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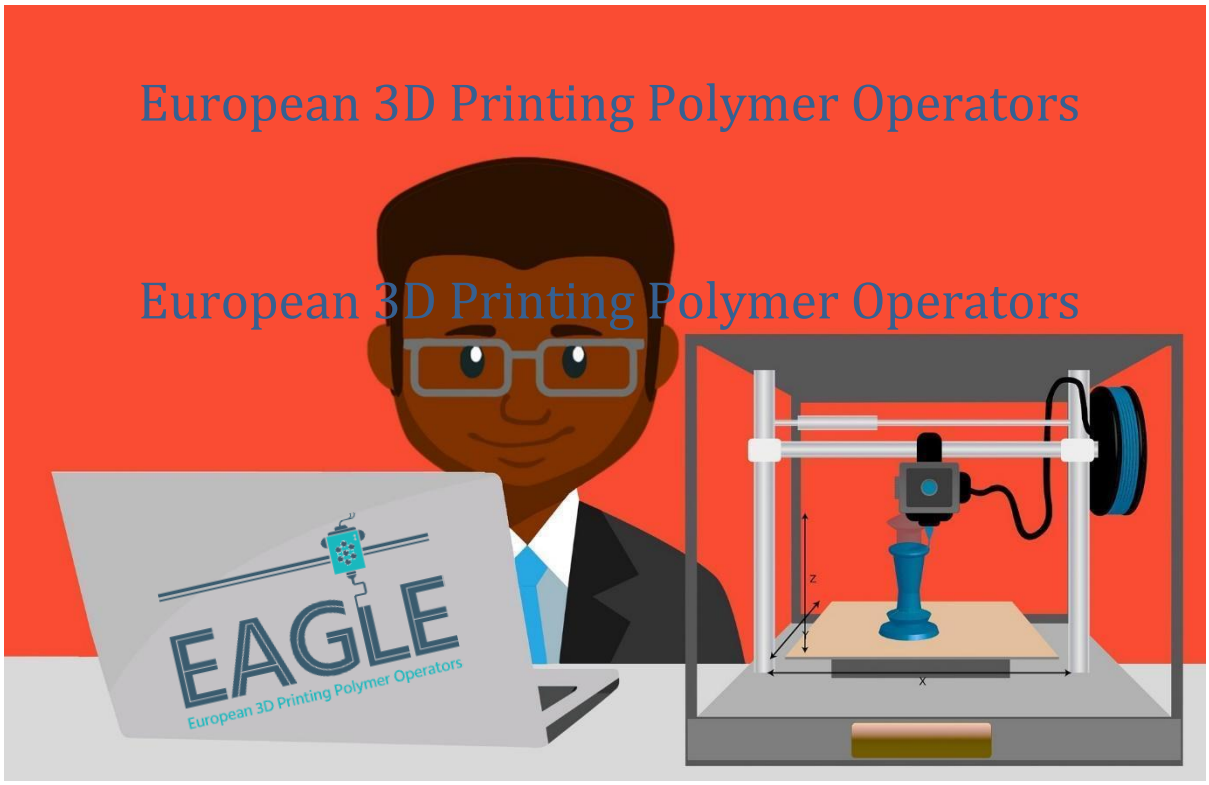
EAGLE
European 3D Printing Polymer Operators



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Polymeric AM Operator

Project No. 2021-1-CZ01-KA220-VET-000033007

This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein. Erasmus+: 2021-1-CZ01-KA220-VET-000033007

THE ADDITIVE MANUFACTURING POLYMER OPERATOR CURRICULUM

Professional Profile

AM Polymer Operators are the professionals with the specific knowledge, skills, autonomy and responsibility to operate machines using polymeric AM based processes. His/her main tasks are to:

- Operate polymeric based machines for AM, including the fitting and setting up, post processing and maintenance.

He/She will be able to:

– Prepare the AM polymeric machine to manufacture the part(s) – including routine maintenance procedures;
– Self-manage the handling of feedstock (approval, storage, contamination, traceability);
– Develop solutions on basic and specific problems related with polymeric AM machines and processes;
– Perform the required post-processing operations.

Competence Units for Polymeric AM Operator

Introduction

This guideline covers the minimum requirements for education and training in terms of Learning Outcomes (Knowledge and Skills) and the recommended contact (teaching) hours to be devoted to achieving them. Students successfully completing examinations will be expected to be capable of applying the achieved learning outcomes at a level consistent with the qualification diploma level.

