EE22005 Engineering Practice and Design Skill Evidence Framework

2025-26

Version	Author	Date	Changes
v1	Dr Melusine Pigeon	01/10/2025	Initial document
v2	Dr Melusine Pigeon	29/10/205	Corrected Standard and regulations Synthesis requirements
v3	Dr Melusine Pigeon	10/11/2025	Modification of the Moodle quiz Application requirement in “Engineering design for circular economy” skill.
v4	Dr Melusine Pigeon	08/01/2026	Modification of the Application level requirement of the “Market Analysis” skill. Modified submission date for this skill.

EE22005 Engineering Practice and Design Skill Evidence Framework

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The purpose of this Skills Framework is to evidence your acquisition of important engineering skills. Thus, it combines a combination of technical, sustainable and professional engineering skills. It is designed so that the final portfolio can be used as a showcase of your skills attainment.

To reflect the differing levels of skills attainment, each of the skills in this framework can be demonstrated at three different levels:

Knowledge: Achieved when you demonstrate a basic understanding of the skill's learning outcome.

Application: Achieved when you demonstrate the skill at request at a more advance level of autonomy and/or difficulty than Knowledge.

Synthesis: Achieved when you have demonstrated the skill without guidance or instruction for a complex project. A critical reflection demonstrates your understanding of the skill by highlighting what went well and what could be improved (50-100 words). The choice of the skills for this complex project must be supported by evidence showing that it is a suitable combination of skills. This allows you to demonstrate your understanding of when this skill is appropriate and how it fits within a wider context. There is also an expectation that you are demonstrating this skill effectively at a more difficult level to achieve synthesis.

Each skill will have specific requirements for the skill to be satisfactorily endorsed. In addition, there are **overarching requirements** for all pages of your ePortfolio. If any page does not satisfy these requirements, the page will **not be considered** in any further detail.

1. The page comprises an **introduction** that summarises all the digital artefacts on the page.
2. The page comprises an **AI Acknowledgement section** that summarises how AI was used for this page with a link to the chat used. If you have not used GenAI at all, this should simply state “GenAI was not used in the preparation of this assignment.”
3. Every digital artefact (e.g. photos, figures, videos and other non-text items) must clearly **show the username of everyone contributing to the work** in such a way as to authenticate the intellectual ownership of the artefact.
4. All the skills being claimed are **arranged below a 'Skills Mapping' block** at the bottom of the page, as per the template.
5. The page is of **sufficient quality** to present to people external to the University.
6. The page has **fewer than 5 errors** such as spelling mistakes or other typographical errors.
7. Any evidence in audio format must be recorded in a quiet, stable environment, with **clear speech at a moderate pace**, to ensure clarity and comprehensibility.
8. **References** are used to support statements made.

1. Professional Engineering

1.1 Feasibility Study			
Size/Category	Large, Compulsory	**Skill Owner**	Dr Melusine Pigeon
# of students	3-6	**Formative Deadline**	Friday W19
Learning Outcomes	Analyse technical against target specifications and identify the best solution for a given target specification using a weighted methodology.		
Knowledge Requirements	For Knowledge, you should complete the " Feasibility study" Moodle quiz available on this unit's Moodle page.		
Application Requirements	For Application, the page should include a section titled 'Feasibility study' which includes: 1) The design and development matrix competed until the columns 'Possible/alternative solutions' and 'Chosen technical solution'. It means the user needs and related Target specifications are correctly completed as per Y1 skill. With the users need column covering the following categories: performance, societal, aesthetic, sustainability, usability and business. This will involve consideration of applicable health & safety, diversity, inclusion, cultural, societal, environmental and commercial matters, codes of practice and industry standards. 2) All information in this table would be supported by relevant references. 3) The possible/alternative solutions listed as bullet points. 4) For each chosen technical solution, a description of the criteria used to make the decision, and the importance/value allocated to each of them is included. It should be clear how those criteria relate to the target specifications column. 5) For each decision made, a choice matrix for the solutions discussed which clearly shows the weighting applied to the different alternatives and which one is the best. 6) The section also includes a conclusion paragraph which summarises the outcome of the choice matrix (50-100words or 1min audio/video file).		
Synthesis Requirements	For Synthesis, the page should include a section titled " Feasibility study" which includes: 1) The requirement for Application level and in addition: 2) The verification sections of the D&D matrix completed as per Y1 skill. 3) At least 2 verification test protocol documents written as a .doc format with version control and naming related to your related quality management skill. 4) The results of those 2 tests compiled in related .doc file with explanations and conclusion.		
Knowledge Opportunities	After the lecture W9		
Application Opportunities	Project week 2 W17		

