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|----------------------------------------|--------------------------------------------------------|---------------------------------------------|
| <b>Form:</b><br><b>Course Syllabus</b> | <b>Form Number</b>                                     |                                             |
|                                        | <b>Issue Number and Date</b>                           | <u>2/3/24/2022/2963</u><br><u>5/12/2022</u> |
|                                        | <b>Number and Date of Revision or Modification</b>     |                                             |
|                                        | <b>Deans Council Approval Decision Number</b>          |                                             |
|                                        | <b>The Date of the Deans Council Approval Decision</b> |                                             |
|                                        | <b>Number of Pages</b>                                 | 01                                          |

|     |                                                      |                                                                                                                                                                                     |  |
|-----|------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| 1.  | Course title                                         | Knowledge Representation and Reasoning                                                                                                                                              |  |
| 2.  | Course number                                        | 1905221                                                                                                                                                                             |  |
| 3.  | Credit hours                                         | 3 Credit Hours                                                                                                                                                                      |  |
|     | Contact hours (theory, practical)                    | 3 theory                                                                                                                                                                            |  |
| 4.  | Prerequisites/co-requisites                          | Introduction to Artificial Intelligence - 1 (1905120)                                                                                                                               |  |
| 5.  | Program title                                        | Artificial intelligence                                                                                                                                                             |  |
| 6.  | Program code                                         | 5                                                                                                                                                                                   |  |
| 7.  | Awarding institution                                 | The university of Jordan                                                                                                                                                            |  |
| 8.  | School                                               | King Abdullah II School for Information Technology                                                                                                                                  |  |
| 9.  | Department                                           | Artificial Intelligence Department                                                                                                                                                  |  |
| 10. | Course level                                         | Undergraduate                                                                                                                                                                       |  |
| 11. | Year of study and semester (s)                       | Spring 2022/2023                                                                                                                                                                    |  |
| 12. | Other department (s) involved in teaching the course | None                                                                                                                                                                                |  |
| 13. | Main teaching language                               | English                                                                                                                                                                             |  |
| 14. | Delivery method                                      | <input checked="" type="checkbox"/> Face to face learning <input type="checkbox"/> Blended <input type="checkbox"/> Fully online                                                    |  |
| 15. | Online platforms(s)                                  | <input checked="" type="checkbox"/> Moodle <input type="checkbox"/> Microsoft Teams <input type="checkbox"/> Skype <input type="checkbox"/> Zoom<br><input type="checkbox"/> Others |  |
| 16. | Issuing/Revision Date                                | October, 2025                                                                                                                                                                       |  |

**17. Course Coordinator:**

Name: Nadim Obeid

Contact hours: Mon-Wed; 11:30-1:00

Office number: 207

Phone number: 0777631838

Email: obein@ju.edu.jo

**18. Other instructors:**

Name:

Office number:

Phone number:

Email:

Contact hours:

**19. Course Description:**

In this course we discuss the formalization of knowledge and its processing within machines. We shall show how to design and develop computer systems (*Knowledge-based systems*) that can draw conclusions (using reasoning), similar to human reasoning where knowledge is represented in a machine-interpretable form. We shall examine many knowledge representation formalisms such as rule systems, classical logic (Natural Deduction and Resolution proofs) and (Ontology)description logic. We shall also show how to deal incomplete information using defeasible reasoning.

**20. Course aims and outcomes:****A- Aims:**

The aim of the course is to enable students to solve problems using explicit knowledge and reasoning. Students will be able to express and reason about knowledge of a simple domain using an appropriate formalism such as rules, first order predicate calculus and/or ontology.

Upon completion of the course, students are expected to be able to:

1. Understand key knowledge representation formalisms.
2. Perform simple proofs in a knowledge representation formalism.
3. Express knowledge of a domain in a suitable knowledge representation formalism

**B- Students Learning Outcomes (SOs):****Aims:**

The aim of the course is to enable students to solve problems using explicit knowledge and reasoning. Students will be able to express and reason about knowledge of a simple domain using an appropriate formalism such as rules, first order predicate calculus and/or ontology.

**Intended Learning Outcomes (ILOs):**

Upon successful completion of this course students will be able to:

**A-Knowledge and Understanding (students should)**

- A-1: have some understanding of propositional calculus, first order predicate logic and rule-based systems
- A-3: have some understanding of other knowledge formalisms such as ontologies and semantic networks.
- A-4: have some understanding of reasoning with incomplete information.

**B-Intellectual skills-with ability to**

- B-1: Decide the suitability of KR formalisms for a problem/domain.
- B-2: Appreciate the importance of model-theory and proof theory of logic systems
- B-3: Appreciate the importance of the notions of soundness and completeness of inference systems

**C- Practical Skills-With ability to**

- C-1: perform simple logic proofs using resolution.
- C-2: Express knowledge of a domain in a suitable knowledge representation formalism.

