

FRAMEWORK PROGRAMME OF EARLY STAGE RESEARCHER TRAINING¹

1. BASIC DATA

Mentor's name and surname	Miloš Bogataj	Mentor's register number at <u>ARIS</u> (<u>SICRIS):</u>	26217
Mentor's e-mail:	milos.bogataj@um.si	Mentor's tel. no.:	02/22 94 458
Research programme (RP) leader's name and surname:	Zdravko Kravanja	RP leader's register number at <u>ARIS</u> (<u>SICRIS)</u> :	6005
Title of research programme:	Process System Engineering and Sustainable Development	RP's Register number at <u>ARIS</u> <u>(SICRIS):</u>	P2-0414
Research organisation (RO) of University of Maribor, where training shall be conducted:	Faculty of Chemistry and Chemical Engineering	RO Register number at <u>ARIS</u> (SICRIS):	0794
Research field according to <u>ARIS classification</u> :	2.02.03	Research field according to Ortelius classification (EURAXESS)	15.5. Chemical Engineering

2. DEFINITION OF RESEARCH PROBLEM AND GOALS OF DOCTORAL RESEARCH²

Starting point of research task of the early stage researcher and its position in the research programme, where the mentor is included, work hypothesis, research goals and foreseen result with emphasis on an original contribution to science:

Research starting point: The research within the doctoral study will be conducted in the field of Process Systems Engineering. The central goal of both the research field and the Process Systems Engineering and Sustainable Development program is to develop tools and implement them within a holistic, systems-based approach to the design and synthesis of sustainable production processes of the future, as well as their integration into the global supply network. Ensuring the optimality of such systems is a complex task. This complexity arises from multiple factors that must be considered simultaneously to fully exploit the interconnections and synergies between the

¹ Term early stage researcher (ESR) is written in male form and used as neutral for women and men.

² Research and study programme of training have to harmonise with contents of the research programme, where the mentor is a member.

process building blocks and entire supply networks. First, models must cover multiple spatial and temporal scales, ranging from nanometers and nanoseconds at the molecular level to kilometers and years at the level of global supply networks. Second, the models should be detailed enough to accurately represent the real world while remaining simple enough for effective application in process design and computer-aided synthesis. Third, the synthesis must produce process designs that are resilient, meaning resistant to changes in operational parameters, as well as reliable, controllable, and inherently safe. An additional layer of complexity arises in solving the developed models, as this task is highly challenging due to the immense combinatorial scale and nonlinearity of these problems.

Working Hypothesis: One of the key tools in Process Systems Engineering for addressing challenges in process design, optimization, and synthesis of innovative processes and technologies is the application of computer-aided approaches, such as mixed-integer nonlinear programming (MINLP). By developing new concepts, numerical approaches, algorithms, and optimization and solution strategies for describing and solving complex synthesis problems, it is possible to contribute to faster and more efficient identification of new sustainable solutions that meet the requirements of Sustainable Development, the Green Transition, and the Competitiveness Compass.

Research objectives: The main objective of the research is to develop the building blocks for a computer-aided approach that will enable systematic process design, optimization, and synthesis of technologies, ranging from initial concepts and preliminary designs to testing and final industrial implementation. The more specific research objectives are: i) development of fundamental optimization approaches, which include new algorithms, methods, and solution strategies for solving complex continuous-discrete optimization problems and ii) development of approaches to bridge the gaps between different modeling paradigms across temporal and spatial scales. This includes the development of explicit surrogate models as well as surrogate models based on machine learning etc.

Expected outcomes: The doctoral candidate is expected to publish at least two research articles in peer-reviewed journals with an impact factor. Additionally, the candidate will present research findings at national and international conferences and may pursue training abroad if desired. The candidate is also expected to contribute to the research program within the "Laboratory for Process Systems Engineering and Sustainable Development." The proposed research will contribute to the advancement of process systems engineering research field by developing novel computational tools and optimization strategies for the systematic design,optimization and synthesis of sustainable production processes.

3. STUDY PROGRAMME

Foreseen study programme, to which early stage researcher shall be enrolled in academic year 2025/2026:

Chemistry and Chemical Engineering

4. DESCRIPTION OF WORK AND TASKS

The student carries out projects of scientific and research work Participates in the design of research programs. Professionally cooperates with clients for research. Prepares reports and studies on research. Monitors and coordinates research work according to funding agreements.

Takes care of safe and healthy work.

Organizes and teaches employees and students about the use of the laboratory equipment and personal protective equipment and other security measures.

Performs other related tasks as instructed by supervisor.

Participates in working and permanent commissions of UM member bodies and other members. Replaces colleagues and superiors in his/her absence (by authorization).

Performs other related work as instructed by supreriors.

5. REQUESTED LEVEL OF EDUCATION

VII. /2. tariff group

6. REQUESTED FIELD OF EDUCATION

Technical, natural sciences

7. KLASIUS SRV

Seventh level: Second level higher education and similar education/second-level higher education and similar

8. KLASIUS P

4- Natural sciences, mathematics and computer science5- Technology, production technologies and construction

9. REQUESTED KNOWLEDGE

Requested computer skills: MS Windows, Word, Excel, Internet, email

10. REQUESTED SPECIAL REQUIREMENTS

1

11. REQUESTED LANGUAGES

Active knowledge of one world-wide used language.

12. REQUESTED WORK EXPERIENCE

1

13. FORESEEN POSTDOCTORAL TRAINING

Mentor's signature:

Research programme leader's signature:

Name and surname of Dean or authorised person³: prof. dr. Zoran Novak

Signature of dean or authorised person:

Place and date:

Kliknite ali tapnite tukaj, če želite Kliknite ali vnesti besedilo. Kliknite ali

Kliknite ali tapnite tukaj, če želite vnesti datum.

Stamp:

³ The training program is signed by the dean of the member where the ESR's employment and training will take place.