1.2 Ethics for Engineering			
Size/Category	Large, Compulsory	**Skill Owner**	Dr Melusine Pigeon
# of students	1	**Formative Deadline**	Friday W19

Learning Outcomes	Identify and analyse ethical concerns and make reasoned ethical choices informed by professional codes of conduct. Understand intellectual property and legal aspects of engineering.
Knowledge Requirements	For Knowledge, you should complete the "Ethics for Engineering" Moodle quiz available on this unit's Moodle page.
Application Requirements	For Application, the page should include a section titled 'Ethics for Engineering' that includes the following elements. Each element should be a sub-section with a related title: 1) Description of an ethical consideration considered in the design of a work or product. And how it relates to a code of conduct of an engineering body (50-100 words or 1min audio/video) 2) Discussion of an intellectual property element linked to the work or product (100-250 words or 2 min audio/video). 3) Discussion of a legal aspect related to the work or product (100-250 words or 2 min audio/video). 4) All the sections should be supported with relevant references.
Synthesis Requirements	For Synthesis, the page should include a section titled 'Ethics for Engineering' that includes: 1) The requirements for Application level but 2) each of them in the form of a pro/con argumentation. In this argumentation you should provide for each argument made at least: - one pro element - one con element - a critical judgement taking both into account. For this the word count is modified and doubled for each sub-section. If you decide to use the audio/video format, it could be the recording of a debate. 3) References are key here even for the audio/video format.
Knowledge Opportunities	After the lecture W9
Application Opportunities	Project week 2 W17

1.3 Risk Mitigation

Size/Category	Large, Compulsory	**Skill Owner**	Dr Philip Shields
# of students	1-6	**Formative Deadline**	Friday W25
Learning Outcomes	Use a risk management process to identify, evaluate and mitigate risks (the effects of uncertainty) associated with a particular project or activity.		
Knowledge Requirements	For Knowledge, you should complete the "Risk Mitigation" Moodle quiz available on this unit's Moodle page.		
Application Requirements	Achieving the skill at application requires completion of the skill at Knowledge and additionally... The page should include a section entitled 'Risk assessment', that includes: 1) A risk assessment matrix using the provided template as a PDF document (screenshots are not acceptable) which identifies the risks to the project (minimum of 5 risks), describes them concisely, and identifies their periodicity and severity, and ranks them according to the combination of periodicity and severity weighting. 2) Further risk mitigation should be described (20-50 words each) to ensure all risks		

	are at an acceptable level, with new values of either periodicity or severity, and risk rating. 3) The levels of periodicity must be quantitatively defined. 4) The severity scale must be defined in terms of criteria and relate clearly to the context of the project. 5) A risk acceptance matrix that has been colour coded to identify what risk ratings are acceptable, require mitigation or must be avoided.
Synthesis Requirements	Achieving the skill at Synthesis requires: 1) Completion of the requirements detailed at the Application level, and 2) Your independent project must use this skill alongside the Project Management and Time Management skills and have consistent content.
Knowledge Opportunities	After the lecture W21
Application Opportunities	Project week 3 W24

