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Master Degree in Industry 4.0

Ind4.0 (610455-EPP-1-MY-EPPKA2-CBHE-JP

DELIVERABLE OF ERASMUS+IND4.0 WP2
D2.6 Ind4.0 MSc Course Catalogue-Profile

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Abstract: This deliverable describes the structure and the content of the courses of the MSc Industry 4.0 curriculum.

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1.0	*15/3/2021*	*HOU*	*Contents, section 1*
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1.3	*24/5/2021*	*HOU*	*References to all courses, minor changes/corrections.*

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Abstract

This report describes the courses of the Industry 4.0 Curriculum as they were designed during the study visits. The curriculum includes 23 courses of 4 different types and 3 additional VET courses. All partners contributed to the design of the curriculum and the description of the courses.

1 Introduction

1.1 The curriculum structure

The structure of the curriculum was finalised during the 1st study visit, while the description of the courses was finalised during the 2nd study visit. All partners contributed to this process. A total of 23 courses of four different types have been defined:

- Core courses: 7 courses
- Compulsory courses: 3 courses
- Elective courses: 4 courses
- Orientation courses: 9 courses

Three VET courses were also identified.

Individual HEIs will design the structure of the curriculum according to national regulations and institutional capacity.

Each HEI adjusts credits awarded to different course categories according to their national accreditation system.

Each HEI will be responsible for the organisation of courses into semesters according to institutional regulations and capacity.

1.2 List of courses

The list of courses per type is presented in the following tables:

Code	Course Title	Course Type	Application Area
CO1	Cybersecurity in Industry 4.0	Core	All
CO2	Networking Technologies and Sensors	Core	All
CO3	Artificial Intelligence	Core	All
CO4	Big Data Analytics	Core	All
CO5	Cloud Computing Services and Technologies	Core	All
CO6	Robotics and Industry 4.0	Core	All
CO7	Ind. 4.0 cyber-physical systems Engineering	Core	All

Table 1: Core Courses

Code	Course Title	Course Type	Application Area
COM1	Research Methodology	Comp	All
COM2A	Research Theses	Comp	All
COM2B	Placement/Dissertation	Comp	All

Table 2: Compulsory Courses

Code	Course Title	Course Type	Application Area
EL1	Digital Transformation and Business Models	EL	All
EL2	Entrepreneurship, funding and Innovation management	EL	All
EL3	HCI for Industry 4.0	EL	All
EL4	Optimization of Intelligent Systems	EL	All

Table 3: Elective Courses

Code	Course Title	Course Type	Application Area
OM1	Sustainable Product Design & Manufacturing	O	Manufacturing
OM2	Prototyping in Manufacturing 4.0	O	Manufacturing
OM3	Process management in Manufacturing 4.0	O	Manufacturing
A1	Agriculture/ Aquaculture system design	O	Agri/Aquac. 4.0
A2	Autonomous robots	O	Agri/Aquac. 4.0
A3	Ecosystems for optimised/precision farming/aquafarming	O	Agri/Aquac. 4.0
H1	Medical Imaging and Digital Image Processing fundamentals	O	Health 4.0 /Pervasive Health
H2	Machine learning and big data analytics in Healthcare	O	Health 4.0
H3	Mobile and Pervasive Health Technologies	O	Health 4.0

Table 4: Orientation Courses

VET Courses		
Code	**Course Title**	**Durations (in hours)**
INDVET1	Introduction to Manufacturing 4.0	4
INDVET2	Introduction to Agriculture/Aquaculture 4.0	4
INDVET3	Introduction to Pervasive Health/ Health 4.0	4

Table 5: VET Courses

The following section presents the description of the courses.

2 Courses description

2.1 Core Courses

There are 7 core courses in the curriculum, defined as follows:

2.1.1 Cybersecurity in Industry 4.0

Course Title: Cybersecurity in Industry 4.0
Course Code: C01
Semester: Depends on the Institution, Semester A' is proposed
Direction: ALL
ECTS: Depends on the Institution
Course Summary
The course aims to provide the concepts necessary to: (a) understand the meaning of information security and security of infrastructures and networks; (b) enable the student to make an analysis of the fundamental security features of networks and infrastructures; (c) provide the fundamental tools for the design and the assessment of the solutions implemented in the network for the information security requirements. Understanding of cyber threats arising from interaction with the web and the internet in general. Knowledge of the fundamentals of cryptography. Understanding of certification mechanisms and digital signature. Capacity to (i) recognize the requirements of confidentiality, integrity, authenticity, authentication and non-repudiation during the analysis/design phase, identifying suitable standards to guarantee them; (ii) support the process of analysis and definition of security policies at the organization level; (iii) critically evaluate infrastructures and applications with respect to security requirements; (iv) assess the presence of significant vulnerabilities in infrastructures and applications; (v) study and understand security standards.
Course Pre-requisites (if applicable)
Basic knowledge of computer networks, Cloud computing
Approximate Time Needed
Number of weeks the Course is taught: Depends on the Institution, **Number of hours per week the Course is taught:** Depends on the Institution,
Course Foundation
Student Objectives/Learning Outcomes
After the end of the course, the student will be able to: - define ICT security landscape, analyze ICT network architecture and break down into hardware and software components, identify connected services, interact with industrial and ICT domain specialists for all issues related to information security, - analyze industry 4.0 case studies, - apply threat modelling process (STRIDE, PASTA) and methodologies to systematically identify possible attacks, identify vulnerabilities, prioritize specific issues and classify threats (DREAD), define mitigation actions, - setup a secure audit methodology (OSINT), - apply security standards (ETSI, NIST, ISO), - use standard cryptographic mechanisms to reinforce security (AES, ECC), digital securities, - deploy a public key infrastructure, use federated identity management frameworks.
Assessment tools
☐ Project X Final exam ☐ Mid-term exam ☐ Presentations

References:	1. Thames, Lane, Schaefer, Dirk (Eds.), Cybersecurity for Industry 4.0. Analysis for Design and Manufacturing, 2017, Springer, ISBN 978-3-319-50660-9. 2. Gautam Kumar, Om Prakash Singh Cybersecurity: Ambient Technologies, IoT, and Industry 4.0 Implications (Artificial Intelligence (AI): Elementary to Advanced Practices), 2021, CRC Press, ISBN-13: 978-0367702168.

