Faculty of Engineering
The University of Hong Kong

DASE 7503 ROBOTIC SYSTEMS INTEGRATION

Course Outline

Course code:	DASE 7503
Course title:	Robotic Systems Integration
Offered by (department):	DASE
Level:	MSc
Credit units:	6
Pre-requisite course code:	Nil
Co-requisite course code:	Nil
Learning hours:	30
Student quota:	90
Course type:	Core
Offer in academic year:	2026-27
Assessment (%):	In-course assessment (60) Written examination (40)

The intention of this document is for students undertaking the course to be well informed in terms of its learning expectations and to help make their learning journey an enjoyable one.

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Course Description and Aims

This course focuses on the principles and practices involved in integrating robotic systems into various industrial and service environments. It covers hardware and software components, control systems, programming, and real-world applications. The course includes both theoretical knowledge and practical hands-on experience. This course is aimed to help students:

- Understand the fundamental components of robotic systems and their integration
- Learn methods for integrating robotic hardware and software
- Develop skills in programming and configuring robotic systems
- Apply knowledge to real-world robotic integration projects
- Explore advanced topics such as multi-robot systems, AI in robotics, and industrial applications

Teaching Staff

Contact details for the course coordinator and course teachers are shown below:

Course Teacher	
Name (Department)	**Contact Details**
Dr. H.H. Cheung (DASE Department)	E-mail: hh.cheung@hku.hk

Course Learning Outcomes and Alignment with Program Learning Outcomes

By the end of this course students should be able to demonstrate a threshold level of mastery of the following course learning outcomes. The appropriate Program Learning Outcomes associated with each of the course learning outcomes are also presented.

MSc (Eng)(RIS) Program Learning Outcomes

I. Underpinning science and mathematics, etc.

PO(1) A comprehensive understanding of the relevant scientific principles of the specialization.

PO(2) A critical awareness of current problems and/or new insights much of which is at, or informed by, the forefront of the specialization.

PO(3) An understanding of concepts relevant to the discipline, some from outside engineering, and the ability to critically evaluate and apply them effectively.

II. System analysis and design

PO(4) The ability to use fundamental knowledge to investigate new and emerging system models and technologies.

PO(5) The ability to apply appropriate models for solving problems in engineering systems and the ability to assess the limitations of particular cases.

PO(6) The ability to collect and analyze research data and use appropriate engineering tools to tackle unfamiliar problems, such as those with uncertain or incomplete data or specifications, by the appropriate innovation, use or adaptation of engineering analytical methods.

PO(7) The ability to apply original thought to the development of practical solutions for products, systems, processes, or services.

III. Economic, social, and environmental context

PO(8) Knowledge and understanding of management and business practices, and their limitations, and how these may be applied appropriately, in the context of the particular specialization.

PO(9) The ability to make general evaluations of risks through some understanding of the basis of such risks.

IV. Engineering and management practices

PO(10) A thorough understanding of current practices and their limitations, and some appreciation of likely new developments.

PO(11) Advanced level knowledge and understanding of a wide range of industrial management and system operations.

PO(12) The ability to apply industrial engineering techniques taking account of a range of commercial and industrial constraints.

Course Learning Outcomes	Relevant Program Learning Outcomes
1. An in-depth understanding of the relevant components of robotic systems and their integration.	1,2,3
2. An ability to design, fabricate and program robotic systems through integrating robotic hardware and software, sensors and AI technologies for real-world applications	4,5,7
3. Competency in identifying and integrating technologies for the development of robotic systems for real-world applications	8, 10, 11

Course Teaching and Learning Activities and Alignment with Learning Outcomes

The teaching and learning processes include lectures, tutorials, demonstrations/laboratories, and a hands-on group project.

Lectures/tutorials

Lectures are designed to cover the concepts and principles of robotic systems integration, including the relevant robotic hardware like sensors, actuators and controllers, robotic software like simulation and ROS programming, computer vision and AI technologies, critical challenges regarding technology and integration for developing a robotic system for real-world applications. Tutorial and demonstration sessions are arranged to help enhance students' understanding of course materials. Lectures/tutorials play a vital role in equipping students with the foundation knowledge necessary for further learning, and in achieving the course objectives and learning outcomes.

Laboratories/demonstrations

There would be laboratory sessions on:

(1) ROS2 Programming 1 – ROS2 installation and basic robotic programming
(2) ROS2 programming 2 – sensors and data visualisation
(3) ROS2 programming 3 - actuators
(4) ROS2 programming 4 - simulation
(5) PLC programming – controlling sensors and actuators
(6) Computer vision for robotic systems – OpenCV and AI tools like Yolo for object recognition

Laboratory/demonstration sessions help students consolidate their understanding of course materials and how to apply for relevant knowledge/technologies for solving real-world engineering problems.

Group Project

A hands-on group project allows students to practice designing, fabricating, and programming a robotic system by integrating different technologies learnt in the course that would further consolidate the students' understanding of course materials and how to apply the course knowledge/skills to solve real-world problems like intelligent warehousing and intelligent manufacturing.

