# WM3C8-15 Electronics Design and Development Principles

## 24/25

**Department**
WMG
**Level**
Undergraduate Level 3
**Module leader**
Farah Villa Lopez
**Credit value**
15
**Module duration**
1 week
**Assessment**
100% coursework
**Study location**
University of Warwick main campus, Coventry

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## Description

## Introductory description

This modules focuses on various aspects of the design and development of printed circuit boards for electronic products. Both theoretical and practical aspects involved in the design, manufacture, assembly and testing of electronics are covered.

In this module, principles of CAD tools are applied for the design of electronic boards. Practical sessions will be carried out for the manufacture of printed circuit boards.

This modules is linked with C1, C2, C3, C12, C13 and C17 of the AHEP 4.

LO1 - C1, C2, C3, C14, C17
LO2 - C13, C17
LO3 - C3
LO4 - C12, C13

Module web page

## Module aims

This module aims to introduce learners to the principles and processes used in the design, manufacture and assembly of electronic systems for finished products. The module enable learners to consider practical aspects in the design and development of electronic boards including design constraints, product requirements, manufacturing capabilities and testing considerations.

Learners will be introduced to the use of Computer Aided Design (CAD) software for the design of printed circuit boards (PCBs). They will apply layout design considerations for signal integrity, manufacturability and testability and use the CAD software for the design of complex circuit boards.

## 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.

- Electronic Components: Packaging technologies (surface mount and through-hole mount).
- Integrated circuits (hybrid, monolithic and chip-on-board integration) .
- Passive components (composition and general characteristics, and selection).
- Printed Circuit Boards (PCBs): layer stack , configurations and materials.
- Layout design features: tracks, pads, solder lands, footprints, vias, mounting holes.
- General Design of PBCs: component placement, thermal relief, necking, teardrops.
- Design for Manufacture: minimum spacing, widths, hole sizes, manufacturer tolerances and capabilities.
- Design for Signal Integrity: track current carrying capacity, crosstalk, grounding, EMC.
- Thermal considerations and electronics cooling: heatsinks and thermal vias.
- Design for Testability: testing methods and test points.
- Design for other applications such as high-frequency boards or flexible substrates.
- Manufacturing and assembly processes for prototyping and mass production.
- Schematic capture, routing and fabrication outputs.

## Learning outcomes

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

- Apply practical design considerations related to signal integrity, manufacturability, testability and assembly of printed circuit boards according to product specifications. [AHEP:4-C1,C2,C13]
- Discuss practical issues associated with the design, manufacture and assembly of electronic circuits for mass production. [AHEP:4-C13,C17]
- Design printed circuit boards using computer aided design software. [AHEP:4-C3]
- Manufacture and test a prototype printed circuit board to meet design and product assembly specifications. [AHEP:4-C12,C13]

## Indicative reading list


- P. Wilson (2017) The Circuit Designer’s Companion. 4th Edition. Oxford: Newnes.

- K. Mitzner (2019) Complete PCB design using OrCAD Capture and PCB editor. London: Academic Press.
- H. Veendrick (2019) Bits on Chips. Cham: Springer Nature
- R.S. Khandpur (2006) Printed Circuit Boards: Design, fabrication, assembly and testing. New York: McGraw-Hill.
- D. Brooks and J. Adam (2021) PCB Design Guide to Via and Trace Currents and Temperatures. Artech House.


View reading list on Talis Aspire

## Subject specific skills

Translate conceptual ideas or technical requirements into operational designs or specifications for systems or components to solve electrical/electronic challenges.

Select, use and apply approved problem-solving methods to solve complex problems and determine appropriate solutions.

Collate and use a range of data sources and supporting documentation to support projects.

Interpret and produce technical documentation such as schematic and circuit diagrams, engineering drawings or CAE models, simulation models, project plans, engineering reports, test reports, fault reports or data analytics.

Identify and rectify faults, inaccuracies, discrepancies or unexpected results during the electrical/electronic assembly, testing and commissioning processes, which may impact the quality and reliability of the component or system.

Ensure that all systems or testing/prototyping equipment has been correctly configured and checked for safe operation before use.

Identify areas for improvement and lead continuous improvement activities in the operation and performance of the system or component.

Use of Computer Aided Design software relevant to electrical/electronic engineering.

## Transferable skills

Critical thinking: Recognise patterns, themes and key messages from sometimes confused and incomplete data. Make information decisions on the value of a range of sources allowing an evidence based conclusion based on this analysis.

Problem solving: Use rational and logical reasoning to deduce appropriate and well-reasoned conclusions. Retain an open mind, optimistic of finding solutions, thinking laterally and creatively to look beyond the obvious.

Communication: Present arguments, knowledge and ideas, in a range of formats.

Information literacy: The systematic collection, analysis and evaluation of information in the investigation of a topic.

Digital literacy: Comfortable with using digital media to communicate, solve problems, manage information, collaborate, create and share content.

Professionalism: Prepared to operate autonomously. Aware of how to be efficient and resilient. Manages priorities and time. Self-motivated, setting and achieving goals, prioritising tasks.

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## Study

## Study time

| Type | Required |
|---|---|
| Lectures | 12 sessions of 1 hour (8%) |
| Seminars | 2 sessions of 1 hour (1%) |
| Tutorials | 15 sessions of 1 hour (10%) |
| Supervised practical classes | 2 sessions of 1 hour (1%) |
| Other activity | 4 hours (3%) |
| Private study | 55 hours (37%) |
| Assessment | 60 hours (40%) |
| Total | 150 hours |

## Private study description

- Revision of module contents.
- Study and use of PCB design software through supplementary tutorials.
- Online forum and discussion (asynchronous).

### Other activity description

On-line support and consultancy before assessments.

## 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.

### Assessment group A1

| | Weighting | Study time | Eligible for self-certification |
|---|---|---|---|
| Assignment 1 | 30% | 18 hours | No |
| A presentation (video recording) of the in-module work: design and manufacture of a prototype printed circuit board. Students work and submit in pairs. No peer-marking. | | | |
| Assignment 2 | 70% | 42 hours | Yes (extension) |
| Individual written report on the design of a printed circuit board for a specific application and design requirements. | | | |

### Feedback on assessment

Feedback given as appropriate to the assessment type:

- Verbal formative feedback given during seminar/practical sessions.
- Written feedback on Assignment 1.
- Written individual feedback on Assignment 2.

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## Availability

## Courses

This module is Core for:

- DWMS-H7C6 Undergraduate Applied Professional Engineering (Electrical/Electronic Support Engineer) (Degree Apprenticeship)
    - Year 3 of H7C6 Applied Professional Engineering (Electrical/Electronic Support Engineer) (Degree Apprenticeship)
    - Year 4 of H7C6 Applied Professional Engineering (Electrical/Electronic Support Engineer) (Degree Apprenticeship)