Summer School Syllabus

Title of the Summer School:

REGINNA 4.0 Second Summer School «Diving into high-innovation potential areas: Entrepreneurship and Business Strategies related to Industry 4.0 and Nanotechnology»

Objectives of the Summer School:

Training of talents in the technological areas of Industry 4.0 and Nanotechnology. This event will connect students with academics, businesses, public bodies and non-governmental organisations to explore innovations, business development and transfer of ideas from laboratory to the market. Participants will familiarize with technologies and entrepreneurial potentials in the fields of Industry 4.0 and Nanotechnology. This includes Data modeling, Collaborative robotics, Artificial Intelligence with a focus on advanced materials for nanoelectronics, quantum technologies and high-performance computing. In addition, the participants will learn the basic skills to start a business, develop a business plan, understand marketing and financial management. Objectives are described in detail in the Syllabi of courses.

Competencies and learning outcomes of the Summer School:

Participants will obtain basic knowledge from Industry 4.0 including digital transformation, lean production, assessments, enabling technologies, with a focus on collaborative robotics. They will learn about database management systems, data integration phases and the multidimensional data models; particularly they will understand how different database management systems can be used within an enterprise and the key role played by data warehousing in a decision support system They will understand the relevance of cybersecurity in industrial control systems and critical infrastructures. Understand the main threats and vulnerabilities in industrial control systems in contrast to traditional information systems. Acquire a high-level view of the procedures and measures available to mitigate cybersecurity risks. Learn how to explain, analyze and visualize the sources and types of data in tourism and their characteristics and limitations. Understand how digital technologies and cultural heritage go hand in hand. Learn about real life cases of data collection in tourism.

From the nanotechnology field, the participants will gain general knowledge about nanomaterials and their properties. They will be able to identify different types of nanomaterials and distinguish between classical and quantum size effects. Participants will learn about the basic concept of quantum mechanics and quantum computing. And they will learn about recent progress and challenges in the field of quantum computing technologies.

Within the block of Entrepreneurship and Innovation, the participants will gain knowledge about the economic function of entrepreneurship, the strengths and weaknesses of different patterns to the start-up and will be able to apply the principles of the “lean start-up” methodology to an entrepreneurial idea. More, they will obtain basic knowledge about different types of innovation and how to manage an innovation process. They will learn about different business models, problems and solutions, and they will consider

examples of business models of well-known startups. With digital technologies, which are built on the basis of artificial intelligence, they will learn how to develop entrepreneurship and startups.

Evaluation criteria:

The evaluation of learning outcomes of the summer school will be conducted with the help of an online exam. Participants who successfully complete the online exam will be issued with a certificate of participation in the Summer School.

Persons responsible for the certification purposes (who will sign the diplomas):

Franco Scolari – Director of Polo Tecnologico Alto Adriatico

Place and date of the summer school:

Pordenone, Italy, 4-9. 9. 2023

Content of the Summer School:

Reginna4.0 Second Summer School comprises total 54 hours of which are 36 contact hours and 18 are individual work hours. More details are available in the Syllabi of courses.

Host organization:

Polo Tecnologico Alto Adriatico c/o Consorzio Universitario – Pordenone - Italy

Host organization responsible:

Diego Santaliana – EU projects

Second Summer School, 4-9.9.2023

Summer School - Syllabi of courses

Title of the summer school:

REGINNA 4.0 Second Summer School «Diving into high-innovation potential areas: Entrepreneurship and Business Strategies related to Industry 4.0 and Nanotechnology»

Overview of courses:

ID	*COURSE*	*Course name*	*Contact hours*	*Individual work*
1	A1	Technology Readiness Level	2	1
2	A2	Digital Transformation Journey	2	1
3	A3	Data Modeling: From Relational Databases to Big Data	4	2
4	A4	Introduction to Industrial Cybersecurity	2	1
5	A5	Digital interpretation of cultural heritage	1	1
6	A6	A case study of the application of Tourism 4.0 technology in Odesa, Ukraine	1	1
7	A7	Lean production and Digital Agency model	2	1
8	A8	Collaborative robotics	2	1
9	B1	Nanomaterials - Introduction	2	1
10	B2	Nanomaterials: Magic of Carbon	2	1
11	B3	An introduction to Quantum Computing	2	1
12	B4	Introduction to Deep Learning and Nanotechnology Applications	2	1
13	C1	Entrepreneurship and start-up management	3	1
14	C2	Business strategies in high-innovation potential areas (Nanotechnology, Industry 4.0, Artificial intelligence)	2	1
15	C3	Innovation as a management challenge	3	1
16	C4	Digital marketing	2	1
17	C5	Innovation in the field (real cases)	2	1
	C6	**Independent study and Networking (total hours)**		**18**
		Total contact hours	**36**	
		TOTAL SUMMER SCHOOL	**54**	

List of courses:

Section A. Industry 4.0

Course A.1 Technology Readiness Levels

Course title:	**Technology Readiness Levels**	**ID:1**
Lecturer:	**Francesco Giovanni Scolari**	
Affiliation:	**Polo Tecnologico Alto Adriatico Andrea Galvani SCPA**	

Duration (hours)

Lectures	Seminar	Tutorial	Laboratory work	Field work	Individ. work
2					**1**

Assessment methods:	Written examination

Syllabus outline:

Based on ESA's definition, the Technology Readiness Levels are different points on a scale used to measure the progress or maturity level of a technology. The scale ranges from 1 to 9, where TRL 1 is the lowest and TRL 9 is the highest. When a technology is at TRL 1, scientific research is beginning and those results are being translated into future research and development, while at TRL 9 the technology has already been proven to work during a flight mission in space.

Based on Horizon's definition, these below are the TRLs and related descriptions:

- TRL 1 – basic principles observed
- TRL 2 – technology concept formulated
- TRL 3 – experimental proof of concept
- TRL 4 – technology validated in lab
- TRL 5 – technology validated in relevant environment (industrially relevant
- environment in the case of key enabling technologies)
- TRL 6 – technology demonstrated in relevant environment (industrially relevant
- environment in the case of key enabling technologies)
- TRL 7 – system prototype demonstration in operational environment
- TRL 8 – system complete and qualified
- TRL 9 – actual system proven in operational environment (competitive
- manufacturing in the case of key enabling technologies; or in space)

Based on NASA's definition: When a technology is at TRL 1, scientific research is beginning and those results are being translated into future research and development. TRL 2 occurs once the basic principles have been studied and practical applications can be applied to those initial findings. TRL 2 technology is very speculative, as there is little to no experimental proof of concept for the technology.

When active research and design begin, a technology is elevated to TRL 3. Generally, both analytical and laboratory studies are required at this level to see if a technology is viable and ready to proceed further through the development process. Often during TRL 3, a proof-of-concept model is constructed.

Once the proof-of-concept technology is ready, the technology advances to TRL 4. During TRL 4, multiple component pieces are tested with one another. TRL 5 is a continuation of TRL 4, however, a technology that is at 5 is identified as a breadboard technology and must undergo more rigorous testing than technology that is only at TRL 4. Simulations should be run in environments that are as close to realistic as possible. Once the testing of TRL 5 is complete, a technology may advance to TRL 6. A TRL 6 technology has a fully functional prototype or representational model.
TRL 7 technology requires that the working model or prototype be demonstrated in a space environment. TRL 8 technology has been tested and "flight qualified" and it's ready for implementation into an already existing technology or technology system. Once a technology has been "flight proven" during a successful mission, it can be called TRL 9.
The lecture will be composed by these parts:

1) TRL: history
2) Subjective and objective measurement
3) Fields of application

- The original example aerospace and mechanical
- The 9 levels from idea to product
- Start up and TRL

Objective competences:
The lecture will explain briefly how to evaluate the maturity of a new technology through the Technology Readiness Level. The participants will gain knowledge on TRLs and use cases and will learn how to measure the maturity of a new technology.