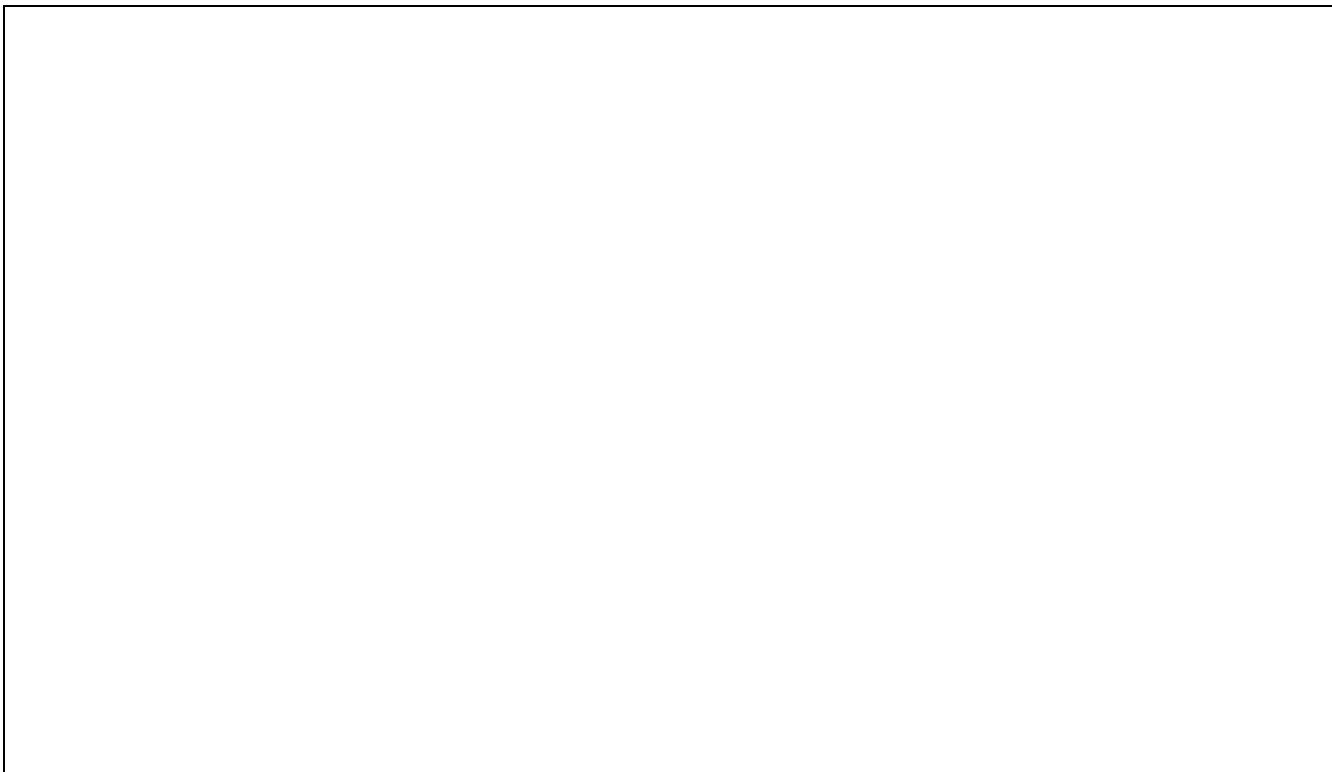
**D-Transferable Skills-With ability to**

- D-1: Deploy communication skills.
- D-2; Work effectively within a group to analyze, design and implement a KBS.
- D-3: effectively present the final work in a demo.

|                |        |        |        |
|----------------|--------|--------|--------|
| Program<br>SOs | SO (1) | SO (2) | SO (3) |
|----------------|--------|--------|--------|



| ILOs of the course                                                                                   |   |   |  |   |
|------------------------------------------------------------------------------------------------------|---|---|--|---|
| A-1: have some understanding of propositional calculus, first order predicate logic and rule systems | √ |   |  |   |
| A-2: have some understanding of other knowledge formalisms such as ontologies and semantic networks  | √ |   |  |   |
| A-3: have some understanding of reasoning with incomplete information                                | √ |   |  |   |
|                                                                                                      |   |   |  |   |
|                                                                                                      |   |   |  |   |
| B-1: Decide the suitability of KR formalisms for a problem/domain.                                   | √ |   |  |   |
| B-2: Appreciate the importance of model-theory and proof theory of logic systems                     | √ |   |  |   |
| B-3: Appreciate the importance of the notions of soundness and completeness of inference systems.    | √ |   |  |   |
| C-1: perform simple logic proofs using resolution.                                                   |   | √ |  |   |
| C-2: Express knowledge of a domain in a suitable knowledge representation formalism.                 |   | √ |  |   |
|                                                                                                      |   |   |  |   |
| D-1: Deploy communication skills.                                                                    | √ |   |  | √ |
| D-2: Work effectively within a group to analyze, understand an AI t system.                          |   |   |  | √ |
| D-3: Present the final work (Project) and make demo.                                                 |   |   |  | √ |
| D-3: Effectively present the final work (Project)                                                    |   |   |  | √ |



