| 1. | School | **School of Engineering** |
|----|--------|---------------------------|
| 2. | Department | **Computer Engineering Department** |
| 3. | Program title (Arabic) | ماجستير في الذكاء الاصطناعي والروبوتات |
| 4. | Program title (English) | **M.Sc. in Artificial Intelligence and Robotics** |
| 5. | Track | Thesis Track |

| | Specialization # | Degree | Dep # | Faculty # | Year | Track |
|---|---|---|---|---|---|---|
| Plan Number | 071 | M.Sc. | 07 | 09 | 2021 | Thesis |

**First: General Rules & Conditions:**

1. This plan conforms to the valid regulations of the programs of graduate studies.
2. Specialties of Admission:
   - **First Priority:** BSc in any of the Electrical Engineering specializations (Computer Engineering, Mechatronics Engineering, Electrical Engineering, Biomedical Engineering, Communications Engineering).
   - **Second Priority:** BSc in Engineering Specializations
   - **Third Priority:** BSc in AI, Intelligent Systems, and IT Specializations

**Second: Special Conditions:** The specializations from the second and the third priorities will be evaluated by the graduate studies committee at the department to decide if undergraduate courses should be taken by the applicant if needed.

**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 |
|---|---|---|---|---|---|
| 0907703 | Research Methodology | 3 | 3 | - | - |
| 0907726 | Applied Machine Learning | 3 | 3 | - | - |
| 0907752 | Computer Vision | 3 | 3 | - | 0907726 |
| 0908721 | Robotic Systems | 3 | 3 | - | - |
| 0908722 | Industrial and Applied Robotics | 3 | 3 | - | 0908721 |

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

| Course No. | Course Title | Credit Hrs. | Theory | Practical | Pre/Co-requisite |
|---|---|---|---|---|---|
| 0907725 | Internet of Things Applications | 3 | - | - | - |
| 0907753 | Natural Languages Processing | 3 | - | - | 0907726 |
| 0907754 | Unsupervised Learning | 3 | - | - | 0907726 |
| 0907755 | Reinforcement Learning | 3 | - | - | 0907726 |
| 0907761 | Applied Data Science | 3 | - | - | 0907726 |
| 0908723 | Autonomous Mobile Robots | 3 | - | - | 0907726 & 0908721 |
| 0908725 | Advanced Control Theory | 3 | - | - | 0908721 |
| 0908751 | Advanced Topics in Artificial Intelligence and Robotics | 3 | - | - | 0907726 & 0908721 |

3. M.Sc. Thesis, 0907799; (9) Credit Hours.

## Fourth: Course Descriptions

**0907703**     **Research Methodology**           **(3 Credit Hours)**
**Pre-requisite: -**
This course gives an Introduction to the research process like: Formulating research problems, Asking research questions and finding answers, Making arguments, Writing research arguments, and Ethics of research. Topics in performance evaluation: Selection of evaluation techniques and metrics, Types of workloads and workload selection, Data presentation and ratio games, Summarizing measured data and comparing systems, Introduction to experimental design, and Introduction to simulation and analysis of simulation results. Ethical, safety, and social impact issues related to engineering solutions. This course includes assignments and a term project that focuses on preparing and presenting a research proposal or research report.

**0907725**     **Internet of Things Applications**       **(3 Credit Hours)**
**Pre-requisite: -**
The course starts by reviewing networks and TCP/IP protocol stack. Then, the course will focus on concepts related to IoT including: Defining IoT, Characteristics of IoT, 5G communication and its relation to IoT, Physical design of IoT, Logical design of IoT, Machine to Machine, Industry applications, Surveillance applications, Body Area Networks, Smart Homes, Smart City, and other IoT applications. The course uses active learning techniques to guarantee better engagement from the students. Also, experts from the industry are invited to talk about the practical applications in this domain. This course includes assignments and a practical term project.

**0907726**     **Applied Machine Learning**          **(3 Credit Hours)**
**Pre-requisite: -**
This graduate course concentrates on the application of state-of-the-art AI and machine learning algorithms for solving real-world problems. This course starts with reviewing the Python programming language and its important related packages. The covered topics include data preparation, training, evaluation, metrics, supervised learning (regression, classification, neural networks, deep learning, convolutional neural networks, and recurrent neural networks), basics of unsupervised and reinforcement learning, and recommender systems. The course uses active learning techniques to guarantee better engagement from the students. Also, experts from the industry are invited to talk about the practical applications in this domain. This course includes assignments and a practical term project.

**0907752**     **Computer Vision**               **(3 Credit Hours)**
**Pre-requisite: 0907726**
This course introduces computer vision including fundamentals of image formation, camera imaging geometry, feature detection and matching, stereo, motion estimation and tracking, video processing, image classification and scene understanding. The course focuses on robotics applications and

applications that include finding known models in images, depth recovery from stereo, camera calibration, image stabilization, automated alignment, tracking, boundary detection, and recognition. The course uses active learning techniques to guarantee better engagement from the students. Also, experts from the industry are invited to talk about the practical applications in this domain. This course includes assignments and a practical term.