Intended learning outcomes:
1. Familiarity with digital technologies, which are built on the basis of TRL; 2. Students will be able to use the tool for evaluating and advancing their startups.

Lecturer's references
- European Space Agency; - EU Horizon Programme Research & Innovation; - Ministry of Defence NASA USA.

Course A.2 Digital Transformation Journey

Course title:	**Digital Transformation Journey**	**ID:2**
Lecturer:	**Andrea Fornasier**	
Affiliation:	**Polo Tecnologico Alto Adriatico**	

Duration (hours)

Lectures	Seminar	Tutorial	Laboratory work	Field work	Individ. work
2					**1**

Assessment methods:	Written examination

Syllabus outline:
The course allows to understand the meaning of a digital transformation. How to identify the needs of the enterprise? how to design a digital project? In the second part of the lecture there will be provided examples of digital transformation that has been realized. • Introduction to industry 4.0 • How to guide a Digital Transformation Project • Digital Transformation Project: evidences from the FVG firms

Objective competences:
1. Comprehensive overview about digital transformation. 2. Knowledge acquisition about enabling technologies and digital use cases 3. Basic knowledge and methods about how to support a successful digital transformation inside the organizations

Intended learning outcomes:
1. To know the basic knowledge about digital transformation 2. To know about digital assessments 3. To know enabling technologies 4. To build a classification about tools and methods to guide digital transformation.

Course A.3 Data Modeling: From Relational Databases to Big Data

Course title:	**Data Modeling: From Relational Databases to Big Data**	**ID:3**
Lecturer:	**Andrea Brunello**	
Affiliation:	**University of Udine**	

Duration (hours)

Lectures	Seminar	Tutorial	Laboratory work	Field work	Individ. work
4					**2**

Assessment methods:	Written examination

Syllabus outline:
Database management systems are a fundamental tool to store and analyze data in countless domains, empowering business intelligence as well as descriptive, predictive, and prescriptive analytics tasks. Choosing the right database technology is not trivial since, due to the intrinsic heterogeneous nature of information, different approaches must be followed to handle structured, semi-structured, and unstructured data, and the so called Big Data. This gives rise to complex information systems, in which data regarding a specific object may be fragmented and possibly replicated into several repositories, both relational as well as NoSQL in their nature. Data warehousing allows to bring order into such an information jungle, by means of employing a single, enterprise-wide storage, which should be continuously fed by data streams, engineered to perform ETL (Extract, Transform, Load) tasks. The goal of the lecture is that of covering, from a general and intuitive point of view, all the main aspects pertaining to the previously described issues. 1. What is data? (Lecture) 2. Approaches to store, integrate and manage data within an enterprise IT infrastructure (Lecture)

Objective competences:
1. Understand the different kinds of data and their peculiarities

2. Learn how different database management systems can be used within an enterprise 3. Understand the key role played by data warehousing in a decision support system

Intended learning outcomes:
1. Know which database management system is better suited in a given scenario 2. Know the strengths and weaknesses of the different database management systems 3. Know the key ideas behind the ETL data integration phase and the multidimensional data model

Literature
1. A. Silberschatz, H. F. Korth, S. Sudarshan. Database System Concepts, 7th ed, 2019. 2. W. H. Inmon. Building the Data Warehouse, 2005. 3. A. Brunello, P. Gallo, E. Marzano, A. Montanari, N. Vitacolonna (2019). An event-based data warehouse to support decisions in multi-channel, multi-service contact centers. Journal of Cases on Information Technology (JCIT), 21(1), 33-51.

Lecturer's references
Andrea Brunello is an Assistant Professor at the Department of Humanities and Cultural Heritage of the University of Udine, where he teaches Database Systems. Furthermore, he has been teaching Data Warehousing and Big Data courses within joint courses between the University of Udine and the University of Trieste. His research interests are in the fields of data modelling, digital humanities, and artificial intelligence applied to the domains of indoor positioning and healthcare.