The modular course contents are given in the following structure (overview):

COMPETENCE UNITS	Recommended Contact Hours*
CU-A – Polymer Materials on AM	3,5
CU-B – Material Extrusion (MEX) Process	3,5
CU-C – Powder Bed Fusion (PBF-LB/P) Process	3,5
CU-D – Material Jetting (MJT) Process	3,5
CU-E – Vat Photopolymerization Process	3,5
CU-F – Manufacturing of MEX parts	7
CU-G – Manufacturing of PBF-LB/P parts	7
CU-H – Manufacturing of MJT parts	7
CU-I – Manufacturing of Vat parts	7
CU-J – Quality Assurance of AM Polymer parts	3,5
TOTAL	**45,5**

* Recommended Contact Hours are the minimum recommended teaching hours for the Standard Routes. A contact hour shall con-tain at least 50 minutes of direct teaching time.
** Expected Workload is calculated in hours, corresponding to an estimation of the time students typically need to complete all learning activities required to achieve the defined learning outcomes in formal learning environments plus the necessary time for individual study.

Within this qualification, there are two types of Competence Units:

Cross-cutting Competence Unit - A competence unit whose learning outcomes are not directly linked with one job function since the knowledge and skills achieved will be mobilized in several job functions and activities.

Functional Competence Unit - A competence unit whose learning outcomes are directly linked with at least one job function and in which the knowledge and skills achieved will be mobilized in specific job functions and related activities.

The expected learning outcomes are described in two ways: generic outcome descriptors organized in knowledge, skills, autonomy and responsibility; and in detail for each competence unit, organized in job functions and related activities, knowledge and skills corresponding to a specific proficiency level within EWF´s Systems Framework levels (see Appendix I).

On each Competence Unit, objectives and scope are defined for a specific depth of knowledge and skills. Recommended contact hours are distributed between theoretical (A), assigned pro-jects/exercises (B), practical workshop training (C), etc., as shown in the following example:

*Qualification: E*xample 1	
CONTACT HOURS	**X= (SUM A:C)**
Subject Contents	A + B + C

CU-A – Polymer Materials on AM

CU-A – Polymer materials on AM	RECOMENDED CONTACT HOURS
SUBJECT TITLE	
Overview of Polymer Materials, their properties, and applications	3,5
Total	3,5
WORKLOAD	7

Learning Outcomes – CU-A: Polymer materials on AM	
KNOWLEDGE	Basic factual knowledge of: – Polymer materials and characteristics – Polymer Materials effects on AM – Potential and limitations of Polymer materials
SKILLS	– List the advantages and limitations of polymers materials over other materials, including its applicability – Identify Polymer Materials for AM use according to real-life applications' requirements

CU-B – Material Extrusion (MEX) Process

CU-B – Material Extrusion (MEX) Process	RECOMENDED CONTACT HOURS
SUBJECT TITLE	
MEX Process Overview	2,5
Overview of Polymer Materials, their properties and applications	1
Total	3,5
WORKLOAD	7

Learning Outcomes – CU-B: Material Extrusion (MEX) Process	
KNOWLEDGE	Factual and broad of: – Material Extrusion (MEX) process and principles – Polymer Materials and characteristics and their effects on MEX additive manufacturing – Potential and limitations of Polymer MEX materials
SKILLS	– Recognise the advantages and limitations of MEX over other AM Polymers processes, including its applicability according to the characteristics of the process – Identify the main components of MEX equipment – Identify Polymer Materials for MEX applications

CU-C – Powder Bed Fusion (PBF-LB/P) Process

CU-C – Powder Bed Fusion (PBF-LB/P) Process **SUBJECT TITLE**	**RECOMENDED CONTACT HOURS**
PBF-LB/P Process Overview	2,5
Overview of Polymer Materials, their properties and applications	1
Quality Assurance	1
Total	3,5
WORKLOAD	7

Learning Outcomes – CU-C: Powder Bed Fusion (PBF-LB/P)	
KNOWLEDGE	Factual and broad of: – Powder Bed Fusion (PBF-LB/P) process and principles – Polymer Materials and characteristics and their effects on PBF-LB/P additive manufacturing – Potential and limitations of Polymer PBF-LB materials
SKILLS	– Recognise the advantages and limitations of PBF-LB over other AM Polymers processes, including its applicability according to the characteristics of the process – Identify the main components of PBF-LB/P equipment – Identify Polymer Materials for PBF-LB applications

