

WM3G9-30 Design of Automation Systems

26/27

Department

WMG

Level

Undergraduate Level 3

Module leader

Paolo Villella

Credit value

30

Module duration

42 weeks

Assessment

100% coursework

Study locations

University of Warwick main campus, Coventry Primary

Distance or Online Delivery

Description

Introductory description

This 30CATS module, running throughout the academic year, gives learners an opportunity to apply academic knowledge to real-life scenarios/work-based challenges.

The module provides an overview on architectures and technologies for control and supervision of industrial automation and follows a bottom-up approach. The first part is dedicated to microcontrollers as tools for implementing field control (lowest control level). The second part introduces the students to the problem of task scheduling, which is central to process control (middle control level). The third and final part focuses on architectures of distributed communication networks for supervision and coordination of processes (high level control).

This module is linked with C1, C2,C3,C4, C5, C6, C9,C11,C12, C13, C16, C17, C18 of the AHEP 4.

LO1- C3, C4, C12, C13

LO2- C1,C2,C3,C6,C9,

LO3- C1,C2,C3,C4,C6,C9,C11,C12,C13

LO4- C17

Module aims

This module aims at introducing students to the most relevant problems and solutions of industrial automation. It is structured in order to raise awareness about the interconnections among different technologies and how they are integrated in modern industrial automation systems.

At the end of the course, the students will be acquainted with every aspect of the design of an automation system: initial specifications, selection of a high-level control architecture suitable for a given plant, definition of task scheduling for coordinating various processes, implementation of a digital low level controller.

Finally the module aims at cultivating a reflective approach of assessing one's input and effectiveness when working as an individual/group member/group leader.

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.

- Introduction to Automation Systems
- Microcontrollers: general characteristics, integrated peripherals, programming, motion control.
- Task scheduling: definition of the problem, classification of scheduling algorithms, Rate Monotonic Priority Ordering (RMPO), Earliest Deadline First (EDF), Deadline Monotonic Priority Ordering (DMPO), Time Scheduling (TS), .
- Distributed computer systems: communication networks, classification of networks, ISO-OSI architecture, fieldbus.
- CAN bus protocol, simulations and practical work
- LIN and FlexRay protocols and applications
- XCP (ECU measurement and calibration protocol) simulations

Learning outcomes

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

- Select and program a microcontroller for motion control. [AHEP:4-C3, C4, C12, C13]
- Define and solve problems of task scheduling for the coordination of different processes. [AHEP:4-C1,C2,C3,C6,C9]
- Formulate requirements and identify control architectures for distributed systems at the coordination level.[AHEP:4-C2,C3, C4, C12]
- Communicate the findings of their work to technical and non-technical audience. [AHEP:4-C17]
- Demonstrate the ability to work as an individual or a team member to achieve shared objectives in a project of work while being able to reflect and retrospectively critique the

overall outcome of one's contribution. [AHEP:4-C16]

Indicative reading list

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

[Specific reading list for the module](#)

Subject specific skills

- Translate conceptual ideas or technical requirements into developmental outcomes or operational designs or specifications for systems or components to solve electrical/control challenges. (S1 in both DA standards)
- Select, use and apply approved problem-solving methods to solve complex problems and determine appropriate solutions or actions (S2 in both DA standards).
- Collate and use a range of data sources and supporting documentation to support projects. (S3 in both DA standards).
- Observe, record and draw accurate and auditable conclusions from data and/or developmental or test evidence.(S5 in both DA standards).
- Manage assigned projects or programmes of work, taking into account factors such as safety, quality, cost and performance criteria (S6 in both DA standards).
 - Identify resources required to complete control system projects, project tasks or programmes of work, with consideration to factors such as cost, quality, safety, security, environmental impact as applicable to the activity. (S8 in ST0023; S9 in ST0024).
 - Create a project or work programme plan and develop activities in a logical process embedding mechanisms for adapting to changing circumstances or requirements.(S9 in ST0023; S10 in ST0024).
 - Ensure that all systems or testing/prototyping equipment has been correctly configured and checked for safe operation before use. (S11 in ST0023; S13 in ST0024).