Course A.4 Introduction to Industrial Cybersecurity

Course title:	**Introduction to Industrial Cybersecurity**	**ID:4**
Lecturer:	**Miguel A. Prada**	
Affiliation:	**University of León**	

Duration (hours)

Lectures	Seminar	Tutorial	Laboratory work	Field work	Individ. work
2					**1**

Assessment methods:	Written examination

Syllabus outline:
The aim of the lecture is to raise awareness about the relevance of cybersecurity in the context of Industry 4.0 and to get a glimpse of the most common threats and vulnerabilities in industrial control systems as well as the countermeasures available to mitigate risks.

Objective competences:
1. Awareness of cybersecurity risks in industrial control systems and critical infrastructures 2. Overview of the features of industrial control systems in contrast to traditional information systems 3. Overview of threats, vulnerabilities and countermeasures in industrial control systems

Intended learning outcomes:
1. Understand the relevance of cybersecurity in industrial control systems and critical infrastructures 2. Understand the main threats and vulnerabilities in industrial control systems in contrast to traditional information systems

3. Acquire a high-level view of the procedures and measures available to mitigate cybersecurity risks.

REGINNA 4.0

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European Institute of Innovation & Technology

Course A.5 Digital interpretation of cultural heritage

Course title:	**Digital interpretation of cultural heritage**	**ID:5**
Lecturer:	**Matevž Straus**	
Affiliation:	**Arctur d.o.o.**	

Duration (hours)

Lectures	Seminar	Tutorial	Laboratory work	Field work	Individ. work
1		**1**			**1**

Assessment methods:	Written examination

Syllabus outline:

- Digital interpretation of cultural heritage and its potentials (Slides)
- How a 3D model is made (Slides)
- Making a simple 3D model with a mobile phone (Hands-On)
- New media for 3D digital interpretation – from AR, to VR, immersive technologies and metaverse (Slides)
- Narrating a heritage story with digital technologies (Hands-On).

Objective competences:

1. An overview of potentials digital interpretation brings to cultural heritage
2. Understanding 3D and its difference from 360-degree images and 2D images
3. Differences between various new media tools and when to use which
4. “Content is King” logic and the importance of storytelling

Intended learning outcomes:

1. Understand how digital technologies and cultural heritage go hand in hand
2. Students will be able to ideate new media tools for digital interpretation of CH
3. Getting accustomed with 3D as a basis of digital development

Literature

https://tourism4-0.org/wp-content/uploads/2023/03/e-Heritage_Handbook_New_EN.pdf

https://www.youtube.com/watch?v=3RB_iTRQTKg&ab_channel=Arcturd.o.o.

https://www.insitesproject.eu/curriculum-and-open-educational-resources/

Lecturer's references

Matevž Straus (male) is the Heritage+ Lead and holds an Erasmus Mundus M.Sc. degree from Urban Studies as well as an MSc degree from Market Communication and a B.A. degree from Analytical Sociology, both from the University of Ljubljana. He has been working at the crossroad of heritage and innovation for the past 15 years, has led several award-winning projects on innovating heritage.

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Course A.6 A case study of the application of Tourism 4.0 technology in Odesa, Ukraine

Course title:	**A case study of the application of Tourism 4.0 technology in Odesa, Ukraine**	**ID:6**
Lecturer:	**Paul Goriup**	
Affiliation:	**NGO Agricola**	

Duration (hours)

Lectures	Seminar	Tutorial	Laboratory work	Field work	Individ. work
1	**1**				**1**

Assessment methods:	Written examination

Syllabus outline:

- Overview of Odesa City as a tourist destination
- Organisation of tourism in Odesa
- Problems of tourism development in Odesa
- Application of Tourism 4.0 models to address these problems
- Results and discussion of the findings

Objective competences:

1. Identification of data sources and collection relating to tourism development

2. Analysis and models for developing a sustainable site-based tourism sector using High-Performance Data Analytics

Intended learning outcomes:

