

# ES4A1-15 Advanced Robotics

**20/21**

**Department**

School of Engineering

**Level**

Undergraduate Level 4

**Module leader**

Emma Rushforth

**Credit value**

15

**Module duration**

13 weeks

**Assessment**

50% coursework, 50% exam

**Study location**

University of Warwick main campus, Coventry

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## Description

### Introductory description

ES4A1-15 Advanced Robotics

[Module web page](#)

### Module aims

Advanced Robotics will explore in great depth areas relevant to not only industrial robotics but service robots (i.e. robots outside a factory environment particularly mobile robots) and the application of this technology to real world environments e.g. driverless vehicles, unmanned aerial vehicles and tele-robots. Students will also master robot kinematics and dynamics.

### 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.

Geometric, kinematic, and dynamic analysis of serial robots manipulators.

Robot, vision, PLC (programmable logic controller) and safety controller programming.

Robot tooling /end-effector and fixture design.

Safety in a robot cell.

Current and future application of robotics outside industry, i.e. service robots.

Mobile robotics: locomotion, sensors, perception, SLAM (Simultaneous Localisation And Mapping) and probabilistic techniques.

## **Learning outcomes**

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

- Solve complex kinematic and dynamic calculation problems applied to serial robots arms.
- Independently program a PLC (programmable logic controller).
- Undertake self-directed research and critically evaluate current and future non-industrial applications of robotic technology.
- Appraise, evaluate and creatively apply mobile robot technology: locomotion, sensors and probabilistic techniques.
- Design and critically evaluate: a safe system in a robot cell; a robot end-effector; fixturing and tools for robot cells.

## **Indicative reading list**

"An Introduction to Robotics Analysis, Systems, Applications", Niku, S.B, 2010, 9780470604465, TJ 211.N4

"Implementation of Robotic Systems", Wilson, Mike, 2014, 9780124047334, EBOOK/TS191.8.W55

"Introduction to robotics : mechanics and control", Craig, J. J, 2013, 9781292040042, TJ 211.C7

"Robotics: A Very Short Introduction", Winfield, Alan, 2012, 9780199695980, TJ211.W56

"Principles of Modern Manufacturing" Groover, Mikell P., 2013 9781118474204, TS183.G763

"PLC Hardware and Programming", Lamb, Frank, 2016, 978-1524648183,

"Introduction to autonomous mobile robots", Siegart, Roland, Nourbakhsh, Illah R., (2nd Edition), 2011, 978-0262015356, TJ 211.S4

"Probabilistic Robotics", Thrun, Sebastian, Burgard, Wolfram, Fox, Dieter, 2005, 978-0262201629, TJ 211.T575

[View reading list on Talis Aspire](#)

## **Subject specific skills**

Ability to conceive, make and realise a component, product, system or process.

Ability to be pragmatic, taking a systematic approach and the logical and practical steps necessary for, often complex, concepts to become reality.

Ability to be risk, cost and value-conscious, and aware of their ethical, social, cultural, environmental, health and safety, and wider professional engineering responsibilities.

## **Transferable skills**

Numeracy: apply mathematical and computational methods to communicate parameters, model and optimize solutions.

Apply problem solving skills, information retrieval, and the effective use of general IT facilities.

Overcome difficulties by employing skills, knowledge and understanding in a flexible manner.

Appreciation of the global dimensions of engineering, commerce and communication.

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## Study

### Study time

Type	Required
Lectures	18 sessions of 1 hour (12%)
Tutorials	10 sessions of 1 hour (7%)
Practical classes	9 sessions of 1 hour (6%)
Other activity	2 hours (1%)
Private study	111 hours (74%)
Total	150 hours

### Private study description

Guided Independent learning 111 hours (including completion of tutorial problem sheets and coursework assignments)

Practical Class-

1 x 1 hour Safety Controller Lab

2 x 1 hour PLC Programming Lab

1 x 3 hour on-line robot programming lab

1 x 3 hours (plus additional 3 hours if required) Vision Guided Robot programming lab

### Other activity description

2 x 1 hr revision class

## Costs

No further costs have been identified for this module.

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## Assessment

You must pass all assessment components to pass the module.

Students can register for this module without taking any assessment.

### Assessment group C4

	Weighting	Study time
Written Essay	30%	

	Weighting	Study time
Written essay 2250 words		
Mini Design Portfolio	20%	
Design portfolio 1500 words		
Online Examination	50%	
QMP		

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- Online examination: No Answerbook required
- Students may use a calculator
- Engineering Data Book 8th Edition

## Feedback on assessment

Verbal communication in the robot labs. Written comments and electronically marked-up assignments for the written essay and report.

Cohort level feedback on examinations

[Past exam papers for ES4A1](#)

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## Availability

### Courses

This module is Optional for:

- RESA-H6P9 Postgraduate Research Wide Bandgap Power Electronics
  - Year 1 of H6P9 Wide Bandgap Power Electronics (EngD)
  - Year 2 of H6P9 Wide Bandgap Power Electronics (EngD)

This module is Option list A for:

- Year 4 of UESA-H163 MEng Biomedical Systems Engineering
- Year 4 of UESA-H63X MEng Electronic Engineering
- Year 5 of UESA-H636 MEng Electronic Engineering with Intercalated Year
- Year 4 of UESA-H114 MEng Engineering
- Year 4 of UESA-HH76 MEng Manufacturing and Mechanical Engineering
- Year 5 of UESA-HH38 MEng Manufacturing and Mechanical Engineering with Intercalated Year
- Year 4 of UESA-H311 MEng Mechanical Engineering
- Year 4 of UESA-HH31 MEng Systems Engineering
- Year 1 of TESA-H643 Postgraduate Taught Electrical Power Engineering

- Year 1 of TESA-H642 Postgraduate Taught Energy and Power Engineering
- Year 4 of UESA-H606 Undergraduate Electrical and Electronic Engineering MEng

This module is Option list B for:

- Year 4 of UESA-H336 MEng Automotive Engineering
- Year 5 of UESA-H636 MEng Electronic Engineering with Intercalated Year
- UESA-H311 MEng Mechanical Engineering
  - Year 4 of H30G Mechanical Engineering with Business Management
  - Year 4 of H30P Mechanical Engineering with Fluid Dynamics
  - Year 4 of H30M Mechanical Engineering with Robotics
  - Year 4 of H30H Mechanical Engineering with Sustainability
- Year 4 of UCSA-G408 Undergraduate Computer Systems Engineering

This module is Option list C for:

- UESA-H311 MEng Mechanical Engineering
  - Year 4 of H311 Mechanical Engineering
  - Year 4 of H30J Mechanical Engineering with Appropriate Technology
  - Year 4 of H30L Mechanical Engineering with Automotive Engineering
  - Year 4 of H30N Mechanical Engineering with Systems Engineering
- Year 4 of UESA-H316 MEng Mechanical Engineering
- Year 4 of UESA-H318 MEng Mechanical Engineering with Exchange Year
- Year 5 of UESA-H317 MEng Mechanical Engineering with Intercalated Year