THE INTERNATIONAL QUALIFICATIONS

AND ASSESSMENT CENTRE (IQAC)

«Approved»

2025 y. «16» 6 yul

Programme	Level 7 Diploma in Data Science		
Unit Number/ Unit Title	UNIT 3 ARTIFICIAL INTELLIGENCE AND AUTONOMOUS SYSTEMS		
Cohort Code:	L07AIAS-U3		
Unit Level	Level 7		
Total GLH	Total qualification time 200/ Total Guided learning hours 90/ Self-guided learning hours 110		
Credits	20 CATS/ 10 ECTS		
Lecturer			
Start Date		**End Date**	

Unit Aims	This module explores the application of artificial intelligence (AI) in building autonomous systems. Students will examine intelligent agent design, decision-making under uncertainty, robotics integration, and reinforcement learning, gaining practical experience with simulation environments.
Differentiation Strategies *(e.g. planned activities or support for individual learners according to their needs)*	The total number of students to be in the lesson is approximately 20. This is a multicultural group of students predominantly between the ages of 24 – 45, with numerous ethnic, gender, and creed background. These are UK academic level 5 students; hence it is assumed that they have practical, theoretical, or technological knowledge and understanding of a subject or field of work to find ways forward in broadly defined, complex contexts. These students must be able to generate information, evaluate, synthesise the use information from a variety of sources. Various approaches to addressing the various identified students needs will be adopted throughout the lesson. Such will include:- 1. Progressive tasks 2. Digital resources 3. Verbal support 4. Variable outcomes 5. Collaborative learning

	6. Ongoing assessment 7. Flexible-pace learning
Equality & Diversity	Variety of teaching techniques will be employed to ensure that the needs of each individual learner are met.
Safeguarding & Prevent	Safeguarding policies and the Prevent duty are strictly observed to ensure the safety, well-being, and inclusivity of all students and staff.
Health & Safety	SIRM H&S policies will be maintained.
Learning Resources	**Teaching and Learning Materials**
	• Sutton, R. S., & Barto, A. G. (2018). Reinforcement Learning: An Introduction. MIT Press. • Russell, S. J., & Norvig, P. (2021). Artificial Intelligence: A Modern Approach. Pearson. • Murphy, K. P. (2022). Probabilistic Machine Learning. MIT Press. • Arkin, R. C. (2009). Governing Lethal Behavior in Autonomous Robots. CRC Press.

Learning Outcome	Assessment Criteria
LO1. 1. Design AI-based decision-making systems.	Simulation Project: 1.1 Build intelligent agents using rule-based and learning-based approaches. 1.2 Evaluate decision trees and MDPs.
LO2. 2. Apply reinforcement learning techniques	Practical Assessment: 2.1 Implement Q-learning and policy gradient methods. 2.2 Test models in simulated environments.
LO3. 3. Examine robotics and autonomous control.	Group Presentation: 3.1 Explain integration of AI in robotics. 3.2 Review real-world use cases (e.g., drones, autonomous vehicles).
LO4. 4. Evaluate risks and ethics of AI deployment.	Case Study: 4.1 Analyze safety and accountability challenges in autonomous systems. 4.2 Propose governance frameworks