2.1.2 Networking Technologies and Sensors

Course Title: Networking Technologies and Sensors	
Course Code: CO2	
Semester: Depends on the Institution, Semester A' is proposed	
Direction: ALL	
ECTS: Depends on the Institution	
Course Summary	
Sensors and measurement instruments, their networking allow the monitoring of physical objects and/or events, whereas the Internet of Things (IoT) paradigm enables the inter-communication of everyday objects and humans. The course topics include: • Low cost, low power communication and networking solutions • Communication/networking technologies • Sensors • Problems of reliability and data integrity, performance issues (speeds, capacity/reliability measurements), physical realities and the limitations • High-frequency data transmission • Examples of networking protocols implementation and how they work in Ind4.0 (usage, best practices of this technology relevant to the country/university/company)	
Course Pre-requisites (if applicable)	
None	
Approximate Time Needed	
Number of weeks the Course is taught: Depends on the Institution, **Number of hours per week the Course is taught:** Depends on the Institution	
Course Foundation	
Student Objectives/Learning Outcomes	
After the end of the course, the student will be able to: • understand fundamental concepts, principles and building blocks, • build various sensor network-based applications, • apply knowledge on various applications, • understand the various protocols, • compare and analyse different networking protocols, • choose the appropriate sensor type and measurement instrument for each application, • apply measurement estimation techniques and data processing	
Assessment tools	
X Project X Mid-term exam	☐ Final exam X Presentations
References:	1. John R. Vacca (Editor) Handbook of Sensor Networking: Advanced Technologies and Applications 1st Edition, 2015, CRC Press, ISBN-13: 978-1466569713. 2. Fatos Xhafa Fang-Yie Leu Li-Ling Hung, Smart Sensors Networks, 1st Edition, Communication Technologies and Intelligent Applications, 2017, Academic Press, ISBN: 9780128098592

2.1.3 Artificial Intelligence

Course Title: Artificial Intelligence
Course Code: CO3
Semester: Depends on the Institution, Semester A' is proposed
Direction: ALL
ECTS: Depends on the Institution
Course Summary
A concise overview of the Course that includes the topic, a description of the main concepts to be learner and a brief explanation on how the activities help students reach the educational objectives. This course provides fundamental knowledge on artificial intelligence (AI) concepts in various field (Example: Machine Learning, Robotics to Natural Language Processing). Learners will be exposed to the methodology and tools used in Artificial Intelligence include problem solving, decision systems, planning, robotics, data mining, collective intelligence, expert systems, etc. Learners will also learn to design reliable and high quality Artificial Intelligence (AI) systems and implement them in solving problems related to the development of Artificial Intelligence (AI) systems. And overcome human limits by applying Artificial Intelligence to new problems.
Course Pre-requisites (if applicable)
-
Approximate Time Needed
Number of weeks the Course is taught: Depends on the Institution, **Number of hours per week the Course is taught:** Depends on the Institution
Course Foundation
Student Objectives/Learning Outcomes
After the end of the course, the student will be able to: • describe the application of Artificial Intelligence in various field (Machine Learning, Robotics to Natural Language Processing), • apply methodology and tools of Artificial Intelligence in problem solving, decision systems, planning, robotics, data mining, collective intelligence and expert systems, • design and implement reliable and high quality Artificial Intelligence (AI) systems, • solve problems related to the development of Artificial Intelligence (AI) systems, • overcome human limits by applying Artificial Intelligence to new problems.
Assessment tools
X Case Study ☐ Mid-term exam X Final exam ☐ Presentations

References:	1. Dingli, Alexei, Haddod, Foaad, Klüver, Christina (Eds.) Artificial Intelligence in Industry 4.0, 2021, Springer, ISBN 978-3-030-61045-6. 2. Aydin Azizi, Applications of Artificial Intelligence Techniques in Industry 4.0 (SpringerBriefs in Applied Sciences and Technology) 1st ed. 2019, Springer, ISBN-13: 978-9811326394.

2.1.4 Big Data Analytics

Course Title: Big Data Analytics
Course Code: CO4
Semester: Depends on the Institution
Direction: ALL
ECTS: Depends on the Institution
Course Summary
This course emphasizes the importance of emerging big data analytics and appropriate technologies for managing different types and characteristics of big data in Industry 4.0, including data management, data engineering, warehousing, visualization, and decision analysis. Students will develop the ability to analyze, apply, design, and develop big data analytics applications considering technical and industrial requirements.
Course Pre-requisites (if applicable)
Statistics, programming
Approximate Time Needed
Number of weeks the Course is taught: Depends on the Institution, **Number of hours per week the Course is taught:** Depends on the Institution
Course Foundation
Student Objectives/Learning Outcomes
After the end of the course, the student will be able to: • identify the emerging of big data analytics in IR 4.0 and its implementation, • understand the process of data engineering, data management, data warehousing, and data visualization, • apply methodologies in extracting information from big data, • apply data modelling from real-world problems, • apply business intelligence and decision analysis using big data, • design data analysis system on a specific case (project).
Assessment tools
X Project and presentations ☐ Final exam ☐ Mid-term exam ☐ Presentations

References:	1. G. Rajesh, X. Mercilin Raajini, Hien Dang Industry 4.0 Interoperability, Analytics, Security, and Case Studies, CRC Press, 2021, ISBN 9781003048855. 2. Bettiol, Marco, Di Maria, Eleonora, Micelli, Stefano (Eds.). Knowledge Management and Industry 4.0, 2020, Springer, ISBN 978-3-030-43589-9. 3. Choo, Kim-Kwang Raymond, Dehghantanha, Ali (Eds.) Handbook of Big Data Privacy, 2020, Springer ISBN 978-3-030-38557-6.

2.1.5 Cloud Computing Services and Technologies

Course Title: Cloud Computing Services and Technologies	
Course Code: CO5	
Semester: Depends on the Institution	
Direction: ALL	
ECTS: Depends on the Institution	
Course Summary	
Cloud Computing Environment is one of the new vital enablers of the emerging technology of the Industrial Revolution 4.0. As one of the essential pillars for the new Industry Revolution, cloud computing effectively supports the developments on the Internet of Things (IoT), automation, and robotics. Students must be able to apply the capabilities of cloud computing technologies in support of the fourth Industrial Revolution via the integration of several cloud platform compute services. This Emerging technology of cloud computing courses is feature- and functionality-focused on a cloud computing platform that is conducted in guided labs.	
Course Pre-requisites (if applicable)	
-	
Approximate Time Needed	
Number of weeks the Course is taught: Depends on the Institution, **Number of hours per week the Course is taught:** Depends on the Institution	
Course Foundation	
Student Objectives/Learning Outcomes	
After the end of the course, the student will be able to: • identify key concepts of cloud computing services and technologies, • manage cloud computing services, • analyze the applicability of cloud computing infrastructures for different IR4.0 applications, • apply cloud computing solutions for computational and engineering applications related to Industry 4.0.	
Assessment tools	
X Project ☐ Mid-term exam	☐ Final exam X Presentations
References:	1. Introduction to Cloud Computing: From a beginner's perspective 2019 ISBN-13 : 978-1090655202. 2. Docker in the Cloud, Sébastien Goasguen, April 2016, O'Reilly Media, Inc. ISBN: 9781491940969. 3. The Kubernetes Book, Independently published July 2017 ISBN-10: 1521823634 ISBN-13 : 978-1521823637.