1.4 Being Security Minded

Size/Category	Large, Compulsory	**Skill Owner**	Dr Philip Shields
# of students	1	**Formative Deadline**	Friday W22
Learning Outcomes	Engineers should be security-minded: identifying, assessing, and mitigating threats to ensure the safety and integrity of engineering projects. This ranges from protecting sensitive information and intellectual property to ensuring the physical security of assets and infrastructure. Engineers are expected to consider potential vulnerabilities and implement mitigation to safeguard against deliberate, unwanted, hostile, or malicious acts in a holistic and proportionate way.		
Knowledge Requirements	For Knowledge, you should complete the "Being Security Minded" Moodle quiz available on this unit's Moodle page.		
Application Requirements	Achieving the skill at application requires completion of the skill at Knowledge and additionally... The page should include a section entitled 'Being security-minded' where you consider and respond to one of the following principles within the context of a case study provided to you (100-250 words or 2 min audio/video): 1) Adopting a security-minded approach to your professional life. 2) Applying responsible judgement to security issues. 3) Understanding and complying with security codes. 4) Ensuring security-minded communications. 5) Understanding and complying with security management policies. 6) Contributing to awareness of security.		
Synthesis Requirements	To achieve the skill at Synthesis you should discuss a significant security consideration within your Synthesis project in the context of more than one of the following principles (250-500 words or 5 min audio/video): 1) Adopting a security-minded approach to your professional life. 2) Applying responsible judgement to security issues. 3) Understanding and complying with security codes. 4) Ensuring security-minded communications.		

	5) Understanding and complying with security management policies. 6) Contributing to awareness of security.
Knowledge Opportunities	After the lecture W21
Application Opportunities	Case study released after the lecture W21

1.5 Team Leadership			
Size/Category	Large, Compulsory	**Skill Owner**	Dr Melusine Pigeon
# of students	3-6	**Formative Deadline**	Friday W25
Learning Outcomes	Understand the roles in a team and the responsibilities for leading a team with civility.		
Knowledge Requirements	For Knowledge, you should complete the "Controversy with Civility" Moodle quiz available on this unit's Moodle page.		
Application Requirements	For Application, the page should include a section titled " Team leadership" which includes: 1) A team charter 2) A skill matrix completed as per Y1 "inclusive Teamwork" skill. 3) A description of a process that you have implemented in your team to facilitate communication of controversy with civility (50-100 words or 1 min audio/video). 4) An explanation about how the impact of this process on expressing controversy with civility (50-100 words or 1 min audio/video).		
Synthesis Requirements	For Synthesis, the page should include a section titled " Team leadership" which includes: 1) The requirement for Application level and in addition: 2) An organisation chart of the team with clear identification of the different roles within the team and related allocated tasks. 3) A description of the team management tools used for this project consistent with the information provided for the project, time, risk, quality and change management skills (100-250 words or 2 min audio/video).		
Knowledge Opportunities	After the controversy and civility lecture W19		
Application Opportunities	Project week 3 W24		

1.6 Investigation of complex problems with practical laboratory skills			
Size/Category	Large, Compulsory	**Skill Owner**	Dr Melusine Pigeon
# of students	1	**Formative Deadline**	Friday W19
Learning Outcomes	Demonstrate that you know how to use laboratory skills such as the use of instrumentation equipment to help you solve problems with non-trivial solution (complex).		
Knowledge Requirements	For Knowledge, you should complete the "Complex Problem" Moodle quiz available on this unit's Moodle page.		

Application Requirements	For Application, on the Project Week 2 and/or 3 page, you should claim the skill by identifying where in the Project Week page you have used laboratory equipment to solve the project week problem. You need to provide the exact name of the different sections where laboratory equipment was used and proof of the accurate and relevant use of this equipment.
Synthesis Requirements	For Synthesis, on the your own Synthesis COMPLEX problem page you should claim the skill by identifying where in the page you have used laboratory equipment to solve the complex problem of your project. You need to provide the exact name of the different sections where laboratory equipment was used and proof of the accurate and relevant use of this equipment.
Knowledge Opportunities	Beginning of project week 2 W17
Application Opportunities	Project week 2 W17

