INTERNATIONAL QUALIFICATIONS

AND ASSESSMENT CENTRE (IQAC)

«Approved»

2025 y. «__» _____

Programme	LEVEL 5 EXTENDED DIPLOMA IN ARTIFICIAL INTELLIGENCE		
Unit Number/ Unit Title	UNIT 10 ROBOTICS		
Cohort Code:	L05ROB-U10		
Unit Level	5		
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	To provide students with an understanding of the principles and technologies used in robotics, enabling them to design and develop robotic systems. Students will explore the fundamental principles of robotics, including kinematics, dynamics, and control systems. The unit will also cover robotic sensors and actuators, allowing students to design and implement systems for various applications, such as automation and autonomous navigation. By the end of the course, students will possess the skills to develop and troubleshoot their own robotic systems effectively.
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** • "Introduction to Robotics: Mechanics and Control" by John J. Craig • "Robotics: Modelling, Planning and Control" by Bruno Siciliano, Lorenzo Sciavicco, Luigi Villani, and Giuseppe Oriolo • "Probabilistic Robotics" by Sebastian Thrun, Wolfram Burgard, and Dieter Fox • "Robot Programming: A Guide to Controlling Autonomous Robots" by Cameron Hughes and Tracey Hughes • "Hands-On Robotics Programming with C++" by Dinesh Tavasalkar.

Learning Outcomes	Assessment Criteria
LO1. **1. Understand the fundamentals of robotics.**	1.1 : Describe the key components of robotic systems, including sensors, actuators, and controllers. 1.2 : Explain the principles of robotic kinematics and dynamics. 1.3 : Discuss the applications of robotics in various industries.
LO2. **2. Design and implement robotic systems.**	2.1 : Develop robotic models and simulations using software tools. 2.2 : Implement control algorithms for robotic motion and navigation. 2.3 : Design and build simple robotic systems for specific tasks.
LO3. **3. Utilize AI and machine learning in robotics.**	3.1 : Apply machine learning techniques for robotic perception and decision-making. 3.2 : Implement computer vision algorithms for object detection and recognition in robotics. 3.3 : Use reinforcement learning for robotic task optimization.
LO4. **4. Evaluate and test robotic systems.**	4.1 : Assess the performance and reliability of robotic systems. 4.2 : Conduct experiments to validate robotic designs and control strategies. 4.3 : Optimize robotic systems for efficiency and robustness.
LO5. **5. Understand the ethical considerations in robotics.**	5.1 : Discuss the ethical implications of deploying robots in various domains. 5.2 : Evaluate the impact of robotics on employment and society. 5.3 : Develop strategies to ensure the responsible use of robotics.

No	Learning Outcome / Topic	Learning and Teaching Activities	Which assessment criteria does the session relate to?	Day/month/year/ signature
1.	**Introduction to Robotics**	**Introduction to Robotics** Definition, history, and key components (sensors, actuators, controllers)	LO1: Fundamentals of Robotics	
2.	**Robotic Sensors & Perception**	**Robotic Sensors & Perception** Types (LiDAR, IMU, cameras), signal processing	LO1: Fundamentals of Robotics	
3.	**Actuators & Effectors**	**Actuators & Effectors** Motors (servo, stepper), grippers, and mobility systems (wheels, legs)	LO1: Fundamentals of Robotics	
4.	**Robotic Kinematics**	**Robotic Kinematics** Forward/inverse kinematics (2D/3D), Denavit-Hartenberg parameters	LO1: Fundamentals of Robotics	
5.	**Robotic Dynamics**	**Robotic Dynamics** Lagrangian mechanics, torque control, and motion equations	LO1: Fundamentals of Robotics	
6.	**Industrial Applications**	**Industrial Applications** Case studies: Manufacturing, healthcare, agriculture	LO1: Fundamentals of Robotics	
7.	**Robot Modeling & Simulation**	**Robot Modeling & Simulation** Tools: ROS, Gazebo, Webots (simple robot URDF modeling)	LO2: Design & Implementation	
8.	Half-Term Exam	- Review of LO1 topics - Practice questions and mock assessment - **Half-term assessment** based on LO1 (theory)	LO1 LO2	
9.	**Control Systems**	**Control Systems** PID control, feedback loops, stability analysis	LO2: Design & Implementation	

10.	**Path Planning & Navigation**	**Path Planning & Navigation** A* algorithm, RRT, SLAM (Simultaneous Localization and Mapping)	LO2: Design & Implementation	
11.	**Robot Operating System (ROS) Basics**	**Robot Operating System (ROS) Basics** Nodes, topics, services (hands-on with TurtleBot)	LO2: Design & Implementation	
12.	**Embedded Systems for Robotics**	**Embedded Systems for Robotics** Microcontrollers (Arduino, Raspberry Pi) for motor control	LO2: Design & Implementation	
13.	**Capstone Project: Task-Specific Robot**	**Capstone Project: Task-Specific Robot** Design/build a line-follower or pick-and-place robot	LO2: Design & Implementation	
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.	**Machine Learning for Perception**	**Machine Learning for Perception** Sensor fusion, Kalman filters for state estimation	LO3: AI & Machine Learning in Robotics	
18.	**Computer Vision in Robotics**	**Computer Vision in Robotics** Object detection (YOLO), pose estimation (OpenCV)	LO3: AI & Machine Learning in Robotics	
19.	**Reinforcement Learning (RL) for Robotics**	**Reinforcement Learning (RL) for Robotics** Q-learning, policy gradients (simulated environments)	LO3: AI & Machine Learning in Robotics	

20.	**Neural Networks for Control**	**Neural Networks for Control** Imitation learning, end-to-end control (e.g., self-driving cars)	LO3: AI & Machine Learning in Robotics	
21.	**Performance Metrics**	**Performance Metrics** Accuracy, repeatability, latency, energy efficiency	LO4: Evaluation & Optimization	
22.	**Experimental Validation**	**Experimental Validation** Design of experiments (DOE), statistical analysis	LO4: Evaluation & Optimization	
23.	Half-Term Exam	**Final Project: AI-Driven Robot** Example: Vision-based sorting robot with RL optimization		
24.	**Fault Tolerance & Robustness**	**Fault Tolerance & Robustness** Redundancy, error recovery strategies	LO4: Evaluation & Optimization	
25.	**Optimization Techniques**	**Optimization Techniques** Genetic algorithms, swarm intelligence	LO4: Evaluation & Optimization	
26.	**Ethical Dilemmas in Robotics**	**Ethical Dilemmas in Robotics** Autonomous weapons, privacy invasion, accountability	LO5: Ethics & Society	
27.	**Robotics & Employment**	**Robotics & Employment** Job displacement vs. creation, reskilling	LO5: Ethics & Society	
28.	**Responsible Robotics**	**Responsible Robotics** Safety standards (ISO 10218), transparency in AI decisions	LO5: Ethics & Society	
29.	Final Exam Preparation & Review	LO1, LO2, LO3, LO4	LO1, LO2, LO3, LO4	
30.	Final Exam		LO1, LO2, LO3, LO4	