2.1.6 Robotics and Industry 4.0

Course Title: Robotics and Industry 4.0	
Course Code: CO6	
Semester: Depends on the Institution	
Direction: ALL	
ECTS: Depends on the Institution	
Course Summary	
The course refers to robots in industry, automation, and their role in how robots work in the industry providing commercial solutions. Features that make robotics collaborative will be explained. Discuss the role of Robotics in Industry 4.0, various challenges and its applications.	
Course Pre-requisites (if applicable)	
-	
Approximate Time Needed	
Number of weeks the Course is taught: Depends on the Institution, **Number of hours per week the Course is taught:** Depends on the Institution	
Course Foundation	
Student Objectives/Learning Outcomes	
After the end of the course, the student will be able to: • understand the role of robots in industry, • describe the different types of robots used in industry, • determine how robots communicate, • explain the applications of robotics in Ind. 4.0, • discuss human-robots interaction and collaboration.	
Assessment tools	
☐ Project X Mid-term exam	X Final exam ☐ Presentations
References:	1. Kravets, Alla G. (Ed.) Robotics: Industry 4.0 Issues & New Intelligent Control Paradigms, 2020, Springer, ISBN 978-3-030-37841-7. 2. Anand Nayyar, Akshi Kumar, A Roadmap to Industry 4.0: Smart Production, Sharp Business and Sustainable Development. 2020, Springer, ISBN: 978-3-030-14544-6.

2.1.7 Industry 4.0 cyber-physical systems Engineering

Course Title: Industry 4.0 Cyber-physical systems Engineering	
Course Code: CO7	
Semester: Depends on the Institution	
Direction: ALL	
ECTS: Depends on the Institution	
Course Summary	
The aim of this course is to teach the students how to devise a digital mock-up for Cyber Physical systems (CPS) for use in modelling and advanced engineering. Other topics include Reverse Engineering of CPS, Digital chain for CPS engineering in a heterogeneous context, supervision of CPS during the engineering and exploitation phases. Finally, introductory topics in mechatronics, advanced control, identification and fault-detection for CPS will be taught.	
Course Pre-requisites (if applicable)	
-	
Approximate Time Needed	
Number of weeks the Course is taught: Depends on the Institution, **Number of hours per week the Course is taught:** Depends on the Institution	
Course Foundation	
Student Objectives/Learning Outcomes	
After the end of the course, the student will be able to: • analyze the methods used in CPS engineering and Industry 4.0 technologies and processes, • understand the mainstream concepts and models involved in CPS engineering and Industry 4.0 technologies and processes, • discuss the use of CPS and process monitoring in Industry 4.0, • use CPPS (Cyber-physical production systems) on manufacturing or general.	
Assessment tools	
☐ Project X Mid-term exam	X Final exam ☐ Presentations
References:	1. Kravets, Alla G., Bolshakov, Alexander A., Shcherbakov, Maxim (Eds.) Cyber-Physical Systems: Design and Application for Industry 4.0, 2021, Springer, ISBN 978-3-030-66081-9. 2. *Vikram Bali, Vishal Bhatnagar, Deepti Aggarwal, Shivani Bali, Mario José Diván.* Cyber-Physical, IoT, and Autonomous Systems in Industry 4.0, 2021, CRC Press,ISBN 9780367705152.

2.2 Compulsory Courses

2.2.1 Research Methodology

Course Title: Research Methodology	
Course Code: COM1	
Semester: Depends on the Institution, Semester A' or B' is proposed	
Direction: ALL	
ECTS: Depends on the Institution	
Course Summary	
The course aims to teach students the theory of science, research problems and strategies in various Industry 4.0 topics. Other topics covered include qualitative and quantitative research designs, methods, instruments, data analysis and presentation, research ethics, principles and techniques of statistical analysis and the conceptualizing and conducting a research proposal.	
Course Pre-requisites (if applicable)	
-	
Approximate Time Needed	
Number of weeks the Course is taught: Depends on the Institution, **Number of hours per week the Course is taught:** Depends on the Institution	
Course Foundation	
Student Objectives/Learning Outcomes	
After the end of the course the student will be able: • to understand the primary research strategies, • to apply qualitative and quantitative analysis methods, • to conduct a research proposal on Industry 4.0 topics, • to evaluate the ethical dimensions of a research subject.	
Assessment tools	
X Project ☐ Mid-term exam	☐ Final exam ☐ Presentations
References:	1. *Shyama Prasad Mukherjee.* A Guide to Research Methodology An Overview of Research Problems, Tasks and Methods, 2019, CRC Press, ISBN 9780367256203. 2. *Ben Kei Daniel, Tony Harland, Higher Education Research Methodology: A Step-by-Step Guide to the Research Process, 2017, Routledge, ISBN 9781138556003.*

2.2.2 Research Theses

Course Title: Research Theses	
Course Code: COM2A	
Semester: Depends on the Institution	
Direction: ALL	
ECTS: Depends on the Institution	
Course Summary	
This course is intended for Master's level students to create a Master's Thesis project and to see it through to the first draft. In this course, students will select and finalize a thesis committee, submit the thesis proposal, make all necessary revisions to the thesis proposal, and produce the first draft of the thesis. Students will work one-on-one with their thesis advisor and the thesis coordinator to identify times that they will meet and create a plan for communication throughout the process of completing the Master's Thesis.	
Course Pre-requisites (if applicable)	
-	
Approximate Time Needed	
Number of weeks the Course is taught: Depends on the Institution, **Number of hours per week the Course is taught:** Depends on the Institution	
Course Foundation	
Student Objectives/Learning Outcomes	
After the end of the course the student will be able to: • perform a literature review, • identify essential issues in a specific field and understand the scientific approach to research questions, • perform a scientific study and appropriately managing its data, • draft a Master Theses.	
X Theses ☐ Mid-term exam	☐ Final exam ☐ Presentations
References:	1. Umberto Eco, How to Write a Thesis, 2015, MIT Press, ISBN: 9780262527132.

