



NewFrac Training Network



Deliverable 2.1 - List of all the training courses to be activated

Marie Skłodowska-Curie Actions (MSCA)

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1. Common training activities

Common training activities will be organized by the network through the CORE Winter school in 2021 (5 ECTS), the PRO Winter school in 2022 (5 ECTS), and the LEAD Autumn school in 2022 (5 ECTS), see below the content description.

Training module		CORE	Date	18-22.01.2021, month 9	Coordinator	US	Venue	Seville, Spain
Aspect	ECTS	Coordinator	Content		Lecturer		Standby Lecturer	
EK	2	US	½ day: Mechanics of heterogeneous materials; Fibre-reinforced plastics/ceramics, biomaterials ½ day: Introduction to fracture models; ½ day: Numerical modeling techniques; ½ day: Experimental techniques.		L. de Lorenzis (ETH) P.P. Camanho (FEUP) D. Leguillon (SU) F. Paris (US) C. Maurini (SU)		F. Welschinger (RB) Z. Yosibash (TAU) J. Reinoso (US) V. Mantic (US)	
AT	1	IMT	1 day: Basics of scientific working and writing, idea management; literature studies. ½ day: Organizing and presenting information. Research ethics.		M. Paggi (IMT) J. Reinoso (US)		M. Corrado (POLITO) I. G. García (US)	
PS	2	US	1 day: Sustainability of innovations, aim of fair society, Dimension of gender in Research and Innovation ½ day: Feedback management. Effective communication.		M. Paggi (IMT) Ignasi Lopez (La Caixa F.) D. Pérez (CUBICOFF)		J. Reinoso (US) F. Welschinger (RB)	

Training module		PRO	Date	17.-21.01.2022, month 21	Coordinator	IMT	Venue	Lucca, Italy
Aspect	ECTS	Coordinator	Content		Lecturer		Standby Lecturer	
EK	1.5	ETH	½ day: Advanced Mechanics of heterogeneous materials; homogenization methods. ½ day: Advanced numerical modeling of failure processes. ½ day: Multi-scale modeling approaches; data analytics.		D. Leguillon (SU) Z. Yosibash (TAU) M. Paggi (IMT) A. Sapora (POLITO)		L. de Lorenzis (ETH) P. Cornetti (POLITO) I. G. García (US)	
AT	1.5	TAU	½ day: Channels of communication; Visualizing complex results. ½ day: Structuring information; Preparing self-explanatory slides. ½ day: Engaging the audience in your talk; Tactics for effective communication.		Z. Yosibash (TAU)		M. Paggi (IMT)	
PS	2	IMT	1 day: Funding opportunities, introduction to business plans. 1 day: fundamentals of intellectual property rights, spin-off and start-up regulations.		M. Paggi (IMT) D. Pérez (CUBICOFF)		Z. Yosibash (TAU) M. Ostorero (BOTTERO)	

Training module		LEAD	Date	17.-21.10.2022, month 30	Coordinator	POLITO	Venue	Torino, Italy
Aspect	ECTS	Coordinator	Content			Lecturer	Standby Lecturer	
EK	-	-	(ESR-specific LEAD training in secondments)			-	-	
AT	3	ETH	1 day: Preparing innovation/ research proposals; Preparing research for the market. 1 day: Which funding programs suit my needs?; Different stages of projects and project proposals; Writing proposals. ½ day: EU grants (Marie-Curie, ERC); funding opportunities for academic career. ½ day: Teaching skills: Didactics; Planning lectures; Using media for teaching; reflection of role.			POLITO L. de Lorenzis (ETH) P. P. Camanho (FEUP)	Within POLITO M. Paggi (IMT) C. Maurini (SU)	
PS	2	ETH	½ day: Funding resources and capital. ½ day: Marketing; Derivation of business canvas; finding investors. ½ day: Career paths and organizational structures in science and industry; Identification of personal strengths and competences. ½ day: Leadership in teams; Roles, tasks and classical problems of managers; Basics of leadership and communication; Management techniques: moderating meetings, delegating tasks properly; Conflict management; Motivating employees.			POLITO D. Pérez (CUBICOFF) M. Ostorero (BOTTERO)	Within POLITO F. Welschinger (RB)	

2. Local Training Courses

Local training courses (at least 6 ECTS for each graduate school of the main host or PhD-issuing institution) will be activated to further enrich the ESR individual training programmes with elective courses on methodologies of high relevance for industry, and on soft skills. A list of courses offered by each university is provided below.

Universidad de Sevilla

All ESRs hosted by the US will be integrated in the Mechanical Engineering and Industrial Management Doctoral Program at the US. As part of this doctoral programme, the ESRs will be required to complete at least 6 ECTS during his/her doctoral studies. There is a vast catalogue of undergraduate and master's courses relevant for the ESRs at the US, given the multidisciplinary character of this university, but especially the following two courses will be highly recommended to the ESRs due to the relation with the NewFrac scientific objectives:

Course	Hours
Fracture Mechanics (4.5 ECTS)	45
Mechanics of Composite Materials (5 ECTS)	40

In addition, depending on the formative starting level of each ESR and his/her particular interests and the Individual Research Projects, they can attend other courses of the catalogue available at the US.

