Course Specifications

Course Title:	**Reinforcement Learning**
Course Code:	**AI 411**
Program:	**Information and Computer Sciences**
Department:	**Computer Science and Information**
College:	**Science at Al-Zulfi**
Institution:	**Majmaah**

Table of Contents

A. Course Identification

1. Credit hours: 3
2. Course type **a.** University ☐ College ☐ Department ☐ Others ☐ **b.** Required ☐ Elective ■
3. Level/year at which this course is offered: Level 7
4. Pre-requisites for this course (if any)**:** (Machine Learning) **AI411**
5. Co-requisites for this course (if any)**: Nil**

6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	**Traditional classroom**	44	80 %
2	**Blended**	3	5 %
3	**E-learning**	3	5 %
4	**Correspondence**	3	5 %
5	**Other**	3	5 %

7. Actual Learning Hours (based on academic semester)

No	Activity	Learning Hours
Contact Hours		
1	**Lecture**	30
2	**Laboratory/Studio**	30
3	**Tutorial**	0
4	**Others** (specify)	0
	Total	**60**
Other Learning Hours*		
1	**Study**	30
2	**Assignments**	30
3	**Library**	20
4	**Projects/Research Essays/Theses**	20
5	**Others** (specify)	0
	Total	**100**

* The length of time that a learner takes to complete learning activities that lead to achievement of course learning outcomes, such as study time, homework assignments, projects, preparing presentations, library times

B. Course Objectives and Learning Outcomes

1. Course Description

This course is intended for students interested in artificial intelligence. Reinforcement learning is an area of machine learning where an agent learns how to behave in an environment by performing actions and assessing the results. Reinforcement learning is how Google DeepMind created the AlphaGo system that beat a high-ranking Go player and how AlphaStar become the first artificially intelligent system to defeat a top professional player in StarCraft II. We will study the fundamentals and practical applications of reinforcement learning and will cover the latest methods used to create agents that can solve a variety of complex tasks, with applications ranging from gaming to finance to robotics. The course is comprised of assignments, short weekly quizzes, a final project and a final exam..

2. Course Main Objective

1. Learn fundamentals and practical applications of reinforcement learning
2. Cover the latest methods used to create agents that can solve a variety of complex tasks, with applications ranging from gaming to finance to robotics.

3. Course Learning Outcomes

Upon successful completion, students will have the knowledge and skills to:

CLOs		Aligned-PLOs
1	**Knowledge:**	
1.1	Understand and work with tabular methods to solve classical control problems	K3-AI
1.2	Understand and work with approximate solutions (deep Q network based algorithms)	
	Learn how to define RL tasks and the core principals behind the RL, including policies, value functions, deriving Bellman equations	
2	**Skills :**	
2.1	Implement in code common algorithms following code standards and libraries used in RL	S3-AI
2.2	Recognize current advanced techniques and applications in RL	
3	**Competence: الكفاءات**	
3.1		
3.2		

C. Course Content

No	List of Topics	Contact Hours
1	Foundations: Introduction and Basics of RL, Defining RL Framework and Markov Decision Process , Polices, Value Functions and Bellman Equations, Exploration vs. Exploitation , Code Standards and Libraries used in RL (Python/Keras/Tensorflow)	12
2	Tabular methods and Q-networks : Planning through the use of Dynamic Programming and Monte Carlo, Temporal-Difference learning methods (TD(0), SARSA, Q-Learning) , Deep Q-networks (DQN, DDQN, Dueling DQN, Prioritised Experience Replay)	12
3	Policy optimization: Introduction to policy-based methods, Vanilla Policy Gradient, REINFORCE algorithm and stochastic policy search, Actor-critic methods (A2C, A3C), Advanced policy gradient (PPO, TRPO, DDPG)	12

4	Model-based RL approach	12
5	Recent Advances and Applications: Meta-learning, Multi-Agent Reinforcement Learning, Partially Observable Markov Decision Process, Ethics in RL, Applying RL for real-world problems	12
Total		60

D. Teaching and Assessment

1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods Live Learning: Lecture, PowerPoint slides and discussion

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
1.0	**Knowledge**		
1.1	Understand and work with tabular methods to solve classical control problems	☒ Lectures ☒ Tutorial ☒ Exercises ☒ Practical Lab ☒ Discussions	- Homework tasks - Quiz - Midterms - Final Exam
1.2	Understand and work with approximate solutions (deep Q network based algorithms)		
	Learn how to define RL tasks and the core principals behind the RL, including policies, value functions, deriving Bellman equations		
2.0	**Skills**		
2.1	Implement in code common algorithms following code standards and libraries used in RL	☒ Lectures ☒ Tutorial ☒ Exercises ☒ Practical Lab ☒ Discussions	- Lab Exercises - Lab Exam - Oral Exam - Presentations
2.2	Recognize current advanced techniques and applications in RL		
3.0	**Competence**		
3.1			
3.2			

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Homework 1	2	2%
2	QUIZ 1	3	5%
3	Homework 2	4	2%
4	QUIZ 2	5	5%
5	Midterm 1	6	10%
6	Homework 3	7	2%
7	QUIZ 3	8	5%
8	Homework 4	9	2%
9	QUIZ 4	10	5%
10	Midterm 2	11	10%
11	Lab Exam/ Project Evaluation	14	12%
12	Final Exam	16	40%

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

E. Student Academic Counseling and Support

Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:

- Determine meeting appointments for the weak' students to solve their problems and give them academic advices.
- One office hour daily
- Dealing a workshops.
- Motivate students

F. Learning Resources and Facilities

1. Learning Resources

Required Textbooks	R. S. Sutton and A. G. Barto, Reinforcement learning: An introduction, MIT Press, 2019.
Essential References Materials	
Electronic Materials	
Other Learning Materials	

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	Classroom - Laboratory
Technology Resources (AV, data show, Smart Board, software, etc.)	Data show – Smart Board
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	Matlab `software – Weka – Python Programming

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
1. Questionnaires (course evaluation) filled by the students and acquired electronically by the University	Students	Indirect Assessment
2. Students-faculty management meetings		

Evaluation Areas/Issues	Evaluators	Evaluation Methods
3. Departmental internal review of the course.	Department Council	Questionnaires
4. Discussion with the industrial partners to enhance the courses in order to meet their needs.	Stockholders	Meetings
5. Midterms and Final Exam 6. Project Evaluation	Course Coordinator Staff	Direct Assessment

Evaluation areas (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
Evaluators (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
Assessment Methods (Direct, Indirect)

H. Specification Approval Data

Council / Committee	
Reference No.	
Date	