2.2.3 Placement/Dissertation

Course Title: Placement/Dissertation	
Course Code: COM2B	
Semester: Depends on the Institution, Semester A' is proposed	
Direction: ALL	
ECTS: Depends on the Institution	
Course Summary	
A placement is an opportunity for students to gain industry experience with an employer while they are enrolled in the MSc programme. The placement should be with an employer that directly uses Industry 4.0 technologies. Students get to apply what they have learned in previous semesters in the real world, gain hands-on experience, and make valuable contacts that could lead to a job after they graduate.	
Course Pre-requisites (if applicable)	
-	
Approximate Time Needed	
Number of weeks the Course is taught: Depends on the Institution, **Number of hours per week the Course is taught:** Depends on the Institution	
Course Foundation	
Student Objectives/Learning Outcomes	
After the end of the placement, the student will be able to: • apply what they have learned in real Industry 4.0 environments, • discover new ways for applying the theoretical knowledge they have acquired, • create new knowledge in a specific Industry 4.0 topic, • improve their Industry 4.0 related skills.	
Assessment tools	
X Report ☐ Mid-term exam	☐ Final exam ☐ Presentations
References:	Not applicable

2.3 Elective Courses

2.3.1 Digital transformation and Business Models

Course Title: Digital Transformation and Business Models
Course Code: EL1
Semester: 2
Direction: ALL
ECTS: Depends on the Institution
Course Summary
This course would expose learners on how digitalization has fundamentally changed how enterprises operate, affecting their business models and supply chain dynamics. The course would allow learners to manage and ties together strategy, innovation and organizing digitalization agenda in more concrete ways by considering the following: • Enterprises' digital logic, which impacts all levels of organizational life including strategies, business models and competencies. • Core operational challenges for organizations building on a digital logic and business model transformation • Digitalization governance and dynamic capabilities, • Digital and business platforms, digital transformation, risk, and value creation, • Digitalization strategic implementation and monitoring.
Course Pre-requisites (if applicable)
-
Approximate Time Needed
Number of weeks the Course is taught: Depends on the Institution, **Number of hours per week the Course is taught:** Depends on the Institution
Course Foundation
Student Objectives/Learning Outcomes
After the end of the course, the student will be able to: • understand the digitalization process on business models, • get to know the basic business models, • choose strategies for implementation and monitoring, • recommend appropriate digital transformation strategy for enterprises, • organize a digitalization agenda in concrete ways.
Assessment tools
X Project ☐ Final exam ☐ Mid-term exam X Presentations

References:	1. Iwona Otola, Marlena Grabowska, Business Models Innovation, Digital Transformation, and Analytics, 2020, Auerbach Publications, ISBN 9780367862794. 2. Ustundag, Alp, Cevikcan, Emre, Industry 4.0: Managing the Digital Transformation, 2018, Springer, ISBN 978-3-319-57870-5. 3. Aagaard, Annabeth (Ed.), Digital Business Models Driving Transformation and Innovation, 2019, Palgrave-McMillan, ISBN 978-3-319-96902-2.

2.3.2 Entrepreneurship, Funding and Innovation

Course Code: EL2	
Semester: Depends on the Institution	
Direction: ALL	
ECTS: Depends on the Institution	
Course Summary	
In this course students will acquire knowledge about entrepreneurship methodologies in order to recognize business and funding opportunities in the Industry 4.0 sector. They will get familiar with international innovation standards and use tools for analysis of the micro and macro business environment at a national and international level. The course will provide knowledge and skill for successful leadership in Industry 4.0 business ecosystems and insights into how organizational models should be applied for efficient business operation.	
Course Pre-requisites (if applicable)	
-	
Approximate Time Needed	
Number of weeks the Course is taught: Depends on the Institution, **Number of hours per week the Course is taught:** Depends on the Institution	
Course Foundation	
Student Objectives/Learning Outcomes	
Upon completing this course, students will be able to: • recognize business and funding opportunities for Industry 4.0, • use innovation standards such as ISO56000, • design a Business plan for Industry 4.0 specific business endeavours, • understand current leadership theories and how leadership models are put into practice, • understand and apply Industry 4.0 organizational models.	
Assessment tools	
☐ Project ☐ Mid-term exam	X Final exam ☐ Presentations
References:	1. Devezas, Tessaleno, Leitão, João, Sarygulov, Askar (Eds.), Industry 4.0: Entrepreneurship and Structural Change in the New Digital Landscape, 2017, Springer, ISBN 978-3-319-49604-7. 2. Krishna Raj Bhandari, Entrepreneurship and Industry 4.0: Balancing Entrepreneurial Exploration and Exploitation, 2021, Cambridge Scholars Publishing, ISBN: 1-5275-6972-1.

2.3.3 HCI for Industry 4.0

Course Title: Human Computer Interaction for Industry 4.0	
Course Code: EL3	
Semester: Depends on the Institution	
Direction: ALL	
ECTS: Depends on the Institution	
Course Summary	
Industry 4.0 b describes a new paradigm for seamless interaction between humans and machines. It relies on intelligent, inter-connected cyber-physical production systems that are able to control the process flow of industrial production. As those machines take many decisions autonomously and further interact with production and manufacturing planning systems, the integration of human users requires a new HCI paradigm. This course provides a comprehensive introduction and deep dive into Human Computer Interaction (HCI), to enable students to design and create user-centered design solution based on Industry 4.0 landscape. The course entails user study, user-centered design, and other models and theories in HCI. This course integrates computer science, behavioural science and man-machine UX design and cyber physical systems.	
Course Pre-requisites (if applicable)	
-	
Approximate Time Needed	
Number of weeks the Course is taught: Depends on the Institution, **Number of hours per week the Course is taught:** Depends on the Institution	
Course Foundation	
Student Objectives/Learning Outcomes	
After the completion of the course, students are expected to be able to: • define fundamental concepts of Human Computer Interaction (HCI) in Industry 4.0, • explain the models and theories of HCI conceptual frameworks for the design of man-man-machine interfaces, • apply appropriate model or theory in designing interface solutions for Industry 4.0, • design user-centered solutions for Industry 4.0, • communicate the proposed design solution to industry stakeholders.	
Assessment tools	
X Project ☐ Mid-term exam	X Final exam ☐ Presentations
References:	1. Paelke V., Röcker C. (2015) User Interfaces for Cyber-Physical Systems: Challenges and Possible Approaches. In: Marcus A. (eds) Design, User Experience, and Usability: Design Discourse. Lecture Notes in Computer Science, vol 9186. Springer, Cham. https://doi.org/10.1007/978-3-319-20886-2_8. 2. Pascual, Diego Galar , Pasquale Daponte and Uday Kumar , "The Industry 4.0 Architecture and Cyber-Physical Systems" , in *Handbook of Industry 4.0 and SMART Systems* ed. Diego Galar Pascual , Pasquale Daponte and Uday Kumar (Boca Raton: CRC Press, 01 Oct 2019), accessed 26 May 2021 , Routledge Handbooks Online.