All ESRs doing secondments at the US will be able to attend all the courses offered by the US.

Every academic year, the Doctoral Programme organizes some courses with invited top-level scientists about very specific topics. All ESRs (either directly hosted by the US or doing a secondment) will be invited to attend these courses.

Finally, due to COVID-19 crisis, the US carried out a great effort to move the lectures to a streaming service last months, with good results. It is expected that the lectures are going to be at least partially streamed, next academic year. In this case, the courses, and particularly those detailed in the table included, could be followed by all the ESRs in the consortium.

Sorbonne Université

The two ESRs hosted by Sorbonne University will be enrolled in SMAER doctoral school (<http://www.ed391.upmc.fr>). During the Ph.D. period each student must attend at least 100h of training courses, which should include at least two academic classes of 3 ECTS and two courses for professional development organized by Doctoral College of Sorbonne University.

The courses on professional development can be chosen from a large catalogue available here: http://college.doctoral.sorbonne-universites.fr/fileadmin/user_upload/documents-telechargeables/Catalogue/Catalogue-2019-20-Web.pdf. They include for example training on methodological skills (bibliography research, time management, and project management), languages, communication, management, teaching, ethics, history of science, job market, or career management.

The academic courses can be chosen from a vast catalogue of graduate courses in Mechanics or Applied Mathematics at Sorbonne University. Selected courses in the scientific domain of the network which will be available to the ESRs include (but are not limited to - see [here](#) for solid mechanics and [here](#) for applied mathematics):

Course	Hours
Fracture Mechanics (3 ECTS)	27
Thermo-mechanics of solids (3 ECTS)	27
Composite Materials (3 ECTS)	24
Numerical methods for nonlinear solids and structures (3 ECTS)	30

Homogenization Theory (3 ECTS)	27
Damage Mechanics (3 ECTS)	27

ESR with secondments in Sorbonne will be allowed to attend all the courses at Sorbonne University.

University of Porto

The Mechanical Engineering Doctoral Program (PRODEM) of the Faculty of Engineering of the University of Porto-FEUP presents a large portfolio of advanced courses to train highly qualified researchers in the area of Mechanical Engineering (see [here](#)). PRODEM's Advanced Studies (3rd cycle) in Mechanical Engineering requires 60 ECTS credits to be completed in the first two semesters of the Doctoral Program, including a [Seminar](#) (12 ECTS) to prepare the research activity leading to the PhD, whose approval is the culmination of the academic part of the Program and the beginning of the period of research leading to the doctorate.

The training is based on high-level tutorial studies or lectures supervised by academy experts in subjects included in the wide range of areas covered by mechanical engineering, as well as other selected courses of the University of Porto. These academic and scientific skills can be complemented by other integral competences, including soft and transferable skills and business training, qualifying the students with the required competences to carry out important autonomous research in the area of their PhD.

Selected courses in the scientific domain of the network which will be available to the ESRs include (but are not limited to - see [here](#)):

Course	Hours
Approximation Methods in Engineering (6 ECTS) <i>(mandatory for PRODEM students)</i>	28
Fatigue and Fracture Mechanics (6 ECTS)	28
Composite Materials (6 ECTS)	28
Non-Linear Mechanics for Finite Element Analysis (6 ECTS)	28
Computational Methods in Plasticity and Fracture Mechanics (6 ECTS)	28
Optimization (6 ECTS)	38



In addition, specific training on soft and transferable skills will be available to the ESRs, such as:

Course	Hours
Assertiveness and Public Presentation Techniques (1.5 ECTS)	10
Time Management and Personal Goals Setting (1.5 ECTS)	10
Leadership and Team Management (1.5 ECTS)	10
From Intellectual Property to Business (3 ECTS)	28
Science Communication for Non-expert Audiences (1.5 ECTS)	14

Politecnico di Torino

All ESRs hosted by POLITO will be integrated in the PhD in Civil and Environmental Engineering. As part of the doctoral programme of POLITO, the ESRs will be required to attend at least 140h of training courses, 100h of which related to hard skills (HS, see the complete list here) and the remaining 40h connected to soft skills (SS, see the complete list here). In this second framework, most of the activities consist of Massive Online Courses.

The following courses will be highly recommended to the ESRs due to the relation with the NewFrac scientific objectives:

Course	Hours
Failure analysis of brittle structures: Finite Fracture Mechanics (HS)	10
Life Cycle Assessment (LCA) (HS)	25
Nonlinear solid mechanics (HS)	25
Structural mechanics of glass (HS)	12
Advanced topics in the finite element method (HS)	20

Aerospace manufacturing processes by advanced composite materials (HS)	24
From science to business: how to get technology out of laboratories and into	20
Research integrity (SS)	5
Writing Scientific Papers in English (SS)	5
Project management (SS)	5
Public speaking+ Public speaking II (SS)	10
Communication+ Communication II (SS)	10
Intercultural & interpersonal management (ss)	8

Tel-Aviv University

The School of Mechanical Engineering at TAU is scheduled to activate 4 elective courses in the Fall Semester of 2020 and 5 elective courses in the Spring semester of 2021 relevant for the training of the ESR8. Being enrolled in the PhD program of TAU, the ESR8 must take 2 courses within the first 18 months of enrolment with a minimum grade of 80 in each, and 2 more courses before completion of the PhD thesis. The list of courses for next academic year will only be available in the summer of 2021.

