UNIVERSITETI /UNIVERSITY
"ISA BOLETINI"
MITROVICË

Course Curriculum Model (Syllabus)		
Faculty:	**FACULTY OF MECHANICAL AND COMPUTER ENGINEERING**	
Department:	Mechanical Engineering	
Level:	Bachelor	
Code of the course:	312 ME	
Course:	Smart Manufacturing and IIoT	
Course Status:	Elective	Mandatory/**Elective**
Semester:	(VI)	Winter/**Summer**
Number of hours per week:	2+2	
ECTS:	5	
Time / location:	Wednesday, 9^{00}-10^{30}, K5	
Year of studies:	2024/2025	
Lecturer:	Prof. Ass. Dr. Fatmir Azemi	
Assistant:		
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Course description	Smart Manufacturing and IIoT (Industrial Internet of Things) is a course that introduces students to the concept of Industry 4.0 and the technologies that are driving the fourth industrial revolution. The course covers the fundamentals of smart manufacturing, including cyber-physical systems, automation, artificial intelligence, and data analytics. Students will learn how to design, implement and optimize smart manufacturing systems, and understand the role of IIoT in revolutionizing the manufacturing industry. Throughout the course, students will explore the various aspects of Smart Manufacturing and IIoT, including its impact on supply chain management, quality control, and predictive maintenance. They will also learn how to analyze data and extract insights to drive operational efficiency and business performance.
Purpose	The purpose of the Smart Manufacturing and IIoT course is to provide students with a comprehensive understanding of the technologies that are driving the fourth industrial revolution and the impact they have on the manufacturing industry. The course aims to equip students with the necessary skills to design, implement, and optimize smart manufacturing systems using IIoT technologies. The course also seeks to help students understand the importance of data analytics, artificial intelligence, and automation in the manufacturing industry.

Learning outcomes	Upon completion of the course, students should be able to: ● Understand the concepts of Industry 4.0 and the principles of smart manufacturing using IIoT technologies. ● Design and implement smart manufacturing systems using IIoT technologies, and analyze data to drive operational efficiency and improve business performance. ● Understand the impact of smart manufacturing on supply chain management, quality control, and predictive maintenance. ● Develop strategies to improve efficiency, reduce costs, and increase productivity in various industrial settings using smart manufacturing solutions. ● Evaluate smart manufacturing solutions and make recommendations for their adoption in different organizational contexts, and communicate effectively with stakeholders about their benefits.

	Weeks	Lecture
Program	***First week:***	Introduction to Smart Manufacturing and IIoT ● Course overview and syllabus review ● Definition and key concepts of Smart Manufacturing and IIoT ● Overview of the industry and its trends ● Examples of Smart Manufacturing and IIoT applications
	Second week:	Sensors and Data Acquisition ● Types of sensors and their applications in manufacturing ● Sensor networks and data acquisition systems ● Data communication protocols for IIoT
	***Third week*:**	Sensors and Data Acquisition ● Types of sensors and their applications in manufacturing ● Sensor networks and data acquisition systems ● Data communication protocols for IIoT
	Fourth week:	Cybersecurity and Privacy ● Security threats and risks in IIoT ● Cybersecurity solutions for Smart Manufacturing ● Privacy concerns in IIoT and regulations
	Fifth week:	Digital Twin and Simulation ● Concept of Digital Twin in Smart Manufacturing ● Digital Twin architecture and implementation ● Simulation and modeling techniques for Smart Manufacturing
	***Sixth week*:**	Control Systems and Automation ● Industrial control systems and their components ● Programmable Logic Controllers (PLCs) and Human-Machine Interfaces (HMIs) ● Automation and robotics in Smart Manufacturing
	Seventh week:	IIoT Infrastructure and Network Design ● IIoT infrastructure and network design ● Edge computing and fog computing for IIoT ● Cloud-based IIoT platforms
	Eighth week:	IIoT Communication Protocols and Standards ● IIoT communication protocols and standards ● OPC UA, MQTT, and other IIoT protocols ● Interoperability and compatibility issues

	Ninth week:	Industrial Big Data and Analytics ● Industrial Big Data analytics ● Data visualization and dashboard design for IIoT ● Predictive maintenance and optimization with IIoT Big Data
	Tenth week:	IIoT and Manufacturing Operations Management (MOM) ● Manufacturing Operations Management (MOM) and IIoT ● MOM architecture and implementation ● Real-time performance monitoring and optimization with IIoT and MOM
	Eleventh week:	Smart Factory and Industry 4.0 ● Smart Factory and Industry 4.0 concepts and principles ● Smart Factory implementation and technologies ● Case studies of Industry 4.0 implementation in various industries
	Twelfth week:	Supply Chain and Logistics ● Smart logistics and supply chain management ● Real-time tracking and monitoring of inventory and assets ● Predictive maintenance and optimization of logistics processes
	Thirteenth week:	Case Studies and Best Practices ● Case studies of Smart Manufacturing and IIoT implementation in various industries ● Best practices and lessons learned from IIoT implementation ● Guest speaker presentations and discussions
	Fourteenth week:	Future Trends and Challenges ● Future trends and challenges in Smart Manufacturing and IIoT ● Emerging technologies and their potential impact on the industry ● Group project presentations and discussions
	Fifteenth week:	Final Project Presentations and Wrap-up ● Final project presentations and demonstrations ● Course summary and review ● Feedback and evaluation