1.7 Quality Management System

Size/Category	Large, Compulsory	**Skill Owner**	Dr Melusine Pigeon
# of students	3-6	**Formative Deadline**	Friday W7
Learning Outcomes	Discuss the role of quality management systems and continuous improvement in the context of complex problems.		
Knowledge Requirements	For Knowledge, you should complete the "Quality Management" Moodle quiz available on this unit's Moodle page.		
Application Requirements	For Application, the page should include a section titled 'Quality management', this section should include: 1) The folder tree of a Quality Management System (QMS). 2) A word document which explains the process for naming the files in the QMS. 3) A list (in an excel format) of all the files in the QMS and their location. 4) Among the files, the traceability matrix which captures the D&D of the product (partially completed) 5) Explanation of the continuous improvement process used for the work or project (50-100 words)		
Synthesis Requirements	For Synthesis, the page should include a section titled 'Quality management', this section should include: 1) The requirements for the Application level with: 2) The D&D completed as per the "Feasibility study" Synthesis skill requirements (up to the verification columns). 3) The testing protocols and results documents rightfully named, stored and listed within the QMS. 4) The others management documents (change, project, risk and time) rightfully named, stored and listed within the QMS.		
Knowledge Opportunities	After the lecture W2		
Application Opportunities	Project week 1 W6		

1.8 Advanced Time Management			
Size/Category	Large, Compulsory	**Skill Owner**	Dr Philip Shields
# of students	1-6	**Formative Deadline**	Friday W7
Learning Outcomes	Managing project time effectively in the face of uncertainty is an essential skill for the engineer since we do not know what obstacles might arise internally from the project or changes that might be imposed by stakeholders or circumstances external to the project.		
Knowledge Requirements	For Knowledge, you should complete the "Time Management" Moodle quiz available on this unit's Moodle page.		
Application Requirements	Achieving the skill at application requires completion of the skill at Knowledge and additionally... The page should include a section entitled 'Time management', that includes: 1) A GANTT chart embedded as a single page PDF file (not screenshot or image) for a time-constrained project, created using Microsoft Project, where a) the timeline of your project must include parallel tasks; b) Tasks on the critical path should be clearly highlighted in red; c) Buffers must be included to account for potential delays. 2) The most significant time-related risk event that could jeopardise the delivery of the project outcome should be described (50-100 words).		
Synthesis Requirements	Achieving the skill at Synthesis requires: 1) Completion of the requirements detailed at the Application level, and 2) Your independent project must use this skill alongside the Project Management and Risk Management skills and have consistent content.		
Knowledge Opportunities	After the lecture W4		
Application Opportunities	Project week 1 W6		

1.9 Advanced Project Management			
Size/Category	Large, Compulsory	**Skill Owner**	Dr Philip Shields
# of students	1-6	**Formative Deadline**	Friday W7
Learning Outcomes	Breaking down project management into scope, aims, objectives, work packages, tasks, deliverables, and milestones ensures clarity and organization. Each element has a specific role, helping to define boundaries, set goals, organize work, specify outputs, and track progress. This structured approach enhances communication and planning, improving project success.		
Knowledge Requirements	For Knowledge, you should complete the "Project Management" Moodle quiz available on this unit's Moodle page.		
Application Requirements	Achieving the skill at application requires completion of the skill at Knowledge and additionally... The page should include a section entitled 'Project management', that includes: 1) Project title 2) Aims (50-100 words) 3) Scope (50-100 words)		

	4) Objectives (more than one, enumerated and described using SMART as a guideline) (20-50 words per objective) 5) Work packages (more than one, enumerated, each with a set of tasks) 6) Deliverables and milestones (at least one of each, with each associated with a specific work package)
Synthesis Requirements	Achieving the skill at Synthesis requires: 1) Completion of the requirements detailed at the Application level, and 2) Your independent project must use this skill alongside the Time Management and Risk Management skills and have consistent content.
Knowledge Opportunities	After the lecture W4
Application Opportunities	Project week 1 W6

1.10 Change Management			
Size/Category	Large, Compulsory	**Skill Owner**	Prof Peter Wilson
# of students	1	**Formative Deadline**	Friday W25
Learning Outcomes	1. Know how to implement change management on a design item (could be document, data element, code or similar) 2. Know what version control entails 3. Be able to use change management software such as github		
Knowledge Requirements	For Knowledge, you should complete the "Change Management" Moodle quiz available on this unit's Moodle page.		
Application Requirements	For application level, provide examples of the following: 1. Provide an example repository on github 2. Demonstrate with an example how you have managed a change to an item in the github repository 3. Show how you created a branch in your repository to make a change, and then how this was merged back into the main branch. 4. Show how you documented the change in github		
Synthesis Requirements	For synthesis level: 1. Provide an example of how you used version control on one of your own projects 2. Demonstrate how you managed your project to implement changes, focussing on how this was documented and tracked 3.Explain how you were able to track all the changes across your project effectively.		
Knowledge Opportunities	After the lecture W20		
Application Opportunities	Project week 3 W24		

