INTERNATIONAL QUALIFICATIONS

AND ASSESSMENT CENTRE (IQAC)

«Approved»

2025 y. «16» _____

Programme	**Level 7 Diploma in Artificial Intelligence**		
Unit Number/ Unit Title	UNIT 1 AUTONOMOUS SYSTEMS AND ROBOTICS IN AI		
Cohort Code:	L07ASRA-U1		
Unit 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 unit explores the integration of artificial intelligence with autonomous systems and robotics, enabling machines to perform tasks without human intervention. It covers robotic perception, motion planning, sensor fusion, embedded AI, and real-time control systems. Learners will also gain insights into autonomous decision-making, swarm intelligence, and safety protocols. The module prepares students to work in sectors such as autonomous vehicles, drones, smart manufacturing, and service robots.
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**
	• Siciliano, B., & Khatib, O. (2016). Springer Handbook of Robotics. Springer. • Thrun, S., Burgard, W., & Fox, D. (2005). Probabilistic Robotics. MIT Press. • Murphy, R. R. (2019). Introduction to AI Robotics. MIT Press. • Bekey, G. A. (2005). Autonomous Robots: From Biological Inspiration to Implementation and Control. MIT Press. • Lin, P. et al. (2012). Robot Ethics: The Ethical and Social Implications of Robotics. MIT Press.

Learning Outcome	Assessment Criteria
LO1. 1. Analyse the components and architecture of autonomous robotic systems.	1.1 Explain the core components of robotic systems and their AI integrations. 1.2 Assess architectures used for autonomous navigation and control. (Report)
LO2. 2. Evaluate sensor technologies and perception methods for robotics.	2.1 Compare various sensors (e.g., LiDAR, ultrasonic, camera) used in robotics. 2.2 Evaluate sensor fusion techniques for perception. (Portfolio Submission)
LO3. 3. Design and simulate AI-driven decision-making processes in robots.	3.1 Implement autonomous decision-making algorithms (e.g., FSMs, path planning). 3.2 Simulate real-world robotic scenarios using AI. (Project-Based Assignment).
LO4. 4. Investigate ethical, legal, and safety issues in autonomous robotics.	4.1 Analyse ethical dilemmas (e.g., autonomy vs. control). 4.2 Propose guidelines for safe and ethical deployment of autonomous systems. (Case Study Presentation)
LO5. 5. Apply AI tools for real-time embedded system integration in robotics.	5.1 Use microcontroller-based systems (e.g., Arduino, Raspberry Pi) with AI libraries. 5.2 Demonstrate AI-driven sensor-actuator interactions. *(Practical Lab Work)*

No	Learning Outcome / Topic	Learning and Teaching Activities	Which assessment criteria does the session relate to?	Day/month/year/ signature
1.	**Introduction to Autonomous Robotics**	**Introduction to Autonomous Robotics** Definition, applications (self-driving cars, drones, industrial robots)	LO1: Components & Architecture of Autonomous Robotic Systems	
2.	**Core Components of Robotic Systems**	**Core Components of Robotic Systems** Sensors, actuators, controllers, AI integration	LO1: Components & Architecture of Autonomous Robotic Systems	
3.	**Robotic System Architectures**	**Robotic System Architectures** Reactive, deliberative, hybrid architectures (e.g., Subsumption, ROS)	LO1: Components & Architecture of Autonomous Robotic Systems	
4.	**Autonomous Navigation Systems**	**Autonomous Navigation Systems** SLAM (Simultaneous Localization and Mapping), path planning	LO1: Components & Architecture of Autonomous Robotic Systems	
5.	**Control Systems in Robotics**	**Control Systems in Robotics** PID control, feedback loops, stability analysis	LO1: Components & Architecture of Autonomous Robotic Systems	
6.	**Sensors in Robotics**	**Sensors in Robotics** LiDAR, ultrasonic, cameras, IMUs, and their trade-offs	LO2: Sensor Technologies & Perception Methods	
7.	**Computer Vision for Robotics**	**Computer Vision for Robotics**	LO2: Sensor Technologies & Perception Methods	

