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| QF01/0408-4.0E | Course Plan for Bachelor program - Study Plan Development and Updating Procedures/<br>Artificial Intelligence Department |
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|----------------|--|---|--|
| Study plan No. | 2021/2022  | University Specialization   | Artificial Intelligence  |
| Course No.     | 0142431  | Course name   | Location based systems   |
| Credit Hours   | 3 hours  | Prerequisite Co-requisite   | Introduction to artificial intelligence  |
| Course type    | <input type="checkbox"/> MANDATORY UNIVERSITY REQUIREMENT<br><input type="checkbox"/> UNIVERSITY ELECTIVE REQUIREMENTS | <input type="checkbox"/> FACULTY MANDATORY REQUIREMENT<br><input type="checkbox"/> Support course family requirements | <input type="checkbox"/> Mandatory requirements<br><input checked="" type="checkbox"/> Elective requirements |
| Teaching style | <input type="checkbox"/> Full online learning  | <input checked="" type="checkbox"/> Blended learning  | <input type="checkbox"/> Traditional learning  |
| Teaching model | <input type="checkbox"/> 2 Synchronous: 1asynchronous  | <input checked="" type="checkbox"/> 2 face to face : 1synchronous   | <input type="checkbox"/> 3 Traditional   |

Faculty member and study divisions' information (to be filled in each semester by the subject instructor)

| Name                           | Academic rank | Office No. | Phone No.          | E-mail         |                |
|--------------------------------|---------------|------------|--------------------|----------------|----------------|
| To be filled by the instructor |               |            |                    |                |                |
|                                |               |            |                    |                |                |
| Division number                | Time          | Place      | Number of students | Teaching style | Approved model |
| To be filled by the instructor |               |            |                    |                |                |
|                                |               |            |                    |                |                |
|                                |               |            |                    |                |                |

Brief description

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| The main objective of this course is to highlight the importance of accurate positioning and provide an understanding of the different technologies used to achieve this. The focus of this course is on location-based services, their applications in cellular networks. |
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Learning resources

|   |  |                               |  |                                 |  |
|---|--|-------------------------------|--|---------------------------------|--|
| Course book information (Title, author, date of issue, publisher ... etc)                     | Adrián Cardalda García Stefan Maier and Abhay Phillips, Location-Based Services in Cellular Networks from GSM to 5G NR, ARTECH HOUSE, 2020   |                               |  |                                 |  |
| Supportive learning resources (Books, databases, periodicals, software, applications, others) | 1. Hassan A. Karimi, "Advanced Location-Based Technologies and Services", CRC Press, 2016<br>2. Miguel A. Labrador, Alfredo J. Perez, Pedro M. Wightman, Computer & Information Science Series Location-Based Information Systems: Developing Real-Time Tracking Application, Chapman & Hall/CRC, 2010 |                               |  |                                 |  |
| Supporting websites   |  |                               |  |                                 |  |
| The physical environment for teaching   | <input checked="" type="checkbox"/> Class room   | <input type="checkbox"/> labs | Virtual <input checked="" type="checkbox"/> educational platform | <input type="checkbox"/> Others |  |
| Supporting people with special needs  | -----  |                               |  |                                 |  |
| For technical support   | -----  |                               |  |                                 |  |

Course learning outcomes (S= Skills, C= Competences K= Knowledge,)

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| No.                | Course learning outcomes   | The associated program learning output code |
|--------------------|--|---|
| <b>Knowledge</b>   |  |   |
| K1                 | Understand positioning fundamentals.   | MK4   |
| K2                 | Understand the applications of positioning to cellular networks both for emergency services and commercial use cases.          | MK4   |
| K3                 | Understand the different localization technologies.  | MK4   |
| <b>Skills</b>      |  |   |
| S1                 | Positioning Overview, Applications, and Use Cases  | MS2   |
| S2                 | Positioning Technologies   | MS2   |
| <b>Competences</b> |  |   |
| C1                 | Have clear picture of the process initiated between a mobile phone and the cellular network related to a localization session. | MC1   |
| C2                 | Have a clear understanding of the different technologies and algorithms involved related to LBS.                               | MC1   |