	3. *P. Papcun, E. Kajáti and J. Koziorek, "Human Machine Interface in Concept of Industry 4.0," 2018 World Symposium on Digital Intelligence for Systems and Machines (DISA), 2018, pp. 289-296, doi: 10.1109/DISA.2018.8490603.*

2.3.4 Optimization of Intelligent Systems

Course Title: Optimization of Intelligent Systems
Course Code: EL4
Semester: Depends on the Institution
Direction: ALL
ECTS: Depends on the Institution
Course Summary
In this course, students will learn about optimization and how it can be used in intelligent systems. Machine learning, knowledge discovery, Fuzzy logic, Neural Networks and Computational intelligence (CI) are only some of the topics that are taught and make students confident about their knowledge in Intelligent Systems.
Course Pre-requisites (if applicable)
Artificial Intelligence (CO3)
Approximate Time Needed
Number of weeks the Course is taught: Depends on the Institution, **Number of hours per week the Course is taught:** Depends on the Institution
Course Foundation
Student Objectives/Learning Outcomes
Upon completing this course, students will be able to: • understand and use relevant scientific literature as a foundation for developing own models and simulations, • determine the appropriate models within the scope of various topics, • use optimization techniques for practical and theoretical problems, • select appropriate methods for problem optimization.
Assessment tools
X Project ☐ Final exam ☐ Mid-term exam ☐ Presentations

References:	1. Vasant, Pandian, Zelinka, Ivan, Weber, Gerhard-Wilhelm (Eds.), Intelligent Computing & Optimization, 2019, Springer, ISBN 978-3-030-00979-3. 2. Fathi, Mahdi, Khakifirooz, Marzieh, Pardalos, Panos M. (Eds.). Optimization in Large Scale Problems: Industry 4.0 and Society 5.0 Applications, 2019, Springer, ISBN 978-3-030-28565-4. 3. Kaushik Kumar,Divya Zindani ,J. Paulo Davim, Digital Manufacturing and Assembly Systems in Industry 4.0, 2020, CRC Press, ISBN 9780367779474.

2.4 Orientation Courses

2.4.1 Sustainable Product Design & Manufacturing

Course Title: Sustainable product design and manufacturing
Course Code: OM1
Semester: Depends on the Institution
Direction: Manufacturing
ECTS: Depends on the Institution
Course Summary
In this course students will learn the basic components of Industry 4.0 service design with a strong focus on Manufacturing 4.0. They will learn how to introduce sustainability, low energy consumption and environmentally friendly characteristics into products and services as early as from their design stage. In depth knowledge on how to protect copyright and intellectual property rights of products will be provided.
Course Pre-requisites (if applicable)
-
Approximate Time Needed
Number of weeks the Course is taught: Depends on the Institution, **Number of hours per week the Course is taught:** Depends on the Institution
Course Foundation
Student Objectives/Learning Outcomes
Upon completing this course, students will be able to: • design new products/services within a Manufacturing 4.0 ecosystem, • use benchmarking techniques for market intelligence of the Industry 4.0 sector, • incorporate sustainability into Industry 4.0 services' design, • understand the process of protecting copyrights and trademarks, • use digital twinning for the design of Industry 4.0 applications that have low energy consumption, and are environment-friendly.
Assessment tools
☐ Project ☐ Mid-term exam X Final exam ☐ Presentations

References:	1. *K. Jayakrishna, Vimal K.E.K, S. Aravind Raj, Asela K. Kulatunga, M.T.H. Sultan, J. Paulo Davim,* Sustainable Manufacturing for Industry 4.0 An Augmented Approach, 2021, CRC Press, ISBN 9781138606845. 2. *Dastbaz, Mohammad, Cochrane, Peter (Eds.), Industry 4.0 and Engineering for a Sustainable Future, 2-19, Springer, ISBN 978-3-030-12953-8.* 3. Carla Gonçalves Machado, Mats Peter Winroth & Elias Hans Dener Ribeiro da Silva (2020) Sustainable manufacturing in Industry 4.0: an emerging research agenda, International Journal of Production Research, 58:5, 1462-1484, DOI: 10.1080/00207543.2019.1652777.

2.4.2 Prototyping in Manufacturing 4.0

Course Title: Prototyping in Manufacturing 4.0	
Course Code: OM2	
Semester: Depends on the Institution	
Direction: Manufacturing	
ECTS: Depends on the Institution	
Course Summary	
In this course, students will be introduced to the benefits of using prototyping to design products that are competitive from a business, economic and technical perspective in the fast-changing market of Industry 4.0 manufacturing sector. They will learn about the process of using digital models for producing prototypes of Manufacturing 4.0 products/services. By learning to use techniques such as 3D printing and digital twinning, students will be able to choose an appropriate method for testing the prototypes and acquire the tangible proof for improving and/or re-designing their products.	
Course Pre-requisites (if applicable)	
-	
Approximate Time Needed	
Number of weeks the Course is taught: Depends on the Institution, **Number of hours per week the Course is taught:** Depends on the Institution	
Course Foundation	
Student Objectives/Learning Outcomes	
Upon completing this course, students will be able to: • design digital models of Industry 4.0 services/products, • incorporate prototyping as a process in a Smart Factory, • understand the business, economic and technical advantages of prototyping in Manufacturing 4.0, • choose the appropriate techniques/methodologies to produce prototypes, • use methodologies for re-designing products/services based in prototyping testing.	
Assessment tools	
☐ Project ☐ Mid-term exam	X Final exam ☐ Presentations
References:	1. Ibrahim H. Garbie, Hamid Parsaei, Reconfigurable Manufacturing Enterprises for Industry 4.0, 2021, CRC Press, ISBN 9780367190903. 2. O. Perez (Author), S. Sauceda (Author), J. Cruz, Manufacturing 4.0: The Use of Emergent Technologies in Manufacturing, 2018, Palibrio, ISBN-10: 1506526187.

