

# WM3G8-15 Robot Programming

**26/27**

**Department**

WMG

**Level**

Undergraduate Level 3

**Module leader**

Paolo Villella

**Credit value**

15

**Module duration**

14 weeks

**Assessment**

100% coursework

**Study locations**

University of Warwick main campus, Coventry Primary

Distance or Online Delivery

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## Description

### Introductory description

This module aims to provide the students with tools and fundamentals of Robot programming. It will be hands-on and focus on practical applications where possible. Essential theory will be covered.

Building on several Y2 and Y3 modules, it equips students with practical skills in the most relevant robot programming languages used in industry.

Examples of robot programmes: teaching a robotic arm how to manipulate objects, simulating autonomous

navigation of mobile robots, implement visual servoing on a collaborative robotic arm using machine vision.

This module is linked with C2, C3, C5, C6, C12 and C17 of the AHEP 4

LO 1: C3, C17

LO 2: C2, C6, C17

LO 3: C3, C5, C12,

LO 4: C2, C3, C5, C12,

[Module web page](#)

## Module aims

This module aims to provide the students with concepts and tools for programming both robotic arms and mobile robots, with particular emphasis on industrial applications.

## Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

- Foundations: position and orientation, time and motion.
- Arm-type robots: Robot arm kinematics, manipulator velocity, dynamics and control.
- Machine vision: Vision - image analysis, cameras, optics, lighting and applications.
- Robot programming and languages: Methods of programming; Teach mode, off line, and graphical simulation. • Languages, (e.g. ABB RAPID), using graphical simulation software (e.g. ABB RobotStudio) to programme an industrial robot.
- Mobile robots: mobile robot vehicles (automatic guided vehicles (AGV's)) , locomotion, navigation, localization

## Learning outcomes

By the end of the module, students should be able to:

- Demonstrate current knowledge of fundamentals of robotics modelling: kinematics and dynamics. [AHEP:4-C3, C17]
- Simulate the dynamical behaviour of mobile robots and solve problems in navigation and localization. [AHEP:4-C2, C6, C17]
- Program an industrial robot off-line using professional kinematic simulation software to perform a specified task. [AHEP:4-C3, C5, C12]
- Devise appropriate machine vision to implement machine vision on a collaborative robot arm. [AHEP:4-C2, C3, C5, C12]

## Indicative reading list

[Reading lists can be found in Talis](#)

## Subject specific skills

Skills from the ST0023 DA Standard:

S1: Translate conceptual designs or technical specifications into operational process control systems..

S4: Interpret and produce technical documentation such as schematic diagrams, project plans, fault reports or data analytics using company documentation systems and guidelines

S5: Observe, record and draw accurate and auditable conclusions from data and/or developmental or test evidence.

S10 Demonstrate leadership when undertaking control system engineering activities such as

system design, integration operational simulation, installation, testing, pre commissioning, commissioning and maintenance of control systems.

S11: Ensure that all instrumentation has been correctly configured and calibrated before use.

S13 Perform checks on control systems documentation to ensure it meets organisational compliance and traceability requirements. Report any non-conformances using the appropriate processes and procedures.

## Transferable skills

- The systematic collection, analysis and evaluation of information in the investigation of a topic.
  - Manages priorities and time.
  - Aware of personal strengths and emotional intelligence.
  - Written communication: Present arguments, knowledge and ideas, in a range of formats
  - Use rational and logical reasoning to deduce appropriate and well-reasoned conclusions.
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## Study

### Study time

Type	Required
Lectures	9 sessions of 1 hour (6%)
Seminars	9 sessions of 1 hour (6%)
Supervised practical classes	3 sessions of 1 hour (2%)
Online learning (scheduled sessions)	9 sessions of 1 hour (6%)
Online learning (independent)	7 sessions of 1 hour (5%)
Other activity	3 hours (2%)
Private study	50 hours (33%)
Assessment	60 hours (40%)
Total	150 hours

### Private study description

- Self-guided study: revision on module contents, solution of additional seminar-type questions, video tutorials and supplementary materials.
- Study and use of simulation software.
- Online forum and discussion (asynchronous).

### Other activity description

- Online consulting / support sessions during assignment work.

## Costs

Category	Description	Funded by	Cost to student
Equipment and project costs		Student	£8.00

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## Assessment

You must pass all assessment components to pass the module.

### Assessment group A

Assessment component	Weighting	Study time	Eligible for self-certification
Assignment 1 : Robot & Machine Vision Laboratory Exercise	40%	24 hours	Yes (extension)

The portfolio is focused on a task executed by a robot provided with a camera. It consists of:

- a pre-lab code written in preparation for the lab, to be submitted prior to the lab session
- a video of the task executed by the robot
- discussion and reflections of the lab experience.

Work in groups of 2/3 students but portfolios are individually written/completed.

#### Reassessment component

Assignment 1 : Robot & Machine Vision Laboratory Exercise			No
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The portfolio is focused on a task executed by a robot provided with a camera. It consists of:

- a pre-lab code written in preparation for the lab, to be submitted prior to the lab session
- a video of the task executed by the robot
- discussion and reflections of the lab experience.

Work in groups of 2/3 students but portfolios are individually written/completed.

#### Assessment component

Assignment 2 (individual): Programming of Mobile Robots.	60%	36 hours	Yes (extension)
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<b>Weighting</b>	<b>Study time</b>	<b>Eligible for self-certification</b>
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An individual report on programming and simulation of the dynamical behaviour of mobile robots. It consists of:

- a description of a case study where a team of mobile robots operates autonomously. This includes user requirements and technical specifications.
- an algorithmic solution to the problem, which demonstrates the effectiveness of the chosen algorithm
- a discussion on results obtained from simulations, which includes graphs and calculations.

Possible to work in pairs but reports are individually written.

#### **Reassessment component**

Assignment 2 (individual): Programming of Mobile Robots.

No

An individual report on programming and simulation of the dynamical behaviour of mobile robots. It consists of:

- a description of a case study where a team of mobile robots operates autonomously. This includes user requirements and technical specifications.
- an algorithmic solution to the problem, which demonstrates the effectiveness of the chosen algorithm
- a discussion on results obtained from simulations, which includes graphs and calculations.

Possible to work in pairs but reports are individually written.

### **Feedback on assessment**

Assignment 1

**FORMATIVE FEEDBACK:**

Automated individual Moodle feedback at on-line tests on Health and Safety.

Automated individual Moodle feedback at on-line tests on Data Security.

Verbal individual feedback given during seminar/tutorial sessions.

**SUMMATIVE FEEDBACK:**

Written individual feedback.

Assignment 2

**FORMATIVE FEEDBACK:**

Verbal individual feedback given during seminar/tutorial sessions.

**SUMMATIVE FEEDBACK:**

Written individual feedback.

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## **Availability**

## **Courses**

This module is Core for:

- Year 3 of UWMS-H7C3 Undergraduate Applied Professional Engineering (Control/Technical Support Engineer)
- Year 3 of DWMS-H7C7 Undergraduate Applied Professional Engineering (Control/Technical Support Engineer) (Degree Apprenticeship)