1. Tourism is a not an isolated sector of economic activity at a site

2. Collecting relevant data, especially in real time, is difficult

3. Understanding the strengths and weaknesses of data analytics for sustainable tourism development

Literature

Goriup, P. D., & Ratkajec, H. (2021). Preliminary application of tourism 4.0 data analytics in Odesa city reveals challenges and opportunities for sustainable tourism development. *Economic Innovations*, *23*(4(81), 36-43. https://doi.org/https://doi.org/10.31520/ei.2021.23.4(81).36-43

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Course A.7 Lean Production and Digital Agency Model

Course title:	**Lean Production and Digital Agency Model**	**ID:7**
Lecturer:	**Marco Olivotto**	
Affiliation:	**Lean Experience Factory**	

Duration (hours)

Lectures	Seminar	Tutorial	Laboratory work	Field work	Individ. work
2					**1**

Assessment methods:	Written examination

Syllabus outline:
1. Introduction to lean manufacturing (slides)
2 The main dimensions for lean intervention (slides)
3. How to detect waste (slides)
4. Value-added and not value-added activities
5. Digital transformation (slides)
4. Tasks (Hands-On)

Objective competences:
1. Understand the Lean enterprise approach and its value
2. Identify Value-added and Not-value-added activities
3. Understand the value of lean as means for digital transformation

Intended learning outcomes:
1. Knowing the main principles of Lean Management
2. Being able to detect Value-added and not value-added activities and waste in business processes

3. Being able to design a digital transformation intervention that builds on Lean Management principles

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Course A.8 Collaborative Robotics

Course title:	**Collaborative Robotics**	**ID:8**
Lecturer:	**Lorenzo Scalera**	
Affiliation:	**University of Udine**	

Duration (hours)

Lectures	Seminar	Tutorial	Laboratory work	Field work	Individ. work
2					**1**

Assessment methods:	Written examination

Syllabus outline:
1. What is collaborative robotics? (Lecture) 2. Approaches to implement a safe collaborative robotics application (Lecture)

Objective competences:
1. A comprehensive overview of collaborative robotics opportunities 2. Learn how to apply safety principles in human-robot collaboration 3. Current developments and future trends in collaborative robotics

Intended learning outcomes:
1. Knowing the basics of collaborative robotics 2. Knowing the strengths and weaknesses of collaborative robotics 3. Being able to apply the principles of safety in a collaborative robotics application

Literature
1. ISO (2016) ISO/TS 15066: 2016 Robots and robotic devices - Collaborative robots. International Organization for Standardization, Geneva, Switzerland. 2. Villani, V., Pini, F., Leali, F., Secchi, C. (2018). Survey on human–robot collaboration in industrial settings: Safety, intuitive interfaces and applications. Mechatronics, 55, 248-266.

3. Scalera, L., Giusti, A., Vidoni, R., Gasparetto, A. (2022). Enhancing fluency and productivity in human-robot collaboration through online scaling of dynamic safety zones. The International Journal of Advanced Manufacturing Technology, 121(9-10), 6783-6798.

Lecturer's references

Lorenzo Scalera is an Assistant Professor at the Polytechnic Department of Engineering and Architecture of the University of Udine, where he teaches Applied Mechanics to Machinery in the Bachelor courses of Mechanical and Management Engineering. His research interests are in the fields of collaborative robotics, trajectory planning, and mobile robotics.

Section B. Nanotechnology

Course B.1 Nanomaterials - Introduction

Course title:	**Nanomaterials - Introduction**	**ID:9**
Lecturer:	**Liliia Turovska**	
Affiliation:	**Vasyl Stefanyk Precarpathian National University**	

Duration (hours)

Lectures	Seminar	Tutorial	Laboratory work	Field work	Individ. work
2					**1**

Assessment methods:	Written examination

Syllabus outline:
Nanotechnology and nanomaterials.
Classifications of nanomaterials, their properties.
Historical overview of nanomaterials.
Reasons for special properties of nanoscale materials.
Classical and quantum size effects.
Basic concepts of quantum physics.
The energy of an electron in an atom.
Harmonic oscillator: transition from classical to quantum.
Wave-particle duality. Uncertainty principle.
Condensed matter physics. Electrons in crystals.
Quantum dots and their applications.
Quantum tunneling.
Application of nanomaterials.

