Study Plan: Master, Higher Diploma, High specialization		
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1.	School	**School of Engineering**
2.	Department	**Mechatronics Engineering Department**
3.	Program title (Arabic)	**ماجستير هندسة الأنظمة الذكية**
4.	Program title (English)	**M.Sc. Smart Systems Engineering**
5.	Track	**Thesis Track**

	Specialization #	Degree	Dep #	Faculty #	Year	Track
Plan Number	07	M.Sc.	08	09	2023	Thesis

First: General Rules & Conditions

1. This plan conforms to the valid regulations of the graduate studies programs.
2. Specialties of Admission:

- First Priority:
  - B.Sc. in Mechatronics Engineering.
- Second Priority:
  - B.Sc. in Electrical Engineering.
  - B.Sc. in Mechanical Engineering.
- Third Priority:
  - B.Sc. in Other Engineering Specializations.

Second: Special Conditions

The specializations from the second and third priorities will be evaluated by the graduate studies committee at the department. This evaluation will determine if additional undergraduate courses are required for the applicant.

Third: Study Plan - Studying (33) Credit Hours as following

1. Obligatory Courses (15) Credit Hours:

Course No.	Course Title	Credit Hrs.	Theory	Practical	Pre/Co-requisite
0908701	Research Methodology	3	3	-	-
0908702	Mechatronics and System Integration	3	3	-	-
0908703	Machine Learning in Smart Systems Engineering	3	3	-	-
0908704	Advanced System Dynamics	3	3	-	0908702
0908705	Advanced Robotics in Smart Systems Engineering	3	3	-	0908702

2. Elective Courses: Studying (9) Credit hours from the following:

Course No.	Course Title	Credit Hrs.	Theory	Practical	Pre/Co-requisite
0908706	Data Analysis and Measurement Techniques in Smart Systems Engineering	3	3	-	-
0908707	Advanced Materials and Micro-Nano System Integration in Smart Systems Engineering	3	3	-	0908704
0908708	Control Innovations in Intelligent System Design	3	3	-	0908702
0908709	Advanced Cybersecurity in IoT and Sensor Networks	3	3	-	-
0908710	AI-Driven Renewable Energy Systems and Smart Control	3	3	-	0908703
0908711	Smart Bio-Transducer Systems in Healthcare	3	3	-	0908702
0908712	Efficient Manufacturing Systems Design	3	3	-	-
0908713	Advanced Topics in Smart Systems Engineering	3	3	-	0908702

3. M.Sc. Thesis, 0908799; (9) Credit Hours.

Fourth: Course Descriptions

0908601 Research Methodology (3 Credit Hours)

Pre-requisite: -

This course delves into fundamental research methodologies, crucial for students in engineering and technology fields. It focuses on developing skills for formulating precise research questions, conducting thorough literature reviews, and crafting well-structured research proposals. A significant portion of the course is dedicated to understanding the impact and implications of research in rapidly advancing areas like mechatronics and smart systems. Students will learn about experiment design, statistical analysis, and adhering to high standards of safety and ethics in research. The curriculum emphasizes effective communication of research findings, both orally and in writing, essential for academic and professional success. This course also equips students to tackle various challenges in the research process and culminates in a term project where students apply their skills to prepare and present a comprehensive research proposal or report.

0908602 Mechatronics and System Integration (3 Credit Hours)

Pre-requisite: -

The course will provide comprehensive instruction on the design, integration, and analysis of mechatronic systems. Students will gain theoretical and practical knowledge across various mechatronic components and systems. This includes understanding the key aspects of mechatronic systems, such as system integration, sensors, actuation, and control. The curriculum encompasses methodology in mechatronics system design and the process of selecting and integrating hardware components. It also covers software development and programming, in-depth study of sensors, transmissions, and actuators, fundamental principles of control systems, and the application of artificial intelligence. Additionally, students will learn techniques of modeling and real-time simulation. A significant component of the course is a term project, enabling students to apply their learning in a practical setting.

0908603 Machine Learning in Smart Systems Engineering (3 Credit Hours)

Pre-requisite: -

This course integrates machine learning with Smart Systems Engineering, focusing on the application of these algorithms in mechatronic systems. Covering supervised, unsupervised, and reinforcement learning techniques, the curriculum is tailored for smart system applications. Emphasizing practical skills, students will learn to develop, apply, and evaluate machine learning algorithms using Python, with a focus on enhancing the functionality of smart systems. The course includes hands-on exercises and a comprehensive term project, where students will implement machine learning solutions in real-world smart systems scenarios, combining theoretical knowledge with practical application.

