QF01/0408-4.0E	Course Plan for Bachelor program - Study Plan Development and Updating Procedures/ Artificial Intelligence Department

Study plan No.	**2021/2022**		**University Specialization**	Artificial Intelligence	
Course No.	**0142231**		**Course name**	Principles of Artificial Intelligence	
Credit Hours	**3**		**Prerequisite Co-requisite**	Introduction to Information Technology	
Course type	☐ MANDATORY UNIVERSITY REQUIREMENT	☐ UNIVERSITY ELECTIVE REQUIREMENTS	☐ FACULTY MANDATORY REQUIREMENT	☐ Support course family requirements	☐ Mandatory requirements ✓Elective requirements
Teaching style	☐ Full online learning		☐ Blended learning	Traditional learning	
Teaching model	☐ **2Synchronous: 1asynchronous**		☐ **2 face to face : 1synchronous**	**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	
Division number	**Time**	**Place**	**Number of students**	**Teaching style**	**Approved model**

Brief description

This course aims to give an introduction to artificial intelligence, symbolic logic and its uses in knowledge representation, control methods, discretionary research methods, and applications of artificial intelligence (expert systems, natural language processing, robotics...). Introduction to Neural Networks, Genetic Algorithm, and Introduction to Machine Learning.

Learning resources

Course book information (Title, author, date of issue, publisher ... etc)	1- George F. Luger. Artificial Intelligence: Structures and Strategies for Complex Problem Solving: Addison-Wesley, latest edition. ISBN 0-201-64866-0 2- Artificial Intelligence: Building Intelligent Systems. (1st edition) by P. Kulkarni and P. Joshi, PHI Learning Private Limited, 2015. ISBN: 978-81-203-5046-5
Supportive learning resources (Books, databases, periodicals, software, applications, others)	**1-** Russell and Norvig, Artificial Intelligence: A Modern Approach, 3rd edition, Pearson Education, Inc., Prentice-Hall-Series, 2010. **2-** Jeff Heaton, Artificial Intelligence for Humans, Volume.1,

	Fundamental Algorithms, Kindle Edition, 2013. **3-** Alan Mackworth and David Poole, Artificial Intelligence: Foundations of Computational Agents, Cambridge Canada Press, 2010. **4-** Robots Are People Too: How Siri, Google Car, and Artificial Intelligence Will Force Us to Change Our Laws by John F. Weaver. Praeger,Nov. 2013. ISBN: 1440829462, 9781440829468.
Supporting websites	1. Artificial Intelligence Applications Institute (AIAI) http://www.aiai.ed.ac.uk 2.
The physical environment for teaching	Class room ☐ labs ☐ Virtual educational platform ☐ Others
Necessary equipment and software	PROLOG, JAVA, PYTHON
Supporting people with special needs	
For technical support	

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

No.	Course learning outcomes	The associated program learning output code
	Knowledge	
K1	**1.** Identify and apply knowledge representation formalisms with emphasis on propositional and predicate calculus but also with conceptual graphs, including representation of uncertainty	**MK1**
K2	**2.** Analyse problems as state space graphs, and apply heuristic state space searches including planning using Prolog or Lisp.	**MK2**
K3	**3.1** Understanding the concepts of production systems. **3.2** Learning the main components of production systems.	**MK3**
K4	**4.1** Learning the concepts of PROLOG language. **4.2** Learning the statements, rules and queries of Prolog language.	**MK4**
K5	**5.1** Learning the concepts of expert systems and applications. **5.2** Learning the concepts of Knowledge Based Systems. **5.3** Learning the concepts of machine learning.	**MK5**
K6	**6.** Evaluate a state space search algorithm in terms of admissibility, monotonicity, and informedness.	**MK6**
K7	**7.** Analyze and evaluate expert systems.	**MK7**
K8	**8.** Identify learning techniques: symbol based (supervised and unsupervised), reinforcement, neural networks, and genetic algorithms	**MK8**
K9	**9.** Analyse the main approaches to natural language processing	**MK9**
	Skills	
S1	**Knowledge and its application.** Demonstrate and apply critical understanding of the artificial intelligence (AI) principles.	**MS1**
S2	**Research skills.** Gain skills how to synthesize and apply theoretical knowledge of AI.	**MS2**