#### Mechanisms for direct evaluation of learning outcomes

| Type of assessment / learning style    | Fully electronic learning | Blended learning | Traditional Learning (Theory Learning) | Traditional Learning (Practical Learning) |
|--|---------------------------|------------------|--|---|
| First exam                             | 0                         | 0                | %20                                    | 0   |
| Second / midterm exam                  | %30                       | %30              | %20                                    | 30%                                       |
| Participation / practical applications | 0                         | 0                | 10                                     | 30%                                       |
| Asynchronous interactive activities    | %30                       | %30              | 0                                      | 0   |
| final exam                             | %40                       | %40              | %50                                    | 40%                                       |

**Note:** Asynchronous interactive activities are activities, tasks, projects, assignments, research, studies, projects, and work within student groups ... etc, which the student carries out on his own, through the virtual platform without a direct encounter with the subject teacher.

#### Schedule of simultaneous / face-to-face encounters and their topics

| Week | Subject   | learning style* | Reference ** |
|------|---|-----------------|--------------|
| 1    | Introduction to Positioning in Cellular Networks        | Lectures        | 1-19         |
| 2    | Positioning Fundamentals                                | Lectures        | 21-45        |
| 3    | Positioning Fundamentals                                | Lectures        | 21-45        |
| 4    | Regulatory Positioning Requirements                     | Lectures        | 47-69        |
| 5    | Regulatory Positioning Requirements                     | Lectures        | 47-69        |
| 6    | Commercial Location-Based Services in LTE               | Lectures        | 71-95        |
| 7    | Commercial Location-Based Services in LTE               | Lectures        | 71-95        |
| 8    | <b>Midterm Exam</b><br>The Evolution of LBS for 5G      | Lectures        | 97-126       |
| 9    | The Evolution of LBS for 5G                             | Lectures        | 97-126       |
| 10   | Assisted GNSS   | Lectures        | 131-169      |
| 11   | Assisted GNSS   | Lectures        | 131-169      |
| 12   | High-Precision GNSS in 5G                               | Lectures        | 171-196      |
| 13   | High-Precision GNSS in 5G                               | Lectures        | 171-196      |
| 14   | Terrestrial Positioning Technologies: Cellular Networks | Lectures        | 197-237      |
| 15   | Terrestrial Positioning Technologies: Cellular Networks | Lectures        | 197-237      |
| 16   | <b>Final Exam</b>                                       |                 |              |

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\* Learning styles: Lecture, flipped learning, learning through projects, learning through problem solving, participatory learning ... etc.

\*\* Reference: Pages in a book, database, recorded lecture, content on the e-learning platform, video, website ... etc.

**Schedule of asynchronous interactive activities (in the case of e-learning and blended learning)**

| Week | Task / activity                                   | Reference            | Expected results   |
|------|---|----------------------|--|
| 1    | Self-Reading: History of Navigation               | Chapter 1: Text book | Being able to present this topic.                                    |
| 2    | Comparison between positioning measurements       | Chapter 1: Text book | Understand the difference between different positioning measurements |
| 3    | Self- Reading Positioning Concepts                | Chapter 2: Text book | Being able to present this topic.                                    |
| 4    | Homework on Advanced Mobile Location              | elearning.zuj.edu.jo | Being able to present this topic.                                    |
| 5    | Self- Reading : ELS and other AML Enhancements    | Chapter 3: Text book | Being able to present this topic.                                    |
| 6    | HW : LTE Commercial LBS Applications              | elearning.zuj.edu.jo | Present examples   |
| 7    | Solving a work sheet on previous topics           | elearning.zuj.edu.jo | Self-check before exam   |
| 8    | <b>Mid Exam Estimated + Revision</b>              |                      |  |
| 9    | HW: The Evolution of LBS for 5G                   | elearning.zuj.edu.jo | Present selected topics  |
| 10   | HW: GPS to Multi-GNSS                             | elearning.zuj.edu.jo | Compare between GPS and GNSS   |
| 11   | Self- Reading : Terrestrial Technologies and IMUs | Chapter 6: Text book | Being able to present this topic.                                    |
| 12   | HW: Network-RTK                                   | elearning.zuj.edu.jo | Define RTK   |
| 13   | HW: PPP-RTK                                       | elearning.zuj.edu.jo | Define PPP-PTK   |
| 14   | Final Summary                                     | Text Book            | To present a final summary   |