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.
 - Reflect on learning, seeking feedback on and evaluating personal practices, strengths and opportunities for personal growth.
 - Written communication: Present arguments, knowledge and ideas, in a range of formats
 - Use rational and logical reasoning to deduce appropriate and well-reasoned conclusions.
 - Operate within, and contribute to, a respectful, supportive and cooperative group climate.
-

Study

Study time

Type	Required
Lectures	12 sessions of 1 hour (4%)
Seminars	12 sessions of 1 hour (4%)
Practical classes	6 sessions of 1 hour (2%)
Online learning (scheduled sessions)	30 sessions of 1 hour (10%)
Online learning (independent)	10 sessions of 1 hour (3%)
Other activity	10 hours (3%)
Private study	100 hours (33%)
Assessment	120 hours (40%)
Total	300 hours

Private study description

Self-guided study: revision on module contents, solution of additional seminar-type questions, video tutorials and supplementary materials.

Group activities: work together on the final group project.

Study and use of simulation software.

Online forum and discussion (asynchronous).

Other activity description

On-line support / consultancy before assessment.

Costs

No further costs have been identified for this module.

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 (individual): Programming 25%		30 hours	Yes (extension)

Weighting

Study time

Eligible for self-certification

of Microcontrollers

The portfolio is focused on a task executed by a microcontroller. It consists of:

- a pre-lab code written in preparation for the lab to be submitted prior to the lab
- during the lab experience, the student runs the code on a real microcontroller and stores all results
- the student then submits a report which includes discussions and analysis on the results obtained in the lab. The report should contain the commented code.

Reassessment component

Assignment 1 (individual): Programming
of Microcontrollers

No

The portfolio is focused on a task executed by a microcontroller. It consists of:

- a pre-lab code written in preparation for the lab to be submitted prior to the lab
- during the lab experience, the student runs the code on a real microcontroller and stores all results
- the student then submits a report which includes discussions and analysis on the results obtained in the lab. The report should contain the commented code.

Assessment component

Assignment 2 (Individual): Task
scheduling

25%

30 hours

Yes (extension)

Individual project on the Task Scheduling for an industrial automation system.

It consists of:

- A description of an industrial process where many tasks need to be executed concurrently.
- A proposed solution for scheduling the tasks, with graphs and simulations.
- A final discussion on the obtained results.

Reassessment component

Assignment 2 (Individual): Task
scheduling

No

Individual project on the Task Scheduling for an industrial automation system.

It consists of:

- A description of an industrial process where many tasks need to be executed concurrently.
- A proposed solution for scheduling the tasks, with graphs and simulations.

Weighting**Study time****Eligible for self-certification**

- A final discussion on the obtained results.

Assessment component

Assignment 3 (Group): Process Control Architecture. 50% 60 hours No

The project contains the design of a full control system for an industrial process chosen by the group of students.

It includes:

- A description of an industrial process that needs to be automated, which includes user requirements and technical specifications.
- The design of a control architecture for automating the process. This includes block diagrams, graphs and simulations.
- The full design of one subsystem of the full control system, with selection of commercial components and implementation details.

Typical group size: 6 possibly 5. Will be subjected to Peer-Marking in line with the WMG policy.

Reassessment component

Assignment 3 Resubmission Individual Project on Process Control Architectures. No

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.

Assignment 3:

FORMATIVE FEEDBACK:

-Verbal individual feedback given during seminar/tutorial sessions.

SUMMATIVE FEEDBACK:

Written group feedback.

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)
- Year 3 of UWMS-H7C2 Undergraduate Applied Professional Engineering (Electrical/Electronic Support Engineer)
- Year 3 of DWMS-H7C6 Undergraduate Applied Professional Engineering (Electrical/Electronic Support Engineer) (Degree Apprenticeship)