanations and discussions	
Additive manufacturing advantages and limitations	20 mins		
Additive manufacturing- types of machines, dimensions, utility	20 mins		
Additive manufacturing- exemplification of finite products, applications in libraries	20 mins		
8. 3 Bibliography: [1] Joel C. Najmon, Andres Tovar, Review of additive manufacturing technologies and applications in the aerospace industry, in Additive Manufacturing for the Aerospace Industry, 2019. [2] Thierry Chartier, Alexander Badev, Rapid Prototyping of Ceramics, in Handbook of Advanced Ceramics (Second Edition), 2013. [3] Loughborough University, Additive Manufacturing Research- About Additive Manufacturing- Material extrusion, <a href="https://www.lboro.ac.uk/research/amrg/about/the7categoriesofadditivemanufacturing/materialextrusion/">https://www.lboro.ac.uk/research/amrg/about/the7categoriesofadditivemanufacturing/materialextrusion/</a> . Accessed on 13 June 2021.			

[4] R. Singh, M.S.J. Hashmi, Implant Materials and Their Processing Technologies, in Reference Module in Materials Science and Materials Engineering, 2016.

[5] Leszek A. Dobrzański, Anna D. Dobrzańska-Danikiewicz, Anna Achteлик-Franczak, Lech B. Dobrzański, Marek Szindler and Tomasz G. Gawęł- Porous Selective Laser Melted Ti and Ti6Al4V Materials for Medical Applications, Chapter from the book Powder Metallurgy - Fundamentals and Case Studies, published by Intech, 2017

[6] <https://all3dp.com/2/selective-laser-melting-slm-3d-printing-simply-explained/>

[7] Tyler Palma, Michael Munther, Praveen Damasus, Sepehr Salari, Ali Beheshti, Keivan Davami- Multiscale mechanical and tribological characterizations of additively manufactured polyamide 12 parts with different print orientations, Journal of Manufacturing Processes, Volume 40, April 2019, Pages 76-83

[8] Farooq I Azam et al 2018 IOP Conf. Ser.: Mater. Sci. Eng. 328 012005

[9] Alkaios Bournias-Varotsis, Ross J. Friel, Russell A. Harris, Daniel S. Engstrøm- Ultrasonic Additive Manufacturing as a form-then-bond process foreembedding electronic circuitry into a metal matrix, Journal of Manufacturing Processes, April 2018, DOI: 10.1016/j.jmapro.2018.03.027

## 9. Evaluation at the end of the course