Objective competences:
Overview of nanomaterials (history and properties). Modern applications of nanomaterials. Basic concepts of quantum physics.

Intended learning outcomes:
Participants will gain general knowledge about nanomaterials and their properties. Participants will be able to identify different types of nanomaterials. Participants will distinguish between classical and quantum size effects. Participants will understand the basic concept of quantum mechanics.

Course B.2 Nanomaterials: Magic of Carbon

Course title:	**Nanomaterials: Magic of Carbon**	**ID:10**
Lecturer:	**Volodymyra Boichuk**	
Affiliation:	**Vasyl Stefanyk Precarpathian National University**	

Duration (hours)

Lectures	Seminar	Tutorial	Laboratory work	Field work	Individ. work
2					**1**

Assessment methods:	Individual tasks, written examination

Syllabus outline:
Carbon. Allotropes.
Electronic structure of carbon.
Diamond. Properties.
Graphite. Properties.
Graphene. Unique properties. Crystal structure. Production.
Obtaining graphene oxide.
Carbon nanotubes. Properties. Synthesis.
Fullerenes. Properties. Application. Synthesis.

Objective competences:
Review of the main properties of allotropic modifications of carbon.
Graphene: unique properties and applications.
Methods for obtaining graphene oxide and reduced graphene oxide.

Overview of methods for experimental study of graphene materials.

Intended learning outcomes:
Participants will gain general knowledge about carbon materials. Participants will distinguish between different allotropic modifications of carbon. Participants will understand the various approaches to obtaining GO and rGO. Participants will be able to distinguish the results of an experimental study of graphene materials.

Course B.3 An introduction to Quantum Computing

Course title:	**An introduction to Quantum Computing**	**ID:11**
Lecturer:	**Egon Pavlica**	
Affiliation:	**University of Nova Gorica**	

Duration (hours)

Lectures	Seminar	Tutorial	Laboratory work	Field work	Individ. work
2					**1**

Assessment methods:	Written examination

Syllabus outline:
Participants will learn about quantum phenomena, which govern nature. These quantum phenomena will be explained through photon's interference, which will be introduced by double-slit and double-beam splitter experiments. Next, classical computation will be compared to quantum computation. Quantum bit will be introduced. Participants will learn through an example of the quantum algorithm, presented in real quantum computer and in a quantum computer simulator.

Objective competences:
1. Learn about quantum nature of photons and possibility of application in quantum computing 2. Learn about the definition of quantum bit (qubit) 3. See a tutorial on quantum programming in quantum computer or quantum computer simulator

Intended learning outcomes:
1. Understand the difference between classical and quantum computing 2. Understanding what is qubit 3. Obtain an idea of quantum computing algorithm

Literature
[1] P. Kaye, R. Laflamme, and M. Mosca, *An Introduction to Quantum Computing*, Repr (Oxford University Press, Oxford, 2010).

Lecturer's references
E. Pavlica is a professor of physics habilitated at the University of Nova Gorica. E. Pavlica is conducting a course of Programming as a part of the programme "Physics and astrophysics" at the School of Science, University of Nova Gorica.

Course B.4 Introduction to Deep Learning and Nanotechnology Applications

Course title:	**Introduction to Deep Learning and Nanotechnology Applications**	**ID:12**
Lecturer:	**Saptashwa Bhattacharyya**	
Affiliation:	**University of Nova Gorica**	

Duration (hours)

Lectures	Seminar	Tutorial	Laboratory work	Field work	Individ. work
1		1			1

Assessment methods:	Written examination

Syllabus outline:
1. Paradigm of AI (Current Advancements) (Slides)
2. How to think about neural networks (Slides)
3. Images = Matrices (+ what is Convolution?)
4. Building your first neural network (Hands-On)
5. Can your network identify simple images? (Hands-On)
6. Complex Network == Complex Tasks (Hands-On)

Objective competences:
1. A comprehensive overview of AI in Science & Tech
2. Hands on sessions for getting started with AI
2 Learn to Build a Neural Network from Scratch and Train It for a specific task.
2. Get started with Image Recognition Task.
2. Application to Nano-materials (similar tasks).