0908604 Advanced System Dynamics (3 Credit Hours)

Pre-requisite: 0908702

This course, crucial for understanding modern mechatronics, delves into the modeling and analysis of dynamic systems, culminating in a practical term project. It aims to provide a solid grasp of key concepts and techniques for modeling mechanical, electrical, and hybrid systems. The curriculum encompasses linear and nonlinear systems, both time-invariant and time-variant, as well as deterministic and stochastic approaches. Students will also learn about contemporary computational tools and simulation methods used in dynamic system design and analysis. The course concludes with a term project, where students apply their learned skills to a real-world scenario, showcasing their ability to design, analyze, and improve dynamic systems in mechatronic applications. This project serves to bridge theoretical knowledge with practical application, offering a hands-on experience in solving mechatronic challenges.

0908605 Advanced Robotics in Smart Systems Engineering (3 Credit Hours)

Pre-requisite: 0908702

This course focuses on the advanced aspects of robotics within the context of smart systems engineering. It provides comprehensive coverage of the design, modeling, and control of various robotic systems, including industrial manipulators, mobile robots, humanoid robots, and drones. The curriculum emphasizes key concepts such as kinematics, dynamics, and advanced control strategies, tailored for application in smart systems. Students will work with state-of-the-art simulation tools and actual robotic platforms, gaining practical skills vital for the field. Contemporary topics like collaborative robotics and bio-inspired robotics are also covered, preparing students to confront modern challenges in robotics. The course aims to develop robust problem-solving abilities, enabling students to effectively design and control diverse robotic systems in real-world smart system scenarios.

0908606 Data Analysis and Measurement Techniques in Smart Systems Engineering (3 Credit Hours)

Pre-requisite:

This course focuses on the foundational methods of engineering data collection and analysis, with a particular emphasis on applications in smart systems. Students will learn about advanced sensor technologies, including their interfaces, the functionality of diverse physical sensors, and signal conditioning. The curriculum covers crucial aspects of data handling in engineering, such as dataset importation, data cleaning, preprocessing, visualization, and efficient storage methods. Special attention is given to the application of analytics algorithms on various platforms, specifically addressing the unique data challenges in smart system environments. This course aims to equip students with the skills to effectively measure, analyze, and apply engineering data in the development and optimization of smart systems, ensuring they are prepared for the data-centric demands of modern engineering.

0908607 Advanced Materials and Micro-Nano System Integration in Smart Systems Engineering (3 Credit Hours)

Pre-requisite: 0908704

This course is designed to provide an advanced understanding of the integration of smart materials and micro-nano systems within the context of smart systems engineering. It delves into the unique properties and applications of smart materials such as shape memory alloys, piezoelectric materials, and magnetostrictive materials. The course also offers in-depth insights into nano and micro-scale devices, including their roles as sensors, actuators, and controllers in smart system design. A significant emphasis is placed on both theoretical knowledge and practical skills, enabling students to effectively model and control smart systems utilizing these cutting-edge technologies. This comprehensive approach prepares students to develop highly precise and efficient solutions in the realm of smart systems, incorporating practical learning through laboratory work, simulations, and case studies focused on real-world applications.

0908608 Control Innovations in Intelligent System Design (3 Credit Hours)

Pre-requisite: 0908702

This course offers an in-depth exploration into the design and optimization of intelligent systems, with an emphasis on their roles in smart systems engineering. It links advanced theoretical knowledge with practical application, covering contemporary control theories such as adaptive control, neural networks, fuzzy logic, and evolutionary computing. The curriculum is intentionally designed to focus on the creation of innovative control algorithms and their real-world application in smart systems. A significant aspect of the course is the hands-on experience students gain using the latest software and real-time control systems. This not only provides a robust theoretical base but also enhances practical skills. As a culmination of the learning experience, the course includes a term project. This project allows students to apply their knowledge and skills to develop and optimize an intelligent system solution, simulating a real-world challenge in smart systems engineering. This project is crucial in preparing students to tackle complex situations in the field, ensuring they are well-equipped for professional success.