No	Learning Outcome / Topic	Learning and Teaching Activities	Which assessment criteria does the session relate to?	Day/month/year/ signature
1.	**Intelligent Agents & Architectures**	**Intelligent Agents & Architectures** Rule-based vs. learning-based agents, BDI model	LO1: AI-Based Decision-Making Systems	
2.	**Decision Trees & Random Forests**	**Decision Trees & Random Forests** Splitting criteria (Gini, entropy), pruning	LO1: AI-Based Decision-Making Systems	
3.	**Markov Decision Processes (MDPs)**	**Markov Decision Processes (MDPs)** States, actions, rewards, Bellman equations	LO1: AI-Based Decision-Making Systems	
4.	**Partially Observable MDPs (POMDPs)**	**Partially Observable MDPs (POMDPs)** Belief states, applications in robotics	LO1: AI-Based Decision-Making Systems	
5.	**Multi-Agent Systems**	**Multi-Agent Systems** Game theory, Nash equilibrium, swarm intelligence	LO1: AI-Based Decision-Making Systems	
6.	**RL Fundamentals**	**RL Fundamentals** Exploration vs. exploitation, reward shaping	LO2: Reinforcement Learning (RL)	
7.	**Q-Learning & SARSA**	**Q-Learning & SARSA** Temporal difference learning, ε-greedy policies	LO2: Reinforcement Learning (RL)	
8.	Half-Term Exam	- Review of LO1 topics - Practice questions and mock assessment - **Half-term assessment** based on LO1 (theory)	LO1 LO2	
9.	**Deep Q-Networks (DQN)**	**Deep Q-Networks (DQN)** Experience replay, target networks	LO2: Reinforcement Learning (RL)	
10.	**Policy Gradient Methods**	**Policy Gradient Methods** REINFORCE, PPO, Actor-Critic architectures	LO2: Reinforcement Learning (RL)	

11.	**Simulated Environments**	**Simulated Environments** OpenAI Gym, Unity ML-Agents, CARLA (autonomous driving)	LO2: Reinforcement Learning (RL)	
12.	**Robot Perception**	**Robot Perception** SLAM (Simultaneous Localization and Mapping), LiDAR/camera fusion	LO3: Robotics & Autonomous Control	
13.	**Motion Planning**	**Motion Planning** A, RRT, trajectory optimization	LO3: Robotics & Autonomous Control	
14.	Final Exam Preparation & Review	- Comprehensive review of all learning outcomes - Practice questions and revision of key topics		
15.	Final Exam	- **Final-term assessment** covering all learning outcomes (theory and practical elements)		
16.	Feedback & Reflection	- Review of final exam - Individual feedback on performance - Reflective discussion on key learning points		
17.	**Control Systems**	**Control Systems** PID control, MPC (Model Predictive Control)	LO3: Robotics & Autonomous Control	
18.	**Autonomous Vehicles**	**Autonomous Vehicles** Levels of autonomy, sensor suites (Tesla vs. Waymo)	LO3: Robotics & Autonomous Control	
19.	**Drones & UAVs**	**Drones & UAVs** Path planning, obstacle avoidance, swarm robotics	LO3: Robotics & Autonomous Control	
20.	**Safety Assurance**	**Safety Assurance** Fail-safe mechanisms, ISO 26262 (automotive)	LO4: Risks & Ethics of Autonomous AI	
21.	**Accountability Frameworks**	**Accountability Frameworks** Liability laws, black box problem	LO4: Risks & Ethics of Autonomous AI	
22.	**Bias in Autonomous Systems**	**Bias in Autonomous Systems** Case study: Racial bias in facial recognition for robotics	LO4: Risks & Ethics of Autonomous AI	
23.	Half-Term Exam	**Project** Design an autonomous agent with safety/ethics report		

24.	**Ethical Dilemmas**	**Ethical Dilemmas** Trolley problem, ethical decision-making algorithms	LO4: Risks & Ethics of Autonomous AI	
25.	**Governance & Standards**	**Governance & Standards** EU AI Act, IEEE Ethically Aligned Design	LO4: Risks & Ethics of Autonomous AI	
26.	**Human-AI Collaboration**	**Human-AI Collaboration** Cobots (collaborative robots), explainable AI in autonomy	LO5: Integration & Capstone	
27.	**Edge AI for Autonomous Systems**	**Edge AI for Autonomous Systems** TinyML, federated learning for privacy	LO5: Integration & Capstone	
28.	**Case Study: Real-World Failures**	**Case Study: Real-World Failures** Uber ATG fatality, Boeing 737 MAX MCAS	LO5: Integration & Capstone	
29.	Final Exam Preparation & Review	LO1, LO2, LO3, LO4	LO1, LO2, LO3, LO4	
30.	Final Exam		LO1, LO2, LO3, LO4	