Intended learning outcomes:
1. Appreciate that AI takes us to new paradigm of doing science
2. Students will be able to build and train neural networks.

3. Getting accustomed with training networks in clouds (google cloud). 4. Mini-Internship to get started with AI.

Literature
1. Pattern Recognition and Machine Learning: Chris Bishop [Link] 2. Deep Learning: Yoshua Bengio [Link]

Lecturer's references
1. Post Doctoral Researcher; Cosmology and Astrophysics Department, UNG (2020, Aug. – Present) 2. Ph.D. Astrophysics; Waseda University, Tokyo (2013, Oct. – 2019, Feb.) 3. Deep Learning Research Intern; Incubit, Tokyo (2019, Feb – 2019, October)

Section C. Entrepreneurship and Innovation

Course C.1 Entrepreneurship and start-up management

Course title:	**Entrepreneurship and start-up management**	**ID:13**
Lecturer:	**Giancarlo Lauto**	
Affiliation:	**University of Udine**	

Duration (hours)

Lectures	Seminar	Tutorial	Laboratory work	Field work	Individ. work
2		**1**			**1**

Assessment methods:	Written examination

Syllabus outline:

- What is an entrepreneur? (Lecture)
- Approaches to the start-up phase (Lecture)
- The lean start-up approach in action (Hands-on)

Objective competences:

1. A comprehensive overview of the features of entrepreneurial activities

2. An in-depth discussion of various approaches that individuals may adopt when they start a new venture

3. An application of the lean start-up approach to a business case

Intended learning outcomes:

1. Knowing the economic function of entrepreneurship

2. Knowing the strengths and weaknesses of different patterns to the start-up

3. Being able to apply the principles of the “lean start-up” methodology to an entrepreneurial idea

Literature

1. Ries, E. (2011). The lean startup: How today's entrepreneurs use continuous innovation to create radically successful businesses. Currency.

2. Eisenmann, T. R., Ries, E., & Dillard, S. (2012). Hypothesis-driven entrepreneurship: The lean startup. Harvard Business School Entrepreneurial Management Case, (812-095).

Lecturer's references

Giancarlo Lauto is an associate professor of Organization Studies at the University of Udine, where he teaches the Laboratory of cross cultural negotiation in the Master degree in International Marketing, Management and Organization.

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Course C.2 **Business strategies in high-innovation potential areas (Nanotech, I 4.0, AI)**

Course title:	**Business strategies in high-innovation potential areas (Nanotechnology, Industry 4.0, Artificial intelligence)**	**ID:14**
Lecturer:	**Valentyna Yakubiv**	
Affiliation:	**Vasyl Stefanyk Precarpathian National University**	

Duration (hours)

Lectures	Seminar	Tutorial	Laboratory work	Field work	Individ. work
2					**1**

Assessment methods:	Written exam

Syllabus outline:

This course aims to equip students with knowledge and skills in business strategy development and management process of its implementation in high-innovation potential areas (Nanotechnology, Industry 4.0, Artificial intelligence). This course focuses on strategic analysis, strategic planning, developing and implementing strategies.