		Object detection (YOLO), depth estimation (stereo vision)		
8.	Half-Term Exam	- Review of LO1 topics - Practice questions and mock assessment - **Half-term assessment** based on LO1 (theory)	LO1 LO2	
9.	**LiDAR & 3D Perception**	**LiDAR & 3D Perception** Point cloud processing, obstacle detection	LO2: Sensor Technologies & Perception Methods	
10.	**Sensor Fusion Techniques**	**Sensor Fusion Techniques** Kalman filters, particle filters, Bayesian methods	LO2: Sensor Technologies & Perception Methods	
11.	**Real-World Sensor Limitations**	**Real-World Sensor Limitations** Noise, calibration, environmental challenges	LO2: Sensor Technologies & Perception Methods	
12.	**Finite State Machines (FSMs) for Robot Behavior**	**Finite State Machines (FSMs) for Robot Behavior** State transitions, decision logic)	LO3: AI-Driven Decision-Making in Robotics	
13.	**Path Planning Algorithms**	**Path Planning Algorithms** A*, Dijkstra, RRT (Rapidly-exploring Random Trees	LO3: AI-Driven Decision-Making in Robotics	
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.	**Reinforcement Learning (RL) for Robotics**	**Reinforcement Learning (RL) for Robotics** Q-learning, policy gradients in simulated environments	LO3: AI-Driven Decision-Making in Robotics	
18.	**Neural Networks in Robot Control**	**Neural Networks in Robot Control** End-to-end learning vs. modular approaches	LO3: AI-Driven Decision-Making in Robotics	
19.	**Simulation Tools for Robotics**	**Simulation Tools for Robotics** Gazebo, Webots, PyBullet for AI testing	LO3: AI-Driven Decision-Making in Robotics	

20.	**Ethical Dilemmas in Autonomous Robotics**	**Ethical Dilemmas in Autonomous Robotics** Trolley problem, accountability in failures	LO4: Ethical, Legal & Safety Issues	
21.	**Legal Frameworks for Robotics**	**Legal Frameworks for Robotics** Liability laws, international regulations (EU AI Act)	LO4: Ethical, Legal & Safety Issues	
22.	**Safety Standards in Robotics**	**Safety Standards in Robotics** ISO 10218, risk assessment, fail-safe mechanisms	LO4: Ethical, Legal & Safety Issues	
23.	Half-Term Exam	**Capstone Project** Build an autonomous robot (e.g., line-follower, obstacle avoider)		
24.	**Human-Robot Interaction (HRI) Ethics**	**Human-Robot Interaction (HRI) Ethics** Trust, transparency, and user consent	LO4: Ethical, Legal & Safety Issues	
25.	**Case Study: Real-World Robotics Failures**	**Case Study: Real-World Robotics Failures** Tesla Autopilot, drone incidents, industrial accidents	LO4: Ethical, Legal & Safety Issues	
26.	**Microcontrollers in Robotics**	**Microcontrollers in Robotics** Arduino, Raspberry Pi, ESP32 for real-time control	LO5: AI Tools for Embedded Robotics	
27.	**AI Libraries for Embedded Systems**	**AI Libraries for Embedded Systems** TensorFlow Lite, Edge Impulse, TinyML	LO5: AI Tools for Embedded Robotics	
28.	**Sensor-Actuator Integration**	**Sensor-Actuator Integration** Motor control (PWM), servo calibration **Real-Time AI Processing** Latency optimization, hardware acceleration (GPUs, TPUs)	LO5: AI Tools for Embedded Robotics	
29.	Final Exam Preparation & Review	LO1, LO2, LO3, LO4	LO1, LO2, LO3, LO4	
30.	Final Exam		LO1, LO2, LO3, LO4	