0908609 Advanced Cybersecurity in IoT and Sensor Networks (3 Credit Hours)

Pre-requisite:

This course is designed to equip students with a comprehensive understanding of cybersecurity within the realm of the Internet of Things (IoT) and sensor networks. Beginning with an introduction to IoT and cyber-physical systems,

the course lays a foundation for understanding the critical role of cybersecurity in this context. It then progresses to explore the core principles of cybersecurity, focusing on the unique challenges and vulnerabilities inherent in IoT environments. Students will learn about various cyber threats and the strategies to mitigate them, with a special emphasis on the use of intelligent agents for effective resource management and system optimization in IoT networks. The curriculum also includes an in-depth look at agent-based modeling, enabling students to predict and analyze system behaviors under different cyber scenarios. Advanced topics cover the development of robust control strategies to safeguard IoT ecosystems. This course is tailored for students looking to deepen their expertise in IoT cybersecurity and develop the necessary skills to navigate the complexities of securing interconnected devices in rapidly evolving cyber-physical systems.

0908610 AI-Driven Renewable Energy Systems and Smart Control (3 Credit Hours)

Pre-requisite: 0908703

This course provides an in-depth look at the intelligent management and control of renewable energy systems, specifically focusing on their integration within smart and micro-grids using Artificial Intelligence (AI) techniques. It covers detailed modeling and control of power electronics converters and electrical machines, tailored for renewable energy applications. Students will delve into advanced strategies for intelligent energy management, exploring how AI can be leveraged to enhance system efficiency and reliability in the context of renewable energy. The curriculum is crafted to offer practical experience with the latest technologies and methodologies in this field, equipping students for specialized roles in designing and optimizing sustainable energy systems. This course aims to bridge the gap between traditional renewable energy concepts and the modern, AI-driven approaches to smart control and management within the field.

0908611 Smart Bio-Transducer Systems in Healthcare (3 Credit Hours)

Pre-requisite: 0908702

Focusing on the application of smart technologies in biomedicine, this course covers the classification and utilization of various bio-transducers based on electrical principles. Students will explore resistive position and pressure transducers, inductive pressure transducers, capacitive pressure transducers, and self-generating inductive transducers like the linear variable differential transformer (LVDT) and Piezoelectric Transducers. The course emphasizes the practical applications of these transducers in crucial health measurements, including heart rate, blood oxygen saturation (SpO2), and blood pressure monitoring. Key topics include the performance characteristics of transducers, signal conditioning circuits, and the implementation of closed-loop control in biomechanical systems. This course aims to equip students with the knowledge and skills to innovate in the field of healthcare, creating advanced, smart bio-transducer systems that enhance patient care and medical efficacy.

0908612 Efficient Manufacturing Systems Design (3 Credit Hours)
Pre-requisite:
This course centers on applying smart systems engineering principles to enhance manufacturing efficiency and innovation. It emphasizes the translation of cutting-edge research into practical, time-saving solutions for industry. Students will learn how advanced methodologies can significantly reduce component production times and streamline assembly processes. The course covers a range of modern manufacturing techniques, including composites, additive manufacturing, and precision machining. A key focus is on practical implementation, showing how these advancements can be integrated into existing production lines without disrupting ongoing operations. The curriculum is designed to equip students with the skills to innovate within their manufacturing environments, making processes faster, more cost-effective, and sustainable. This course captures the essence of bridging the gap between academic research and the real-world challenges of manufacturing, preparing students to be at the forefront of smart manufacturing solutions.

0908613 Advanced Topics in Smart Systems Engineering (3 Credit Hours)
Pre-requisite: 0908702
This course is specifically tailored to address the evolving landscape of Smart Systems, encompassing a wide array of specialized topics in this field. Each iteration of the course will concentrate on the most current issues and advancements as determined by the department, ensuring that the content is both relevant and timely. Students will have the opportunity to immerse themselves in the latest concepts and technologies that are driving innovation in smart systems across various applications. The course is designed with a flexible structure, which allows for the incorporation of the newest industry trends and research breakthroughs. This approach ensures that students are equipped with up-to-date knowledge and practical skills that are critical for navigating and contributing to the ever-changing realm of smart systems.

Inclusion rates in the program:

A. Courses that will be taught on the principle of full online:

- **Research Methodology**
- **Efficient Manufacturing Systems Design**

Total hours that will be taught on the principle of full online in this program: (6 C.H.).
The percentage achieved for the subjects that will be taught on the principle of full online in this program: (15.4%)

B. Subjects to be taught on the blended learning principle:

- **Machine Learning in Smart Systems Engineering**

- **Smart Bio-Transducer Systems in Healthcare**

The total number of hours that will be taught on the principle of blended learning in this program: (6 C.H.)
Percentage achieved for subjects that will be taught on the principle of blended learning in this program: (15.4%)
C. Face-to-face learning courses:
Number of hours of face-to-face education: (24).