CU-D – Material Jetting (MJT) Process

CU-D – Material Jetting (MJT) Process	RECOMENDED CONTACT HOURS
SUBJECT TITLE	
MJT Process Overview	2,5
Overview of Polymer Materials, their properties and applications	1
Total	3,5
WORKLOAD	7

Learning Outcomes – CU-D: Material Jetting (MJT) Process	
KNOWLEDGE	Factual and broad of: – Material Jetting (MJT) process and principles – Polymer Materials and characteristics and their effects on MJT additive manufacturing – Potential and limitations of Polymer MJT materials
SKILLS	– Recognise the advantages and limitations of MJT over other AM Polymers processes, including its applicability according to the characteristics of the process – Identify the main components of MJT equipment – Identify Polymer Materials for MJT applications

CU-E – Vat Photopolymerization Process

CU-E – Vat Photopolymerization Process	RECOMENDED CONTACT HOURS
SUBJECT TITLE	
Vat Process Overview	2,5
Overview of Polymer Materials, their properties and applications in the context of VAT process	1
Total	3,5
WORKLOAD	7

Learning Outcomes – CU-E: Vat Photopolymerization Process	
KNOWLEDGE	Factual and broad of: – Vat Photopolymerization (Vat) process and principles – Polymer Materials and characteristics and their effects on Vat additive manufacturing – Potential and limitations of Polymer Vat materials – Steps required for the VAT process
SKILLS	– Recognise the advantages and limitations of Vat over other AM Polymers processes, including its applicability according to the characteristics of the process – Identify the main components of Vat equipment – Identify Polymer Materials for Vat applications

CU-F – Manufacturing of MEX parts

CU-F – Manufacturing of MEX parts	RECOMENDED CONTACT HOURS
SUBJECT TITLE	
MEX Equipment and its components	1,5
Feedstock used in the MEX process	1
Type of files and work documentation	1
Post processing operations for MEX	1
Maintenance procedures for MEX machines	1,5
Health, Safety and Environmental procedures	1
Total	7
WORKLOAD	14

CU	EQF/ EWF LEVEL	JOB FUNCTION	JOB REQUIRED ACTIVITIES	CONTACT HOURS	WORKLOAD
Manufacturing of MEX parts	**4 Independent**	Manufacture MEX parts	Fitting and setting up the machine	7	14
			Conducting Post Processing operations		
			Maintaining & cleaning the MEX system		

Learning Outcomes – CU-F: Manufacturing of MEX parts	
KNOWLEDGE	Factual and broad knowledge of: – MEX Equipment and its components – Feedstock used in the MEX process – Type of files and work documentation – Post processing operations for MEX – Maintenance procedures for MEX machines – Health, Safety and Environmental procedures for MEX process
SKILLS	– Prepare the MEX system following all the operational steps required – Remove the parts from the build plate – Remove the supports (if needed) from the part and post-process the parts – Comply with Health, Safety and Environmental procedures – Maintain the MEX system

CU-G – Manufacturing of PBF-LB/P parts

CU-G – Manufacturing of PBF-LB/P parts	RECOMENDED CONTACT HOURS
SUBJECT TITLE	
PBF-LB/P System – Hardware	1
PBF-LB/P machine set-up requirements	1
Consumables, feedstock & substrate	1
Type of files and work documentation	1
Powder and parts removal processes	1
Post Processing	1
Health, Safety and Environmental procedures	1
Total	7
WORKLOAD	14

CU	EQF/ EWF LEVEL	JOB FUNCTION	JOB REQUIRED ACTIVITIES	CONTACT HOURS	WORKLOAD
Manufacturing of PBF-LB/P parts	**4 Independent**	Manufacture PBF-LB/P parts	Fitting and setting up the machine	7	14
			Conducting Post Processing operations		
			Maintaining & cleaning the PBF-LB/P system		

Learning Outcomes – CU-G: Manufacturing of PBF-LB/P parts	
KNOWLEDGE	Factual and broad knowledge of: – PBF-LB/P Equipment and its components – Feedstock used in the PBF-LB/P process – Type of files and work documentation – Post processing operations for PBF-LB/P – Maintenance procedures for PBF machines – HSE for PBF-LB/P process
SKILLS	– Confirm print readiness of the PBF-LB/P system (according to the machine indication) – Remove the build chamber and transfer to the post-processing station – Extract the part from the build chamber (in the post processing station) – Vacuum the excess powder from the parts and post processing station – Storage and mixing of recovered & new powder adequately selecting the mix ratio – Place the powder container on the integrated mixer – Perform post processing operations (media blaster, sand blasters …) – Perform maintenance procedures (e.g.: build platform; optical windows; x-axis lead screw; IR sensor; recoater, cleaning of filters and exhaust hose)