2.4.3 Process Management in Manufacturing 4.0

Course Title: Process Management in Manufacturing 4.0	
Course Code: OM3	
Semester: Depends on the Institution	
Direction: Manufacturing	
ECTS: Depends on the Institution	
Course Summary	
This course provides advanced knowledge about how process management works in manufacturing 4.0 environments and how techniques and tools from engineering disciplines can be used and/or adapted in a smart factory. Students will be able to recognize and exploit the advantages of process design, benchmarking and re-design for efficient operation and continuous improvement within industry 4.0 environments. Additional knowledge will be offered on how to use Process Management techniques for managing the complete lifecycle of a smart factory.	
Course Pre-requisites (if applicable)	
CO7 Industry 4.0 cyber physical systems engineering	
Approximate Time Needed	
Number of weeks the Course is taught: Depends on the Institution, **Number of hours per week the Course is taught:** Depends on the Institution	
Course Foundation	
Student Objectives/Learning Outcomes	
Upon completing this course, students will be able to: • recognize the advantages of process design in Manufacturing 4.0, • use software tools to design and evaluate processes in a smart factory, • choose the appropriate benchmarking methods and use Business Process Reengineering for process improvement, • understand how to apply process management in every stage of the smart factory lifecycle process, from supply chain management to final quality control, • understand quality assurance procedures and standards for continuous improvement of Industry 4.0 cyber-physical systems.	
Assessment tools	
X Project ☐ Mid-term exam	X Final exam ☐ Presentations
References:	1. Carolina Machado, J. Paulo Davim, Industry 4.0 Challenges, Trends, and Solutions in Management and Engineering, 2020, by CRC Press, ISBN 9780815354406. 2. Andrea Benešova, MartinHirman, FrantišekSteiner, JiříTupa, The Role of Process Management in the Context of Industry 4.0, Procedia Manufacturing, Volume 38, 2019, Pages 1691-1696, Elsevier. 3. Knapcikova, Lucia, Balog, Michal (Eds.), Industry 4.0: Trends in Management of Intelligent Manufacturing Systems, 2019, Springer, ISBN 978-3-030-14011-3.

2.4.4 Agriculture/ Aquaculture system design

Course Title: Agriculture/ Aquaculture system design
Course Code: A1
Semester: Depends on the Institution
Direction: Agri/Aquac. 4.0
ECTS: Depends on the Institution
Course Summary
The aim of this course is to give a general understanding of the Impact of Industry 4.0 on Aquaculture/Agriculture Industry. –The course also refers to insights into how Industry 4.0 is impacting and transforming the Aquaculture/Agriculture Industry, including the application of robots and autonomous systems, ocean-to-fork transparency, application of AR, VR and MR; online marketplaces for the aquaculture industry. The barriers of Implementing Industry 4.0 including High Cost of Implementation, Privacy Issues and Concerns, Lack of skilled staff, Technology integration Issues and Lack of standardization and co-ordination across industries, will be explored. The course will also provide students with basic knowledge to design Aquaculture/Agriculture Industry 4.0 ecosystems or integrate Industry 4.0 services to existing ones.
Course Pre-requisites (if applicable)
-
Approximate Time Needed
Number of weeks the Course is taught: Depends on the Institution, **Number of hours per week the Course is taught:** Depends on the Institution
Course Foundation
Student Objectives/Learning Outcomes
Upon completing this course, students will be able to: • identify the drivers of Implementing Industry 4.0 in agriculture/aquaculture, • understand the Impact of Industry 4.0 in the agriculture/aquaculture Industry, • describe the basic components of Industry 4.0 in the agriculture/aquaculture system, • analyse the barriers of Implementing Industry 4.0 in the agriculture/aquaculture industry, • design an Industry 4.0 enabled agriculture/aquaculture service or ecosystem, • integrate Industry 4.0 services in existing ecosystems.
Assessment tools
X Project ☐ Final exam ☐ Mid-term exam ☐ Presentations

References:	1. Rajesh Singh, Amit Kumar Thakur, Anita Gehlot, Ajay Kumar Kaviti, Internet of Things for Agriculture 4.0: Impact and Challenges, 2021, CRC Press, ISBN 9781774630020. 2. Rapela, Miguel Angel, Fostering Innovation for Agriculture 4.0: A Comprehensive Plant Germplasm System, 2019, Springer, ISBN 978-3-030-32493-3. 3. Michael B. Timmons, Recirculating Aquaculture, 2018, Ithaca Publishing, ISBN-10: 0971264678.

2.4.5 Autonomous robots

Course Title: Autonomous robots	
Course Code: A2	
Semester: Depends on the Institution	
Direction: Agriculture /Aquaculture 4.0	
ECTS: Depends on the Institution	
Course Summary	
In this course, students will learn which autonomous robots are used to apply Industry 4.0 and how with a special focus on Agriculture and Aquaculture. The course will also tackle motion planning and kinematics of autonomous robots and their programming. Other subjects include the recognition of the use of autonomous robots within lifecycle of and the Industry 4.0 application and the safety issues and risks that emerge. Students will also gain knowledge about the national and international legal issues stemming from the use of autonomous robots in Agriculture /Aquaculture 4.0.	
Course Pre-requisites (if applicable)	
-	
Approximate Time Needed	
Number of weeks the Course is taught: Depends on the Institution, **Number of hours per week the Course is taught:** Depends on the Institution	
Course Foundation	
Student Objectives/Learning Outcomes	
Upon completing this course, students will be able to: • categorize autonomous robots according to their applications, • understand the use of autonomous robots within various Agriculture /Aquaculture 4.0 processes, • use programming languages for controlling autonomous robots, • recognize safety issues and mitigate risks within an Agriculture /Aquaculture 4.0 ecosystem using autonomous robots, • identify legal issues stemming from the use of autonomous robots in various application areas.	
Assessment tools	
☐ Project ☐ Mid-term exam	X Final exam ☐ Presentations
References:	1. Kevin M. Lynch , By (author) Frank C. Park, Modern Robotics: Mechanics, Planning, and Control, 2017, Cambridge University Press, ISBN10 1107156300. 2. Alla G. Kravets, Robotics: Industry 4.0 Issues & New Intelligent Control Paradigms, Studies in Systems, Decision and Control, 2020, Springer, ISBN: 978-3-030-37840-0. 3. Karabegović I., Turmanidze R., Dašić P. (2020) Robotics and Automation as a Foundation of the Fourth Industrial Revolution - Industry 4.0. In: Tonkonogyi V. et al. (eds) Advanced Manufacturing Processes. InterPartner 2019. Lecture Notes in Mechanical Engineering. Springer, Cham. https://doi.org/10.1007/978-3-030-40724-7_13. 4. Roland Siegwart, Illah Reza Nourbakhsh, Davide Scaramuzza, Introduction to Autonomous Mobile Robots, 2011, MIT Press, ISBN10 0262015358.