1.11 Scientific communication to a non-technical audience			
Size/Category	Large, Compulsory	**Skill Owner**	Dr Fang Duan
# of students	1	**Formative Deadline**	Friday W7
Learning Outcomes	Engineers often need to deliver information concisely in time-limited settings such as project meetings or conferences. Developing the ability to present key ideas clearly without oversimplifying or omitting important details is therefore a critical professional skill.		
Knowledge Requirements	For Knowledge, you should complete the "Scientific communication to a non-technical audience" Moodle quiz available on this unit's Moodle page.		
Application Requirements	Deliver a clear and logically structured presentation within 2:45–3:00 minutes. Demonstrate understanding of the topic by explaining concepts accurately and avoiding major errors. Use basic audience engagement. Include a few visuals aid (e.g., slide, diagram, or image) that supports the explanation.		
Synthesis Requirements	Building on the above of application requirements, students should make the topic clear and engaging by using simple storytelling, such as an analogy, real example, or short narrative. They are expected to pay attention to the audience and use visual aids that support the message without distraction. The overall delivery should feel professional, with content, style, and visuals working well together.		
Knowledge Opportunities	After the lecture W2		
Application Opportunities	Project week 1 W6		

1.12 Write an Executive Summary			
Size/Category	Large, Compulsory	**Skill Owner**	Dr Fang Duan
# of students	1	**Formative Deadline**	Friday W25
Learning Outcomes	To develop students' ability to effectively communicate complex technical information in written form. Engineering students should be able to produce clear, concise, and well-structured executive summary for reports and research papers that meet professional and academic standards.		
Knowledge Requirements	For Knowledge, you should complete the "Executive Summary" Moodle quiz available on this unit's Moodle page.		
Application Requirements	In relation to a specified written existing piece of work, to claim this skill your page must include: 1. A copy of the written piece 2. An executive summary that captures the following key information (250-500 words): 1. Context 2. Methodology 3. Results 4. Conclusion		

	5. Impact
Synthesis Requirements	To claim this skill at the synthesis level in relation to a specified written piece of work, your page must include: 1. A copy of the written piece. 2. An executive summary (250–500 words) that follows the required structure (Context, Methodology, Results, Conclusion, Impact). 3. A justification (50–100 words) explaining why this executive summary format was chosen as the most effective way to communicate the value of the work compared with other possible approaches (e.g., full technical report, presentation slides, infographic). 4. A critical reflection (50–100 words) on how well the executive summary achieved its objective within the wider context of the project or system. This should include: a. What worked well. b. What could be improved. c. How the skill of executive summary writing contributed to a broader project goal or communication strategy.
Knowledge Opportunities	After the lecture W22
Application Opportunities	Project week 3 W24

1.13 Continuous Professional Development (CPD)			
Size/Category	Large, Compulsory	**Skill Owner**	Prof Peter Wilson
# of students	1	**Formative Deadline**	Friday W2
Learning Outcomes	1. Draft a cover letter for a placement or job opportunity 2. Create and Update their LinkedIn profile 3. Outline their goals for the year with plan of key tasks to achieve them 4. Engage with external bodies such as the IET or IEEE.		
Knowledge Requirements	For Knowledge, you should complete the "CPD" Moodle quiz available on this unit's Moodle page.		
Application Requirements	To claim this skill at application level, students will need to: 1. Draft a suitable cover letter for a placement or job opportunity. 2. Create or update their LinkedIn Profile. 3. Provide 3 main goals for the academic year and a plan of key tasks to achieve those goals. 4. Reflect on the previous academic year, focussing on their goals for the year, how well they were achieved, and lessons learned during the year. 5. Complete a 1:1 interview with another student and provide their reflections on how that went, and also comment on their reviewer's questions.		
Synthesis Requirements	To claim this skill at synthesis level students will need to provide one or more of the options below: 1. Provide a reflection on their own experience of applying for positions including		