CU-H – Manufacturing of MJT parts

CU-H – Manufacturing of MJT parts	RECOMENDED CONTACT HOURS
SUBJECT TITLE	
Material Jetting Equipment	1,5
Consumables, Feedstock & Substrate	1,5
Type of files and work documentation	1
Post Processing Operations	1
Maintenance Procedures	1
Health, Safety and Environmental procedures	1
Total	7
WORKLOAD	14

CU	EQF/ EWF LEVEL	JOB FUNCTION	JOB REQUIRED ACTIVITIES	CONTACT HOURS	WORKLOAD
Manufacturing of MJT parts	**4 Independent**	Manufacture MJT parts	Fitting and setting up the machine Conducting Post Processing operations Maintaining & cleaning the MJT system	7	14

Learning Outcomes – CU-H: Manufacturing of MJT parts	
KNOWLEDGE	Factual and broad knowledge of: – MJT Equipment and its components – Feedstock used in the MJT process – Type of files and work documentation – Post processing operations for MJT – Maintenance procedures for MJT machines – HSE for MJT process
SKILLS	– Confirm print readiness of the MJT system (according to the machine indication) – Remove the build chamber and transfer to the post-processing station – Extract the part from the build chamber (in the post processing station) – Vacuum the excess powder from the parts and post processing station – Storage and mixing of recovered & new powder adequately selecting the mix ratio – Perform post processing operations (media blaster, sand blasters …) – Perform maintenance procedures (e.g.: Replace and aligning a print head; Replace a clean head cleaning roll, Refilling the Storage Tank; Vacuum the Sieve; Replacing a Material Cartridge; Scrape the Fusing Lamp Replacing a Heating Lamp; Replacing the External Tank ; Replacing the Vacuum Pump Filter)

CU-I – Manufacturing of Vat parts

CU-I – Manufacturing of VAT parts	RECOMENDED CONTACT HOURS
SUBJECT TITLE	
Vat Equipment and its components	1,5
Materials used in the Vat process	1,5
Type of files and work documentation	1
Post processing operations for Vat	1
Maintenance procedures for Vat machines	1
Health, Safety and Environmental procedures	1
Total	7
WORKLOAD	14

CU	EQF/ EWF LEVEL	JOB FUNCTION	JOB REQUIRED ACTIVITIES	CONTACT HOURS	WORKLOAD
Manufacturing of Vat parts	**4 Independent**	Manufacture Vat parts	Fitting and setting up the machine Conducting Post Processing operations Maintaining & cleaning the Vat system	7	14

Learning Outcomes – CU-I: Manufacturing of Vat parts	
KNOWLEDGE	Factual and broad knowledge of: – Vat Equipment and its components – Materials used in the Vat process – Type of files and work documentation – Post processing operations for Vat – Maintenance procedures for Vat machines – HSE for Vat process
SKILLS	– Prepare the Vat system – Remove the build plate from the machine – Remove the parts from the build plate – Immerse the parts in IPA (isopropyl alcohol) – Cure the parts (with UV light) – Remove the supports from the part and post-process the parts – Remove the excess of resin from the Vat and prepare it for the next use – Check the Vat screen to ensure no resin was split to the reverse side – Remove the excess resin from the resin tank/Vat (use a funnel and a latex paint filter) – Remove the remaining resin with a spatula – Clean the Vat with alcohol and “towels” – Apply lubricant to the Vat (to ensure no resin sticks when printing the next parts) – Comply with Health, Safety and Environmental procedures

CU-J – Quality Assurance of AM Polymer parts

CU-J – Quality Assurance of AM Polymer parts	RECOMENDED CONTACT HOURS
SUBJECT TITLE	
Quality Assurance in MEX processes	0,5
Quality Assurance in PBF-LB/P processes	0,5
Quality Assurance in MJT processes	0,5
Quality Assurance in Vat processes	0,5
QA procedures	1,5
Total	3,5
WORKLOAD	7

Learning Outcomes – CU-J: Quality Assurance of AM Polymer parts	
KNOWLEDGE	Factual and broad of: – Quality Assurance – QA Procedures
SKILLS	– Identify QA principles for MEX processes – Identify QA principles for PBF-LB/P processes – Identify QA principles for MJT processes – Identify QA principles for Vat processes – Perform QA verification