**21. Topic Outline and Schedule:**



| Topic                                                                                                                  | Week    | ILOs               | ABET SOs | Instructor  | TLA (teaching, learning and Assessment)                                                          |
|------------------------------------------------------------------------------------------------------------------------|---------|--------------------|----------|-------------|--------------------------------------------------------------------------------------------------|
| - Welcome and Orientation<br><br>- Introduction to artificial intelligence (concepts, research areas and applications) | 1 and 2 | B1, B2, B3         | 1        | Nadim Obeid | Synchronous lecture (MS-Teams)<br>Luger's book + Available Notes<br>Homeworks, Discussion, Exams |
| - Propositional calculus and first order predicate logic.<br>- Translation between logic and natural language texts    | 3-6     | A1, C1, C3         | 1,2      | Nadim Obeid | Synchronous lecture (MS-Teams)<br>Luger's book + Available Notes<br>Homeworks, Discussion, Exams |
| Programming in Prolog                                                                                                  | 7-9     | A2, C1, C2, C3     | 1,2      | Nadim Obeid | As above                                                                                         |
| Blind and heuristic search techniques                                                                                  | 10-12   | A4, B1, B2, B3, B4 | 1        | Nadim Obeid | As above                                                                                         |
| Production Systems                                                                                                     | 13      | A1, B1, B2, C3     | 1        | Nadim Obeid | As above                                                                                         |
| architecture of Expert systems                                                                                         | 14      | B1, B2, B3, B4     | 1        | Nadim Obeid | As above                                                                                         |
| Rule-based vs Model based reasoning                                                                                    | 15      | B1, B2, B3, B4     | 1        | Nadim Obeid | As above                                                                                         |
| Revision + Discussions                                                                                                 | 16      |                    | 3        | Nadim Obeid | As above                                                                                         |
|                                                                                                                        |         |                    |          |             |                                                                                                  |
|                                                                                                                        |         |                    |          |             |                                                                                                  |

(Please mention instructors per topic if the course topics are being taught by more than one instructor)

## 22. Evaluation Methods:

Opportunities to demonstrate achievement of the SLOs are provided through the following assessment methods and requirements:



| Evaluation Activity      | Mark      | Topic(s)                                | SOs   | Period (Week) | Platform   |
|--------------------------|-----------|-----------------------------------------|-------|---------------|------------|
| Final                    | 16        | Knowledge of KR formalisms + proofs     | 1,2,3 | 16            |            |
|                          |           |                                         |       |               |            |
|                          |           |                                         |       |               |            |
|                          |           |                                         |       |               |            |
|                          |           |                                         |       |               |            |
| <b>Total (Term work)</b> | <b>15</b> |                                         |       |               |            |
| Project                  | <b>20</b> | Study of a KR formalism                 | 1,3   | 13            | E-learning |
| Midterm                  | <b>30</b> | Proofs in Classical Logic               | 1,2   | 8             | E-learning |
| Final Exam               | <b>50</b> | Description logic, defeasible reasoning | 1,2   | 16            | E-learning |

### 23. Course Requirements

- Mobile, Laptop or desktop computers
- Internet connection
- Prolog System
- Account on Microsoft Teams + Moodle.
- Webcam (when needed)

### 24. Course Policies:

**A- Attendance policies:** Every student is expected to attend all classes

**B- Absences from exams and submitting assignments on time:** Absence from exams is handled according to the University of Jordan's regulations. Students should completely adhere to the assignments and project strict deadlines, absolutely no exceptions will be given.

**C- Health and safety procedures:** Following standard policies and procedures of computer labs.

**D- Honesty policy regarding cheating, plagiarism, misbehavior:** all violations to the code of conduct of the University of Jordan is unacceptable and will be punished with an F for the full course.

**E- Grading policy:** grading is treated as follows:

#### 1. Written Reports:



- organization, clarity and continuity.
- quality, completeness and soundness of the analysis

## 2. Assignments:

- On-time submission
- authenticity

F- **Available university services that support achievement in the course:** computer labs, personal computers, internet connection, Microsoft products (Office 2016, Office 365, Windows 10)

## 25. References:

A- Ronald J. Brachman Hector J. Levesque, Knowledge Representation and Reasoning, 2004.

B- Recommended books, materials, and media:

### B- Recommended books, materials, and media:

Notes are provided

### A- Educational Platforms:

1. Elearning.ju.edu.jo
2. <http://teams.office.com/>
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## 26. Additional information:

- Students are encouraged to make heavy use of the library, E-LIBRARY <http://ezlibrary.ju.edu.jo/login> or from within the university using (<http://e-library>)
- Students are encouraged to search for articles related to the material contents discussed during this course.
- University regulations will be preserved at all times

Name of Course Coordinator: Nadim Obeid \_Signature:

Date: March-2023

Head of Curriculum Committee/Department: -----Signature: -----



Head of Department: -----Signature: -----

Head of Curriculum Committee/Faculty: -----Signature: -----

Dean: -----Signature: -----