	placements, internships and other jobs 2. Describe how they have engaged with professional institutions such as the IET, IEEE or similar technical bodies. 3. Describe activities they have undertaken to improve their professional profile including external training, digital certificates, LinkedIn training courses and self-directed learning, reflecting on how they have impacted their abilities and/or how this may have improved their professional profile.
Knowledge Opportunities	During the lab W1
Application Opportunities	Lab W1

1.14 Market Analysis (competitors)			
Size/Category	Large, Compulsory	**Skill Owner**	Dr Matt Cole
# of students	1 Data for max 5 person	**Formative Deadline**	Friday W19
Learning Outcomes	Analyse the competitors related to a product and being able to draw conclusion on whether the product is viable on a commercial point of view.		
Knowledge Requirements	For Knowledge, you should complete the "Business" Moodle quiz available on this unit's Moodle page.		
Application Requirements	A brief analysis of the market in the PM business game. This is to include content on your direct competitors and why they are perceived as such. Using data, this should include details on their product offering, core mission, business strategy, and business structure. (150-200 words).		
Synthesis Requirements	The page should include a written section of no more than 700 words entitled 'Market analysis' for any student-selected real product in the market (e.g. Coke, Apple laptop, etc.) , this section should include: 1) Identification of at least 4 competitors for the product discussed, at least one of which must be an indirect competitor. 2) Definition of the competitors' products and how they differ from one another. 3) An explanation of why these companies were selected and why they are viewed as competitors. 4) A comparison of the business strategies of the selected companies. 5) Use of multiple definitions of the market size for the work or product 6) Exploration of competitive landscape through the use of wider proxy metrics and evidence sources, such as stock market data, social media data, and others.		
Knowledge Opportunities	After the lecture W11		
Application Opportunities	Business game W11		

1.15 Product Production Costing			
Size/Category	Large, Compulsory	**Skill Owner**	Dr Matt Cole

# of students	1	**Formative Deadline**	Friday W15
Learning Outcomes	Detail the costs related to a product including materials, labour, estates, and human resources and link these to a company's business strategy.		
Knowledge Requirements	For Knowledge, you should complete the "Business" Moodle quiz available on this unit's Moodle page.		
Application Requirements	This written submission requires the use of evidence collected during the Business Game laboratory though can be completed using evidence for a personal project should students wish. The Mahara submission should include; - evidence confirming pass of the Knowledge MCQ - a section entitled 'Costing' - a summary excel (or equivalent) image with a breakdown of the costs for the work or project - a written section with justification for each of the stated costs (500 words) Costs to be considered should include: 1) The costs of the components and material to build the work or project. 2) The cost of labour including tax, national insurance, and pension contribution. 3) The cost of using facilities and equipment including estimated maintenance and depreciation. 4) One-off and recurring HR costs such as boarding, firing, and benefits.		
Synthesis Requirements	Evidence of applying the K and A content to a real company, either led by the student or a detailed review of a real company that adds depth the K and A content through the use of extensive numerical data to support the narrative.		
Knowledge Opportunities	After the lecture W11		
Application Opportunities	Business game W11		

1.16 Efficient Referencing			
Size/Category	Large, Compulsory	**Skill Owner**	Dr Fang Duan
# of students	1	**Formative Deadline**	Friday W19
Learning Outcomes	Efficient referencing in report writing ensures that students accurately attribute sources, theories, and data. This improves the clarity and credibility of their arguments, making their reports more authoritative and professional. Learning to distinguish between weak and strong references encourages critical evaluation of sources. It helps you to question the validity, relevance, and reliability of the information you use.		
Knowledge Requirements	For Knowledge, you should complete the "Efficient Referencing" Moodle quiz available on this unit's Moodle page.		
Application Requirements	To claim this skill at the Application level, your page must include: 1. Correct use of IEEE style for in-text and reference list, 2. At least one strong authoritative source (e.g., journal, standard), 3. Writes a "Quality Referencing" section with justified relevance, quality, and timeliness (20–50 words each) - Demonstrates the ability to select high-quality and diverse sources (not overly reliant on websites)		