S3	**Special abilities.** Be able to analyze the organizational capability to innovate and provide recommendations from an AI perspective.	**MS3**
S4	**Social abilities.** Adhere to the principles of professional ethics and citizenship participating in discussions on relevant academic issues. Be able to lead the team and be accountable for its performance.	**MS4**
S5	**Personal abilities.** Develop personal and professional abilities, critical thinking, and creativity.	**MS5**
	Competences	
C1	Use programming languages	**MC1**
C2	Solve computer problems with Math	**MC2**
C3	Exploit the principle of object-oriented programming	**MC3**
C4	Develop transactional web applications	**MC4**
C5	Develop game or simulation applications	**MC5**

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				
Second / midterm exam			%30	
Participation / practical applications			20	
Asynchronous interactive activities			0	
final exam			%50	

Note: Asynchronous interactive activities are activities, tasks, projects, assignments, research, studies, projects, 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	**AI: HISTORY AND APPLICATIONS** **1.1. Attitudes toward Intelligence, Knowledge, and Human Artifice** **1.2. Overview of AI Application Areas** **1.3. Artificial Intelligence: An Attempted Definition**	• **Classroom lectures, discussions, and review of theoretical concepts. Laboratory practical sessions.** • **slides**	**George F. Luger. Artificial Intelligence: Structures and Strategies for Complex Problem Solving.**
2	**2. THE PREDICATE**	• **Classroom lectures,**	**George F. Luger.**

	CALCULUS 2.1. The Propositional Calculus 2.2. The Predicate Calculus 2.3. Using Inference Rules to Produce Predicate Calculus Expressions	discussions, and review of theoretical concepts. Laboratory practical sessions. • slides	Artificial Intelligence: Structures and Strategies for Complex Problem Solving
3	1. STRUCTURES AND STRATEGIES FOR STATE SPACE SEARCHES 3.1. Graph Theory 3.1.1. Structures for State Space Searches 3.1.2. State Space Representations of Problems 3.2. Strategies for State Space Searches 3.2.1. Data-Driven and Goal-Driven Searches 3.2.2. Depth-First and Breadth-First Searches 3.3. Using the State Space to Represent Reasoning 3.3.1. State Space Descriptions of a Logical System 3.3.2. And/Or Graphs	• Classroom lectures, discussions, and review of theoretical concepts. Laboratory practical sessions. • slides	George F. Luger. Artificial Intelligence: Structures and Strategies for Complex Problem Solving
4	4. HEURISTIC SEARCHES 4.1. "Best-First" Searches 4.2. Heuristic Searches and Expert Systems 4.3. Admissibility, Monotonicity, Informedness 4.4. Heuristics in Games 4.4.1. The Minimax Procedure 4.4.2. The Alpha-Beta Procedure 4.5. Complexity Issues	• Classroom lectures, discussions, and review of theoretical concepts. Laboratory practical sessions. • slides	George F. Luger. Artificial Intelligence: Structures and Strategies for Complex Problem Solving
5	Revision Midterm exam 30%		
6	5. CONTROL AND IMPLEMENTATION OF STATE SPACE SEARCHES 5.1. Recursion-Based Searches 5.2. Pattern-Directed Searches 5.3. Production Systems	• Classroom lectures, discussions, and review of theoretical concepts. Laboratory practical sessions. • slides	George F. Luger. Artificial Intelligence: Structures and Strategies for Complex Problem

	5.4. The Blackboard Architecture for Problem Solving		**Solving**
7	**6. KNOWLEDGE REPRESENTATION** **6.1. AI Representational Schemes** **6.1.1. Semantic Networks** **6.1.2. Scripts, Frames 6.2. Conceptual Graphs 6.2.1. Types, Individuals, and Names** **6.2.2. The Type Hierarchy** **6.2.3. Generalization and Specialization** **6.2.4. Propositional Nodes** **6.2.5. Logic** **6.3. Alternatives to Explicit Representation** **6.4. Agent-Based and Distributed Problem Solving**	• **Classroom lectures, discussions, and review of theoretical concepts. Laboratory practical sessions.** • **slides**	**George F. Luger. Artificial Intelligence: Structures and Strategies for Complex Problem Solving**
8	**7. STRONG METHOD PROBLEM SOLVING** **7.1. Expert Systems Technology** **7.2. Rule-Based Expert Systems** **7.2.1. Goal-Driven and Data-Driven Reasoning 7.2.2. Heuristics and Control** **7.3. Model-Based, Case-Based, and Hybrid Systems 7.4. Planning**	• **Classroom lectures, discussions, and review of theoretical concepts. Laboratory practical sessions.** • **slides**	**George F. Luger. Artificial Intelligence: Structures and Strategies for Complex Problem Solving**
9	**8. REASONING UNDER UNCERTAINTY** **8.1. Logic-Based Abductive Inferences** **8.2. Abduction: Alternatives to Logic** **8.2.1. The Stanford Certainty Factor** **8.2.2. Fuzzy Sets** **8.2.3. The Dempster-Shafer Theory of Evidence 8.3. The Stochastic Approach to Uncertainty**	• **Classroom lectures, discussions, and review of theoretical concepts. Laboratory practical sessions.** • **slides**	**George F. Luger. Artificial Intelligence: Structures and Strategies for Complex Problem Solving** **Artificial Intelligence: Building Intelligent Systems.**
10	**9. LANGUAGES AND**	• **Classroom lectures,**	**George F. Luger.**