2.4.6 Ecosystems for optimised/precision farming/aquafarming

Course Title: Ecosystems for optimised/precision farming/aquafarming
Course Code: A3
Semester: Depends on the Institution
Direction: Agri/Aquac. 4.0
ECTS: Depends on the Institution
Course Summary
The aim of this course is to introduce students to the key challenges that the optimised/precision agricultural/aquaculture sector is going to face in the coming years as Industry 4.0 solutions become available. Students will learn how the Industry 4.0 paradigm integrates digital technologies into business processes to raise productivity levels and to develop new business models. During the course, the most appropriate Industry 4.0 technologies in the fields of farming/aquafarming will be analysed and highlight common patterns and technological overlaps.
Course Pre-requisites (if applicable)
-
Approximate Time Needed
Number of weeks the Course is taught: Depends on the Institution, **Number of hours per week the Course is taught:** Depends on the Institution
Course Foundation
Student Objectives/Learning Outcomes
Upon completing this course, students will be able to: • identify the key challenges of applying Industry 4.0 to optimised/precision farming/aquafarming, • describe the use of Industry 4.0 in various business processes of the farming/aquafarming lifecycle, • design new business models for Industry 4.0 enabled optimised/precision farming/aquafarming, • integrate the appropriate Industry 4.0 technologies for optimization of precision farming/aquafarming.
Assessment tools
☐ Project ☐ Mid-term exam X Final exam ☐ Presentations

References:	1. Martin Føre, Kevin Frank, Tomas Norton, Eirik Svendsen, Jo Arve Alfredsen, Tim Dempster, Harkaitz Eguiraun, Win Watson, Annette Stahl, Leif Magne Sunde, Christian Schellewald, Kristoffer R. Skøien, Morten O. Alver, Daniel Berckmans, Precision fish farming: A new framework to improve production in aquaculture, Biosystems Engineering, Volume 173, 2018, Pages 176-193, ISSN 1537-5110. 2. Godwin Idoje, Tasos Dagiuklas, Muddesar Iqbal, Survey for smart farming technologies: Challenges and issues, Computers & Electrical Engineering, Volume 92, 2021, 107104, ISSN 0045-7906. 3. D. Kent Shannon, David E. Clay, Newell R. Kitchen, Precision Agriculture Basics, 2020, Willey Press, ISBN: 978-0-891-18366-2.

2.4.7 Medical Imaging and Digital Image Processing fundamentals

Course Title: Medical Imaging and Digital Image Processing fundamentals	
Course Code: H1	
Semester: Depends on the Institution	
Direction: Health 4.0	
ECTS: Depends on the Institution	
Course Summary	
This course aims to introduce students to the different techniques used for the acquisition, processing and storage of medical images for the purpose of diagnostic and treatment of patients. Also it intends to provide knowledge about different medical imaging modalities such as radiographic imaging, nuclear medicine, magnetic resonance and ultrasound. Moreover, it will present the leading digital image processing approaches for image enhancement, analysis and visualization.	
Course Pre-requisites (if applicable)	
-	
Approximate Time Needed	
Number of weeks the Course is taught: Depends on the Institution, **Number of hours per week the Course is taught:** Depends on the Institution	
Course Foundation	
Student Objectives/Learning Outcomes	
Upon completion of this course, students should be able to: • describe the main medical imaging technologies, • distinguish the differences between medical imaging technologies, • explain the functionality of Picture Archiving and Communication Systems (PACS), • describe the main digital image processing procedures, • apply basic digital processing methods in medical images.	
Assessment tools	
☐ Project ☐ Mid-term exam	☐ Final exam X Presentations
References:	1. Janya Chanchaichujit, Albert Tan, Fanwen Meng, Sarayoot Eaimkhong Healthcare 4.0, Next Generation Processes with the Latest Technologies, 2019, Palgrave Pivot, Singapore, ISBN: 978-981-13-8113-3 2. Elizabeth Carver,Barry Carver, Medical Imaging: Techniques, Reflection & Evaluation, 2012, Elsevier Health Sciences, ISBN10 0702039330.

2.4.8 Machine learning and big data analytics in Healthcare

Course Title: Machine learning and big data analytics in Healthcare	
Course Code: H2	
Semester: Depends on the Institution	
Direction: Health 4.0	
ECTS: Depends on the Institution	
Course Summary	
The course aims to study management techniques and analyse large databases that have, among others, spatial and temporal components. The purpose of analyzing this data is to understand patterns, find similarities, identify correlations, normalities, and anomalies. Examine Big Data Management techniques for efficient data processing and storage in healthcare applications, including privacy-preserving data analysis. Specific applications of Industry 4.0 in healthcare are presented in terms of healthcare data collected by patients, organizations, research centers, hospitals, businesses, etc. Due to the nature of this data, applications vary, such as diagnostics in medicine, business/stock forecasting and decision support, etc.	
Course Pre-requisites (if applicable)	
-	
Approximate Time Needed	
Number of weeks the Course is taught: Depends on the Institution, **Number of hours per week the Course is taught:** Depends on the Institution	
Course Foundation	
Student Objectives/Learning Outcomes	
Upon completion of this course, students should be able to: • understand existing biomedical databases, • understand laws/regulations on privacy of healthcare data, • describe the main machine learning approaches, • explain basic big data analytics techniques and tools, • design an efficient healthcare service in terms of data processing and storage, • integrate new Industry 4.0 healthcare services into existing systems.	
Assessment tools	
X Project ☐ Mid-term exam	☐ Final exam ☐ Presentations
References:	1. Thuemmler, Christoph, Bai, Chunxue (Eds.). Health 4.0: How Virtualization and Big Data are Revolutionizing Healthcare, 2017, Springer, ISBN 978-3-319-47617-9. 2. Sarah Arden, Adam C. Fisher, Katherine Tyner, Lawrence X. Yu, Sau L. Lee, Michael Kopcha, Industry 4.0 for pharmaceutical manufacturing: Preparing for the smart factories of the future, International Journal of Pharmaceutics, Volume 602, 2021, 120554, ISSN 0378-5173.