Synthesis Requirements	To claim this skill at the synthesis level, your page must include: 1. A substantial written piece (e.g., project report) that integrates at least 8 IEEE style references drawn from a wide range of source types (minimum 4 categories from the list: journal articles, standards, patents, conference papers, books, reports, datasheets, websites). 2. Justify your selection of references in relation to your overall project or system objective (why these sources were the most effective compared with alternatives). Show how referencing connected your work to the wider academic, technical, or professional context. 3. A critical reflection (50–100 words) evaluating the effectiveness of your referencing: -What worked well. -What could be improved. -How efficient referencing strengthened the credibility and impact of your work.
Knowledge Opportunities	After the lecture W8
Application Opportunities	Project week 2 W17

1.17 Standards and Regulations			
Size/Category	Large, Compulsory	**Skill Owner**	Prof Peter Wilson
# of students	1	**Formative Deadline**	Friday W7
Learning Outcomes	1. Know the role of standards and regulations in engineering design 2. Find the appropriate standards or regulations relevant to a specific area of engineering 3. Comment on how standards and regulations can have a positive impact on sustainability in engineering		
Knowledge Requirements	For Knowledge, you should complete the "Standards and Regulations" Moodle quiz available on this unit's Moodle page.		
Application Requirements	The page shall be entitled 'Standards and Regulations - Application' using the supplied template. The page shall include entries for all the following sections: 1. Specific Example Provide specific example of a standard (or regulation) defined by an engineering body (such as British Standards [BS], IET, IEC, ISO or IEEE) providing the engineering body, the standard designation number and the title of the standard. (20-50 words) 2. Description Provide a description of why the standard or regulation is in place, its primary purpose, and comment on its importance and relevance (50-100 words) 3. Example of Application: Provide an example of how a standard could be used in the design of an engineering product and how the standard would influence key design decisions (100-200		

	words) 4. Sustainability Impact Postulate where new standards or regulations might be required to improve sustainability of electronic products (50-100 words)
Synthesis Requirements	The page shall be entitled 'Standards and Regulations - Synthesis' using the supplied template. The page shall include entries for all the following sections, for a project of your own choosing. 1. Specific Example Provide specific example of a standard (or regulation) defined by an engineering body (such as British Standards [BS], IET, IEC, ISO or IEEE) providing the engineering body, the standard designation number and the title of the standard and how it was relevant to your own project (20-50 words) 2. Description Provide a description of why the standard or regulation specifically applies to your project (50-100 words) 3. Example of Application: Provide at least one example where the chosen standard influenced your design decisions (100-200 words)
Knowledge Opportunities	After the lecture W5
Application Opportunities	Project week 2 W6

2. Sustainable Engineering

2.1 Engineering design for circular economy			
Skill Category	Large, One compulsory in the section	**Skill Owner**	Dr Melusine Pigeon
# of students	1	**Formative Deadline**	Friday W7
Learning Outcomes	Understand how to design a product that could be either reused, recycled, or repaired. And how its CO2 footprint has been reduced. Understand how value creation (product design) and value recovery (recycling) are interconnected. Recognise how different recycling, repairing or reusing technologies work and what their implications are for product design. Optimise the reusability, recyclability, repairability of electrical and electronic products. Understand the implications of future developments in design for the 4Rs.		
Knowledge Requirements	For Knowledge, you should complete the "Engineering for Circular Economy" Moodle quiz available on this unit's Moodle page.		
Application Requirements	For Application, the page should include a section titled 'Engineering design for the circular economy' that links the following elements to a work or a project. Each element should be a sub-section with related title: 1) Which of the 4Rs has been investigated within the design process? And what technologies have been used to design the product? (50-100 words or 1 min audio/video) 2) What is the impact on the life cycle assessment of the work or project such as the CO2 footprint? (50-100 words or 1 min audio/video) 3) What is the monetary value created through this process? 4) The completion of the Moodle quiz is required but no evidence is needed in the portfolio. This will be checked by the skill owner directly on Moodle.		
Synthesis Requirements	For Synthesis, the page should include a section titled 'Engineering design for the circular economy" which includes: 1) The requirements for Application level but with: 2) The CO2 footprint of the devices thoroughly calculated for its full life cycle. 3) The quantified monetary impact of using the chosen Rs through the life cycle of the product.		
Knowledge Opportunities	After the lecture W3		
Application Opportunities	Project Week 1 W6		