	PROGRAMMING TECHNIQUES FOR ARTIFICIAL INTELLIGENCE **9.1. Prolog Implementation** **9.1.1. Syntax for Predicate Calculus Programming** **9.1.2. Lists and Recursions** **9.1.3. Search Controls** **9.1.4. Abstract Data Types** **9.2. LISP Implementation (Overview)**	**discussions, and review of theoretical concepts. Laboratory practical sessions.** • **slides**	**Artificial Intelligence: Structures and Strategies for Complex Problem Solving** **Artificial Intelligence: Building Intelligent Systems.**
11	**10. UNDERSTANDING NATURAL LANGUAGE 10.1. Deconstructing Language** **10.2. Syntax** **10.2.1. Specification and Parsing Using Context-Free Grammars** **10.2.2. Transition Network Parsers** **10.2.3. The Chomsky Hierarchy and Context-Sensitive Grammars** **10.2.4. ATN Parsers** **10.3. Stochastic Tools for Language Analysis (Overview)** **10.4. Natural Language Applications**	• **Classroom lectures, discussions, and review of theoretical concepts. Laboratory practical sessions.** • **slides**	**George F. Luger. Artificial Intelligence: Structures and Strategies for Complex Problem Solving** **Artificial Intelligence: Building Intelligent Systems.**
12	**11. MACHINE LEARNING: SYMBOL-BASED** **11.1. A Framework for Symbol-Based Learning 11.2. Version Space Searches** **11.3. The ID3 Decision Tree Induction Algorithm (Overview)** **11.4. Inductive Bias and Learnability** **11.5. Knowledge and Learning** **11.5.1. Meta-DENDRAL** **11.5.2. Explanation-Based Learning** **11.5.3. EBL and Knowledge-Level Learning** **11.5.4. Analogical Learning**	• **Classroom lectures, discussions, and review of theoretical concepts. Laboratory practical sessions.** • **slides**	**George F. Luger. Artificial Intelligence: Structures and Strategies for Complex Problem Solving**

	11.6. Unsupervised Learning **11.6.1. Discovery** **11.6.2. Conceptual Clustering** **11.6.3. COBWEB (Overview)** **11.7. Reinforcement Learning**		
13	**12. MACHINE LEARNING: CONNECTIONIST** **12.1. Foundations for Connectionist Networks 12.2. Perceptron Learning 12.3. Backpropagation Learning** **12.4. Competitive Learning** **12.4.1. A Kohonen Network** **12.4.2. Outstar Networks and Counterprobagation 12.5. Hebbian Coincidence of Learning (Overview) 12.6. Attractor Networks or "Memories" (Overview)**	• **Classroom lectures, discussions, and review of theoretical concepts. Laboratory practical sessions.** • **slides**	**George F. Luger. Artificial Intelligence: Structures and Strategies for Complex Problem Solving**
14	**13. MACHINE LEARNING: SOCIAL AND EMERGENT** **13.1. The Genetic Algorithm 13.2. Classifier Systems and Genetic Programming** **13.3. Artificial Life and Society-Based Learning** **13.3.1. The Game of Life** **13.3.2. Evolutionary Programming**	• **Classroom lectures, discussions, and review of theoretical concepts. Laboratory practical sessions.** • **slides**	**George F. Luger. Artificial Intelligence: Structures and Strategies for Complex Problem Solving**
15	**Final Exam 50%**		

*** 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.**