2.4.9 Mobile and Pervasive Health Technologies

Course Title: Mobile and Pervasive Health Technologies	
Course Code: H3	
Semester: Depends on the Institution	
Direction: Health 4.0	
ECTS: Depends on the Institution	
Course Summary	
Initially, integrated health information systems are described, emphasising those used in hospitals and other large clinical structures. In addition, the main types of medical data are described, and the basic medical standards for achieving interoperability between health information systems are analyzed. Electronic health record systems and telemedicine systems and applications are examined in more detail. Next, mobile and pervasive computing is described by analyzing its key concepts, properties and characteristics, as well as the context awareness that is a key concept and the largest field of application of pervasive computing. The application of pervasive and mobile computing in the field of health is presented, where the analysis of various sensors and wireless technologies, biomedical signals and their basic principles of digital processing, as well as clinical decision support systems is performed. Finally, the course includes a number of mobile and pervasive health applications related to both wireless monitoring and management of health and well-being through portable and wearable systems and the support of autonomous living, highlighting the role of smart spaces and assistive technologies.	
Course Pre-requisites (if applicable)	
-	
Approximate Time Needed	
Number of weeks the Course is taught: Depends on the Institution, **Number of hours per week the Course is taught:** Depends on the Institution	
Course Foundation	
Student Objectives/Learning Outcomes	
Upon completion of this course, students should be able to: • explain the functionality and characteristics of electronic and personal health records, • describe the difference between telemedicine systems and mobile and pervasive systems, • define the concepts of pervasive computing, mobile computing and context awareness, • outline the key sensors involved in mobile and pervasive health, • identify the most appropriate wireless communication technologies for different applications, • describe the usage models of mobile and pervasive systems for monitoring and managing health and wellbeing, • apply the architecture and procedures of biosignals acquisition and processing.	
Assessment tools	
☐ Project ☐ Mid-term exam	X Final exam ☐ Presentations
References:	1. Arun Kumar, SangaiahS Shantharajah,Padma Theagarajan, Intelligent Pervasive Computing Systems for Smarter Healthcare, 2019, Wiley, ISBN:9781119438960.

	2. Melania F. Bause, Hannah Forbes, Farnaz Nickpour, Dirk Schaefer, Towards a Health 4.0 Framework for the Design of Wearables: Leveraging Human-Centered and Robust Design, Procedia CIRP, Volume 91, 2020, Pages 639-645, ISSN 2212-8271.

2.5 VET Courses

The titles and the initial description of the VET courses were defined in the 2nd study visit. The content of the VET courses will be finalised in deliverable D2.8 VET outlines. The proposed description of each VET course is described in the following sections.

2.5.1 Introduction to Manufacturing 4.0

Course Title: Introduction to Manufacturing 4.0	
Course Code: INDVET1	
Course Summary	
Manufacturing 4.0, as part of the Industry 4.0 paradigm, concerns the transformation of industrial processes through the integration of modern technologies such as sensors, communication, and computational processing. Technologies such as Cyber Physical Systems (CPS), Internet of Things (IoT), Cloud Computing, Machine Learning, and Data Analytics are considered to be the different drivers necessary for the transformation. Industrial Internet of Things (IIoT) is an application of IoT in industries to modify the various existing industrial systems. The aim of this course is to provide an introduction to Manufacturing 4.0, it's major components, processes and technologies and how new products and services will impact business and society.	
Course Pre-requisites (if applicable)	
-	
Approximate Time Needed: 4 hours	
Student Objectives/Learning Outcomes	
Upon completion of this course, learner should be able to: • understand the various stages of industrial revolutions, • understand the future of manufacturing and the new skillset needed, • recognise the drivers, enablers and compelling forces for Manufacturing 4.0's advancement, • identify the role and importance of data and cloud computing in Manufacturing 4.0, • describe how organizations and knowledge workers can better prepare for Manufacturing 4.0.	
Assessment tools	
☐ Project ☐ Mid-term exam	X Final exam ☐ Presentations
Educational Material	To be defined in D2.8

2.5.2 Introduction to Agriculture/Aquaculture 4.0

Course Title: Introduction to Agriculture/Aquaculture 4.0	
Course Code: INDVET2	
Course Summary	
Agriculture/Aquaculture 4.0, as part of the Industry 4.0 paradigm, concerns the transformation of farming processes through the integration of modern technologies such as sensors, communication, and computational processing. Technologies such as Cyber Physical Systems (CPS), Internet of Things (IoT), Cloud Computing, Machine Learning, and Data Analytics are considered to be the different drivers necessary for the transformation. Industrial Internet of Things (IIoT) is an application of IoT in industries to modify the various existing industrial systems. The aim of this course is to provide an introduction to Agriculture/Aquaculture 4.0, its major components, processes and technologies and how new products and services will impact business and society.	
Course Pre-requisites (if applicable)	
-	
Approximate Time Needed: 4 hours	
Student Objectives/Learning Outcomes	
Upon completion of this course, learner should be able to: • understand the various stages of industrial revolutions, • understand the Future of Agriculture/Aquaculture and the skillset needed, • recognise the drivers, enablers and compelling forces for Agriculture/Aquaculture 4.0's advancement, • identify the role and importance of data and cloud computing in Agriculture/Aquaculture 4.0, • describe how organizations and knowledge workers can better prepare for Agriculture/Aquaculture 4.0.	
Assessment tools	
☐ Project ☐ Mid-term exam	X Final exam ☐ Presentations
Educational Material	To be defined in D2.8

2.5.3 Introduction to Pervasive Health/ Health 4.0

Course Title: Introduction to Pervasive Health/ Health 4.0
Course Code: INDVET3
Course Summary
Health 4.0, as part of the Industry 4.0 paradigm, concerns the transformation of health-related processes through the integration of modern technologies such as sensors, communication, and computational processing. Technologies such as Cyber Physical Systems (CPS), Internet of Things (IoT), Cloud Computing, Machine Learning, and Data Analytics are considered to be the different drivers necessary for the transformation. The aim of this course is to provide an introduction to Health 4.0, it's major systems and technologies and how new products and services will impact business and society. Expose the importance of privacy and security of data in healthcare information systems.
Course Pre-requisites (if applicable)
-

Approximate Time Needed: 4 hours	
Student Objectives/Learning Outcomes	
Upon completion of this course, learner should be able to: • understand the various stages of industrial revolutions, • understand the Future of Health 4.0 and the skills needed, • recognise the drivers, enablers and compelling forces for Health 4.0's advancement, • identify the role and importance of data and cloud computing, • understand the importance of privacy and security in Health 4.0 • describe how organizations and knowledge workers can better prepare for Health 4.0.	
Assessment tools	
☐ Project ☐ Mid-term exam	X Final exam ☐ Presentations
Educational Material	To be defined in D2.8