Calendar Entry

This course provides students with hands-on experience in designing, building, and programming robotic systems. It will enable students to understand and work with robot hardware and software. Topics include electronic circuit design and implementation, embedded system development and programming, computer-aided-design, 3D printing, Robot Operating System (ROS), program advanced robotic systems (both industrial and mobile). Throughout the course, students will work in teams.

Course Content	Responsible Lecturer	Course Learning Outcomes
Introduction to Robotic Systems Integration		
• Overview of robotic systems and their applications • Key components: sensors, actuators, controllers, and software • Examples of real-world robotic systems applications • Challenges in robotic systems integration	Dr. HH Cheung	1, 3
Robotics Hardware and Software Architecture		
• Robotics hardware platforms (e.g., manipulators, mobile robots, drones) • Industrial Controllers and Embedded Controllers • Software frameworks (e.g., ROS - Robot Operating System) • Communication protocols and middleware • Sensors and Actuators in Robotic Systems	Dr. HH Cheung	1, 2, 3

Course Content	Responsible Lecturer	Course Learning Outcomes
• AI in Robotic Systems • Design and manufacturing for robotic systems		
Control Systems, Programming, Simulation, and Path Planning & Navigation for Robotic Systems		
• Control theory basics • PID control and advanced control strategies • Programming for robotics • Simulation for robotics • Path planning algorithms (e.g., A*, RRT, Dijkstra) • Navigation techniques for mobile robots	Dr. HH Cheung	1, 2, 3
Laboratory/demonstration		
• ROS2 programming • PLC programming – controlling sensors and actuators • Computer vision for robotic systems – OpenCV and AI tools like Yolo for object recognition	Dr. HH Cheung	1,2,3
Group Project		
• Design and develop a robotic system by integrating different technologies such as actuators, sensors, micro-controllers, computer vision, and AI for real-world applications like intelligent warehousing and intelligent manufacturing	Dr. HH Cheung	1,2,3

Guidelines on Grading and Standards of Assessment

HKU has adopted standards-based assessment. The general course grade descriptors aim to provide descriptions on the normal expectations of student achieving particular grades.

Course Grade	Description
A	Exceptionally good performance demonstrating a superior understanding of the subject matter, a foundation of extensive knowledge, a skillful use of concepts and/or materials, and ability to analyze and evaluate problems.
B	Good performance demonstrating capacity to use the appropriate concepts, a good understanding of the subject matter, and an ability to handle the problems and materials encountered in the course.
C	Adequate performance demonstrating an adequate understanding of the subject matter, an ability to handle relatively simple problems, and adequate preparation for moving on to more advanced work in the field.
D	Minimally acceptable performance demonstrating at least partial familiarity with the subject matter and some capacity to deal with relatively simple problems, but also demonstrating deficiencies serious enough to make it inadvisable to proceed further in the field without additional work.
F	Unacceptable performance demonstrating unfamiliarity with the subject matter, and lack of capacity to deal with relatively simple problems and demonstrating deficiencies serious enough to make it advisable to retake the course.

Course Assessment Tasks and Alignment with Learning Outcomes

Assessment tasks in this course are described below, which includes weighting, assessment type, and alignment with course learning outcomes.

Weighting of assessments

Assessment Type	Percentage of Total Assessment (%)	Description	Course Learning Outcomes
In-course Assessment	60	This consists of laboratory sessions, assignments, and a group project. The completion of the in-course assessment measures students' understanding of the course materials.	1,2,3
Written Examination	40	A 2-hour examination at the end of the course. This is aimed at measuring the overall subject knowledge acquired.	1,2,3

Course and Assessment Policy

Late Submission
Submission of late assignments/essays will not be accepted under normal circumstances.

Missed laboratory / Missed quiz
There will be no "make-up" for any missed laboratory or missed quiz under normal circumstances.

Academic Conduct
The University Regulations on academic misconduct will be strictly enforced. Students are strongly recommended to refer to http://www.hku.hk/student/plagiarism/ for further details. In addition, students should familiarize themselves with http://lib.hku.hk/turnitin/.

Means / Processes for Student Feedback on Course

SFTL
Students are asked to complete this evaluation (Student Feedback on Teaching and Learning) of their learning experiences at the conclusion of the course. Questionnaire items relate to the overall evaluation of the course as well as an evaluation of teaching.

Other means of student feedback
In addition, teacher(s) may seek other student feedback mechanism in the duration of their course such as through student forums or class discussion feedback.

Date: 2 July 2025 Completed by: H.H. Cheung

Learning Resources

Required text / References
Relevant handouts will be provided in class. Students are also encouraged to read the following reference materials:

References

1. Damith Herath, David St-Onge. Foundations of Robotics – A Multidisciplinary Approach with Python and ROS. Springer.
2. Aaron Martinez, Enrique Fernandez. Learning ROS for Robotics Programming. PACKT Publishing.