Department of Data and Systems Engineering

DASE7503 Robotic Systems Integration

Course Description, Objectives, and Schedule (2026-27, Sem 1A)

Course Description

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.

Course Objectives

This course's objectives are as follows:

- 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

Course Schedule

Week No. (Date)	Topics	Hands-on Tasks/Tutorials
2 (7 Sep)	**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	▪ Setting up an Ubuntu Linux Virtual Machine on a Windows 11 computer. ▪ Installing and running ROS on Ubuntu Linux
3 (14 Sep)	**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)	▪ Basic Robotics Programming with ROS

	▪ Communication protocols and middleware **Design and Manufacturing for Robotics** ▪ CAD Modelling ▪ Prototyping	
4 (21 Sep)	**Sensors in Robotics** ▪ Principles of Sensing ▪ Types of Sensors (e.g., vision systems, lidar, encoders) ▪ Sensor integration and data fusion **Introduction to Group Project**	▪ ROS Programming - Sensors and Data Visualisation ▪ Hands-on Group Project
6 (28 Sep)	**Actuators in Robotics** ▪ Introduction to actuation mechanisms (e.g., motors, pneumatic systems) ▪ Types of actuators	▪ ROS Programming – Actuators ▪ Hands-on Group Project
6 (5 Oct)	**Hands-on Group Project**	▪ Plan and design a robotic system for industrial/service applications
7 (12 Oct)	**Reading Week**	
8 (19 Oct)	**Holiday**	
9 (26 Oct)	**Control Systems for Robotics** ▪ Control theory basics ▪ PID control and advanced control strategies Implementation of control algorithms	▪ ROS Programming – Actuators and PID Hands-on Group Project
10 (2 Nov)	**Robotic Programming and Simulation** ▪ Programming languages for robotics (e.g., Python, C++) ▪ Simulation tools (e.g., Gazebo, Unity) ▪ Writing and testing robot control programs	▪ PLC Group Lab ▪ Hands-on Group Project
11 (9 Nov)	**Path Planning and Navigation** ▪ Path planning algorithms (e.g., A*, RRT, Dijkstra) ▪ Navigation techniques for mobile robots Obstacle avoidance and SLAM (Simultaneous Localization and Mapping)	▪ ROS Programming (Simulation) - AMCL/gmapping (Gazebo) - SLAM ▪ Assignment 1 ▪ Hands-on Group Project
12 (16 Nov)	**Vision and AI in Robotics** ▪ Basics of computer vision ▪ Image processing techniques (filtering, edge detection, feature extraction) ▪ Machine learning and deep learning in robotics ▪ Integrating AI and vision systems into robotic systems	▪ ROS Programming - Object Recognition for Pick-and-Place Applications using OpenCV and AI (Yolo) - Object Recognition for collision detection and avoidance ▪ PLC Group Lab ▪ Hands-on Group Project
13-14 (23 Nov – 30 Nov)	**Hands-on Group Project** ▪ Design and build a robotic system for industrial/service applications	▪ Design and Fabrication ▪ Assembly ▪ ROS Programming

	▪ Project Implementation and Testing ▪ Project Presentation ▪ Documentation and reporting	▪ Testing

Assessment Methods

i) In-course assessment (60%)

- Individual Assignment (15%)
- Hands-on robotic integration project (40%)
- Participation and Attendance (5%)

ii) Written Examination (40%)