Due to Covid-19 pandemic, it is anticipated that during the Fall 2020 semester most of the courses will be online.

Course	Hours
Theory of Elasticity (Fall 2020)	40
Theory of Plasticity (Fall 2020)	40
Introduction to Solid Mechanics of Materials with Micro Structures (Fall 2020)	40
Design and Modelling of Electro Mechanical Micro Systems (Fall 2020)	40

Composite Materials (Spring 2021)	40
Dynamic Systems and Chaos (Spring 2021)	40
Nonlinear Vibrations (Spring 2021)	40
Finite Element Analysis 1 (Spring 2021)	40
Fracture Mechanics (Spring 2021)	40

Robert Bosch GmbH

The ESR hosted by RB will be integrated in the Bosch PhD program. As part of this doctoral program, the ESR will have access to RB-internal industrial training. The following three courses will be highly recommended to this ESR:

Course	Hours
Plastics Technology	24
Failure Analysis of Thermoplastic Parts	12
Simulation and Design of Thermoplastic Parts	16

Depending on the ESR's individual development goals, additional courses available at the RB training center can be attended.

IMT School for Advanced Studies Lucca

The IMT School for Advanced Studies Lucca will activate 21 elective courses relevant for the training of the ESR9, enrolled in the PhD Programme in Systems Science, track Computer Science and Systems Engineering, for the academic year 2020-2021. The ESR will have the possibility to choose among them, complementing those specific for computational mechanics (Numerical Methods for the Solution of Partial Differential Equations, Computer-Aided Engineering for Virtual Prototyping and Advanced Manufacturing Solutions, Computational Contact and Fracture Mechanics, Advanced Topics of Computational Mechanics) with other courses of high interest for industry (Model Predictive Control, Cybersecurity, Principles of Concurrent and Distributed Programming, Machine Learning, etc.), and other on soft skills (Funding and Management of Research and Intellectual Property, Philosophy of Science,



Scientific Writing, Dissemination and Evaluation). According to the Italian regulation, the attendance of at least 120 hours of didactic activities is compulsory to be admitted to the PhD graduation.

In case of Covid-19 emergency, part of the courses might be organized online. This will also allow for the participation of other ESRs of the network to the local training courses organized at the IMT School for Advanced Studies Lucca.

Course	Hours
Advanced Numerical Analysis	20
Advanced Topics of Computational Mechanics	20
Advanced Topics of Control Systems: Numerical Methods for Optimal	20
Applications of Stochastic Processes	20
Computational Contact and Fracture Mechanics	20
Computer Programming and Methodology	30
Computer-Aided Engineering for Virtual Prototyping and Advanced	10
Cybersecurity (essentials)	10
Cybersecurity (advanced topics)	10
Foundations of Probability and Statistical Inference	30
Funding and Management of Research and Intellectual Property (no exam)	10
Identification, Analysis and Control of Dynamical Systems	20
Machine Learning	20
Model Predictive Control	20

Numerical Methods for the Solution of Partial Differential Equations	20
Numerical Optimization	20
Optimal Control	20
Philosophy of Science (no exam)	16
Principles of Concurrent and Distributed Programming	30
Scientific Writing, Dissemination and Evaluation (no exam)	8
Stochastic Processes and Stochastic Calculus	20

ETH Zürich

All ESRs doing secondments at ETH Zürich (in addition to the one working there primarily) will be able to attend all courses offered by ETH, whose catalogue is available [here](#). Already at the hosting department D-MAVT, there is a vast catalogue of courses relevant to NewFrac, ranging from linear and non-linear continuum mechanics to linear and non-linear finite element analysis, fracture mechanics and fatigue, multiscale methods, phase transitions, experimental mechanics, linear and non-linear dynamics. For PhD students at ETH Zürich the attendance of courses is not mandatory, however it is required to gain credits during the course of the PhD program. These credits may be obtained also by attending classes (among other options).

Tentative list of courses (to be updated):

Course	CP
High Performance Computing for Science and Engineering I	4
Mechanics of Composite Materials	4
Continuum Mechanics I	4
Wave Propagation in Solids	4

Nonlinear Dynamics and Chaos I	4
Optical Methods in Experimental Mechanics	4
Computational Mechanics II: Non-linear FEA	4
Fatigue and Fracture in Materials and Structures	4
High Performance Computing for Science and Engineering II	4
Mechanics of Soft Materials and Tissues	4
Continuum Mechanics 2	4
Computational Mechanics I: Intro to FEA	4
Theory of Phase Transitions	4
Nonlinear Dynamics and Chaos II	4
Advanced Dynamics	4