Literature	
Literature	Books: ● "Smart Manufacturing: An Industry 4.0 Perspective" by Luis Ferreira and Nuno Silva (2018) ● "Industrial Internet of Things: Cybermanufacturing Systems" by Sabina Jeschke, Ingrid Isenhardt, and Frank Hees (2017) ● "Industry 4.0: The Industrial Internet of Things" by Alasdair Gilchrist (2016) ● "The Fourth Industrial Revolution" by Klaus Schwab (2016) ● "Data Analytics for Intelligent Transportation Systems" edited by Mashrur Chowdhury and Mahboobeh Aghajani (2017) Articles: ● "The Future of Manufacturing: Smart Factories and the Fourth Industrial Revolution" by Deloitte University Press (2016) ● "The Industrial Internet of Things (IIoT) and the Future of Manufacturing" by Forbes (2017) ● "Smart Manufacturing: Trends and Opportunities" by McKinsey & Company (2018) ● "The Road to Smart Manufacturing" by Gartner (2018) ● "Big Data Analytics in Manufacturing: A Systematic Mapping Study" by Nader Ale Ebrahim, Shamsuddin Ahmed, and Zahari Taha (2019)

Teaching methodology

The teaching methodology for the Smart Manufacturing and IIoT course may involve a combination of the following:

- Lectures to present key concepts and theories related to Smart Manufacturing and IIoT.
- Discussions to encourage student engagement and participation.
- Case studies to provide practical examples of how Smart Manufacturing and IIoT technologies are being used in the real world.
- Hands-on projects to design, implement, and optimize smart manufacturing systems using IIoT technologies.
- Use of visual aids such as slides and videos to illustrate key points during lectures.
- Critical thinking and problem-solving exercises related to the course content during discussions.
- Opportunity to work with relevant hardware and software tools during hands-on projects.
- Interactive and engaging teaching methodology to enable students to develop the skills and knowledge necessary to succeed in the field.

Contribution to student workload (which should correspond to student learning outcomes - 1 ECTS credit = 25 hours)

Activity	Hours	Days/weeks	Total
Lectures	2	15	30
Exercise sessions (with TA)	2	15	30
Practical work	3	3	9
Office hours	1	15	15
Fieldwork	1	2	2
Midterms, seminars	2	2	4
Homework	3	2	6
Self-study	4	3	12
Final exam preparation	3	3	9
Time spent in exams	2	2	4
Projects, presentations, etc.	2	2	4
Total			**125**

Evaluation

Assessment methodology:

In-class quizzes and exams to assess understanding of theoretical concepts and technical details, such as IIoT architecture, communication protocols, industrial sensors and actuators, data analytics, machine learning, and cybersecurity.

Group projects and presentations to assess students' ability to apply concepts to real-world scenarios, such as designing a smart manufacturing system for a specific industry or solving a manufacturing-related problem using IIoT technologies.

Individual assignments and homework to assess students' problem-solving and critical thinking skills, such as analyzing data from an industrial sensor and using it to predict maintenance needs or detecting anomalies in a production process using machine learning algorithms.

Hands-on lab exercises to assess students' practical skills in using IIoT technologies, such as configuring a sensor network, collecting and analyzing data, and designing and implementing an IIoT application.

Class participation and engagement in discussions, case studies, and industry visits to assess students' understanding and appreciation of the benefits, challenges, and trends in smart manufacturing and IIoT.

Final project or exam to assess students' overall understanding and integration of the course materials, as well as their ability to apply them to real-world scenarios.

(according to the Statute and Regulation for studies of UMIB)

Tests / Colloquia (First Test) (Second test)	15% 15%	
Practical test during exercises (Essay)		
Workshop seminar		
Interpretation and presentation of artistic creativity and other works.		
Assignments and courses during the semester	15%	
Professional practice.		
Other, Continuity		
Final exam	55%	
Total	:	100%
Final grade	Points (%)	Mark
	91 – 100	10
	81 - 90	9
	71 - 80	8
	61 - 70	7
	51 - 60	6

Academic policies	**Criteria for regular attendance and rules of etiquette during the organization of the lesson are set.** **Computer work:** Graphic works, I have to draw and write with a computer. In the works it is obligatory to respect the criteria for both the visual and the content aspect of the required works. **Ethics in teaching:** Graphic works should be personal works of each student. There will be no tolerance for copying, "borrowing" from the Internet or any other material. The same or similar works will have negative evaluations in the final evaluation of the student. **Time:** In agreement with the students, the deadlines for submitting works will be determined. There will be no tolerance for delays in the submission of works. Failure to arrive at the time when the assignment is explained does not justify the student for not submitting the paper. The deadline will be given earlier. If you are going to travel abroad, then you need to submit the paperwork in advance. The student has the right to request a consultation with the professor whenever he / she deems it reasonable and necessary for the performance of his / her work. **Rules of conduct and academic policies:** ● active participation of students in lectures o participation in discussion, comments and free expression of opinion, opinion and academic position (with arguments) ● Mandatory independent work and use of additional sources of information (various scientific websites, scientific journals, conference proceedings, etc.) ● Respecting lecture schedules without compromising academic freedom (silent cell phones) of respecting the word, thoughts and ideas of colleagues, ● It is not allowed to arrive late and leave without a valid reason from the lecture, test or exam o preparation and holding of relevant lectures, (obligation of the teacher). ● if the student is absent more than four times without reason in lectures and exercises, does not receive the signature for attendance. o the student cannot take the exam without an official document, ● if the student is dissatisfied with the grade obtained, has the right to complain in writing to the dean, within two working days after the announcement of the results, UMIB Statute o if the student does not follow the rules, in the exam uses tools that are not allowed, it is evaluated with a negative grade.

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Mitrovicë; 29/04/2023 Prof. Ass. Dr. Fatmir Azemi