- Paradigm of Business strategies in high-innovation potential areas (Slide)
- Key methods in strategic analysis in high-innovation potential areas (Slides)
- Creation vision, mission, objectives and road map in startups in high-innovation potential areas (Slides)
- Building a business model canvas for startups in high-innovation potential areas (Slides)
- Workshop (team work) on building a business model canvas for startups in high-innovation potential areas (Hand-On)

Objective competences:

1. A comprehensive overview of business strategies in high-innovation potential areas (Nanotechnology, Industry 4.0, Artificial intelligence)
2. A comprehensive overview of key methods in business strategic analysis in high-innovation potential areas
3. Practical skills for business strategic analysis in high-innovation potential areas

4. Practical skills for formulating the vision, mission, objectives and road map in startups in high-innovation potential areas
5. Practical skills for building a business model canvas for startups in high-innovation potential areas

Intended learning outcomes:

1. Understanding the importance of business planning in the process of creating startups
2. Students will be able to perform the business strategic analysis in high-innovation potential areas.
3. Students will be able to formulate the vision, mission, objectives and road map in startups in high-innovation potential areas
4. Students will be able to build a business model canvas for startups in high-innovation potential areas.

Course C.3 Innovation as a management challenge

Course title:	**Innovation as a management challenge**	**ID:15**
Lecturer:	**Raffaella Tabacco**	
Affiliation:	**University of Udine**	

Duration (hours)

Lectures	Seminar	Tutorial	Laboratory work	Field work	Individ. work
3					**1**

Assessment methods:	Written examination

Syllabus outline:
The lecture aims to present innovation as a major driver of competitiveness. It aims to describe different types of innovation. Additionally, the lecture aims to present some of the main activities a company should manage in order to create a successful innovation. • What is innovation? Different types of innovations • Challenges of managing innovation

Objective competences:
1. A comprehensive overview of innovation opportunities and challenges as a source of competitive advantage 2. Learn to manage different phases of a typical innovation process

Intended learning outcomes:
1. Basic knowledge about different types of innovation 2. Basic knowledge about how to manage an innovation process.

Literature

1. Schilling M. (2022), Strategic Management of Technological Innovation, McGrawHill.

Lecturer's references

Raffaella Tabacco is an Assistant Professor at the *Department of Economics and Statistics* of the University of Udine. She teaches *Innovation Management* and *International Sales & Logistics* in the Master degree course of *International Marketing Management and Organization* at the University of Udine.

Course C.4 Digital marketing

Course title:	**Digital marketing**	**ID:16**
Lecturer:	**Cristian Fiorot**	
Affiliation:	**ALEA**	

Duration (hours)

Lectures	Seminar	Tutorial	Laboratory work	Field work	Individ. work
2					**1**

Assessment methods:	Written examination

Syllabus outline:
• The 4.0 digital transformation • Business functions impacted by the digital transformation • The role of consultancy in supporting digital marketing: a real case

Objective competences:
1. Overview of the impact of the digital transformation on business functions 2. Introduction of methodologies to deal with digital challenges in marketing activities

Intended learning outcomes:
1. Understanding of the implications of digital transformation for different business functions 2. Understanding of the methods that can be used by digital agencies to support companies

Course C.5 Innovation on the field

Course title:	**Innovation on the field**	**ID:17**
Lecturer:	**Simon Mokorel**	
Affiliation:	**RRA SP**	

Duration (hours)

Lectures	Seminar	Tutorial	Laboratory work	Field work	Individ. work
2					**1**

Assessment methods:	Written examination

Syllabus outline:
1. From invention to innovation 2. Art & Design Thinking 3. Cases of innovation

Objective competences:
Overview and critical reflection on the main differences between invention and innovation

Intended learning outcomes:
1. Understanding how inventions become innovations 2. Reflect on real cases of innovation

Course C.6 Independent study and Networking

Course title:	Independent study and Networking
Lecturer:	All lecturers and other participants of the REGINNA 4.0 consortium
Affiliation:	Entire REGINNA 4.0 consortium

Duration (hours)

Lectures	Seminar	Tutorial	Laboratory work	Field work	Individ. work
					18

Assessment methods:	Written exam

Syllabus outline:
• Preparation for the examination • Q&A session between participants and lecturers

Objective competences:
Critical assessment of the summer school programme.

Intended learning outcomes:
Clarification of the material given. Formation of new networks. Exploration of future possibilities within the consortium partners.