ALLEGATO – Schema di Piano formativo individuale (PFI)
PIANO FORMATIVO INDIVIDUALE

DOTTORATO IN APPRENDISTATO DI ALTA FORMAZIONE E RICERCA

Corso di Dottorato di Ricerca in
3D PRINTING OF DRUGS: ENGINEERING, MECHANICS AND DESIGN

SEZIONE 1 – DATORE DI LAVORO

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tipologia contratto: Apprendistato di alta formazione e ricerca
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numero ore settimanali: 28
retribuzione lorda annuale: COME DA CCNL CHIMICA PMI
retribuzione netta mensile: COME DA CCNL CHIMICA PMI

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Politecnico di Bari

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SEZIONE 3 – DURATA E ARTICOLAZIONE ANNUA DELLA FORMAZIONE INTERNA ED ESTERNA

Titolo/Argomento della Tesi (inglese o bilingue): 3D printing of drugs: engineering, mechanics and design
Abstract Progetto (inglese o bilingue) The apprenticeship-based PhD project is situated within the field of additive manufacturing applied to the pharmaceutical sector, with particular reference to the development of 3D printing processes for the production of personalised pharmaceutical dosage forms. The overall objective is to study, optimise and validate technological and process solutions enabling the controlled production of 3D-printed medicines, with particular attention to the geometric quality of the product, process repeatability, material management and the systematic collection of production data.

3D printing of medicines is a technology of growing interest for personalised medicine, as it allows the geometry, dosage, release profile and composition of the pharmaceutical dosage form to be modulated according to the patient's needs. In this context, the project will focus on optimising the performance of the printer in relation to print quality, assessing parameters such as infill, dimensional accuracy, geometric definition, deposit uniformity and process stability. These aspects will be analysed with reference to materials of pharmaceutical interest, including powders, granules or formulations that can be processed by extrusion and controlled deposition.

A significant part of the activity will be dedicated to studying the automatic powder feeding system, with the aim of ensuring continuity, homogeneity and precision in material supply during the printing process. Proper feed management is, in fact, a critical element in ensuring dosage consistency and the reproducibility of the final characteristics of the printed medicine. Possible mechanical and functional configurations of the feeding system will therefore be analysed, assessing their integration with the extruder and with the machine controls.

The project will also include the study of solutions for thermal control of the feeding area, with particular attention to hopper cooling or thermal insulation between the extruder and the hopper. This activity is necessary to prevent undesired phenomena such as preheating, agglomeration, degradation or alteration of the rheological and technological properties of the material before its actual transformation. The thermal stability of the system will therefore be assessed as a key parameter for process quality and reliability.

In parallel, the PhD candidate will work on extracting process data from the printer management software and organising them into structured reports based on predefined templates. Data collection and analysis will make it possible to correlate machine parameters with the characteristics of the finished product, contributing to the definition of standard operating procedures, quality control criteria and process traceability tools.

From a methodological perspective, the project will involve experimental printing activities, geometric and functional characterisation of the produced samples, analysis of process parameters and development of technical solutions to improve machine reliability. The work will be carried out in close integration between the academic environment and the company setting, enhancing the

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applied nature of the apprenticeship-based PhD. The expected outcome is the definition of a more stable and controllable 3D printing process suitable for the production of personalised pharmaceutical dosage forms, contributing to the technology transfer of additive manufacturing into the pharmaceutical sector.

Ore di formazione esterna (in Università, si considerano obbligatorie le ore didattica interdisciplinare previste dalla Scuola di Dottorato): 12

Durata del progetto: mesi 36
Data avvio prevista: Novembre 2026
Data fine prevista: Ottobre 2029

Firmato digitalmente da:
SERGIO FONTANA
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