**0907753     Natural Languages Processing          (3 Credit Hours)**
**Pre-requisite: 0907726**
This course concentrates on computational properties of natural languages. Coreference, question answering, and machine translation. Processing linguistic information. Syntactic and semantic processing. Modern quantitative techniques in NLP. Neural network models for language understanding tasks. The course uses active learning techniques to guarantee better engagement from the students. Also, experts from the industry are invited to talk about the practical applications in this domain. This course includes assignments and a practical term project.

**0907754     Unsupervised Learning          (3 Credit Hours)**
**Pre-requisite: 0907726**
This is a graduate-level course in unsupervised machine learning. This course covers classical and modern techniques for solving problems in machine learning beyond traditional supervised learning, including fitting statistical models, dimensionality reduction, clustering, anomaly detection, density estimation, and exploratory data analysis and visualization. The course uses active learning techniques to guarantee better engagement from the students. Also, experts from the industry are invited to talk about the practical applications in this domain. This course includes assignments and a practical term project.

**0907755     Reinforcement Learning          (3 Credit Hours)**
**Pre-requisite: 0907726**
The course is about prediction and control using reinforcement learning, including aspects of deep reinforcement learning, i.e., the application of neural networks-based functional approximation to reinforcement learning problems. The course covers theory and applications related to the following topics: Markov decision processes. Value function approximation. Policy gradient methods, Actor-critic algorithms. Integration of Learning and Planning. Exploration vs exploitation trade-offs. The course uses active learning techniques to guarantee better engagement from the students. Also, experts from the industry are invited to talk about the practical applications in this domain. This course includes assignments and a practical term project.

**0907761     Applied Data Science          (3 Credit Hours)**
**Pre-requisite: 0907726**
This is a graduate-level course in applied data science. The course covers the

basic definitions, concepts and skills in data science including importing datasets, data cleaning and preprocessing, data visualization and summarization, building predictive and regression models, and designing data pipelines for real-life problems. The course uses active learning techniques to guarantee better engagement from the students. Also, experts from the industry are invited to talk about the practical applications in this domain. This course includes assignments and a practical term project.

**0908721**     **Robotic Systems:**                                **(3 Credit Hours)**
**Pre-requisite: -**
This course introduces students to the fundamentals of robotic systems including kinematics and dynamics as applied to manipulators and mobile robots. It also describes the operation and application of a range of sensors and how they can be applied to a mobile or static robot system. The theory of motion control systems and how they are applied in robotics are also introduced in addition to many types of actuators and drive systems. The course uses active learning techniques to guarantee better engagement from the students. Also, experts from the industry are invited to talk about the practical applications in this domain. This course includes assignments and a practical term project.

**0908722**     **Industrial and Applied Robots**                  **(3 Credit Hours)**
**Pre-requisite: 0908721**
Introduction to robotic manipulator arms; types of joints; number of degrees of freedom; the concept of a workspace; forward kinematics; inverse kinematics; Jacobian; dynamics; simulation of robotic manipulator arms using robotics toolbox; examination of real robots from commercial companies; applications in the industry (e.g., palletizing, welding, spraying, and picking fruits). The course uses active learning techniques to guarantee better engagement from the students. Also, experts from the industry are invited to talk about the practical applications in this domain. This course includes assignments and a practical term project.
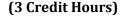
**0908723**     **Autonomous Mobile Robots**                      **(3 Credit Hours)**
**Pre-requisite: 0907726 & 0908721**
This course begins with the most important mechanisms that enable locomotion. The course then proceeds to mobile robot kinematics by applying principles of kinematics to the whole robot. The challenge of perception, mobile robot localization, and planning and navigation are also discussed. The course also covers intelligent agents, autonomous agents, autonomous robots, intelligent robots and the fine line between intelligent agents and autonomous robots. The course uses active learning techniques to guarantee better engagement from the students. Also, experts from the industry are invited to talk about the practical applications in this domain. This course includes assignments and a practical term project.

**0908725**     **Advanced Control Theory**                       **(3 Credit Hours)**
**Pre-requisite: 0908721**

This course aims to provide the basic theory required for solving complex control problems. Concepts and techniques of linear and nonlinear control system analysis and synthesis will be studied. The role of feedback in control will be reinforced, alongside the role of optimization techniques. The course uses active learning techniques to guarantee better engagement from the students. Also, experts from the industry are invited to talk about the practical applications in this domain. This course includes assignments and a practical term project.

**0908751**     **Advanced Topics in Artificial Intelligence and Robotics**     **(3 Credit Hours)**
**Pre-requisite: 0907726 and 0908721**
Topics of special interest in current Artificial Intelligence and/or Robotics issues. The department at every course offering specifies the course description.