2.2 Sustainable materials management			
Skill Category	Large, One compulsory in the section	**Skill Owner**	Dr Philip Shields
# of students	1	**Formative Deadline**	Friday W19
Learning Outcomes	Understanding the materials within your engineering design, how they are sourced, and the environmental impact they may have, is key to working out how you can		

	address these issues to ensure the design is as sustainable as possible with a transparent and ethical supply chain.
Knowledge Requirements	For Knowledge, you should complete the "Sustainable Materials Management" Moodle quiz available on this unit's Moodle page.
Application Requirements	Achieving the skill at application requires completion of the skill at Knowledge and additionally... The page should include a section entitled 'Sustainable Materials Management' in which you identify either a critical raw material or a hazardous material (one material only per skill claim) within your project or year 2 studies (200-500 words), and include: 1) A description of where the material exists within your project. 2) An explanation of why it has been used. 3) An explanation, including a citation from a reliable source, for why it is considered a hazardous or critical raw material. 4) A proposal for at least one engineering solution by which the use of this material can be made more sustainable. Alternatively, an explanation for why the properties of the material are unique and cannot be replaced. 5) You should ensure that your section is fully referenced using the IEEE style. 6) Each entry in the reference list should include a clickable link to the cited document.
Synthesis Requirements	Achieving the skill at Synthesis requires: 1) Completion of the requirements detailed at the Application level, and 2) The skill must be embedded in a wider independent project and the chosen material must be clearly relevant to the overall project and have significant potential impact to its sustainability.
Knowledge Opportunities	After the lecture W10
Application Opportunities	Project Week 2 W17

2.3 Sustainable energy management			
Skill Category	Large, One compulsory in the section	**Skill Owner**	Dr Laiz Souto
# of students	1-6	**Formative Deadline**	Friday W25
Learning Outcomes	1) Understand different sustainable energy management practices in the Life Cycle Analysis (LCA) of a project. 2) Conduct an energy review to identify significant energy uses and establish energy performance indicators, energy baselines, and energy targets. 3) Identify measures to improve the energy performance of a simple sustainable energy management problem.		
Knowledge Requirements	For Knowledge, you should complete the "Sustainable energy management" Moodle quiz available on this unit's Moodle page.		
Application Requirements	Knowledge requirements plus LCA diagram including: (1) identification of energy performance improvements in the project setup (e.g., based on clean energy production, energy efficiency, and energy conservation measures) and		

	(2) covering raw material extraction, processing, manufacturing, use and maintenance, and end of life in the diagram.
Synthesis Requirements	Knowledge and application requirements plus (1) quantification of energy performance improvements in the LCA diagram of your own project setup and (2) reflection on why sustainable energy management is relevant in your own project/working setup.
Knowledge Opportunities	After the lecture W23
Application Opportunities	Project Week 3 W24

2.4 Regenerative Design			
Skill Category	Large, One compulsory in the section	**Skill Owner**	Dr Melusine Pigeon
# of students	1	**Formative Deadline**	Friday W27
Learning Outcomes	1) Understand what regenerative design is. 2) Apply it to a simple design.		
Knowledge Requirements	For Knowledge, you should complete the "Regenerative Design" Moodle quiz available on this unit's Moodle page.		
Application Requirements	For Application, the page should include a section titled "Regenerative Design" that links the following elements to a work or project. Each element should be a sub-section with related title: 1) What is the whole system considered? Using the schematic description presented in the lecture. For one aspect/factor of the project: 2) What is the positive environmental impact? And how the system eventually mimicks the natural world? Using the phase 1 to 4 of the workshop to thoroughly describe the impacts and biomimicry (100-200 words or 2min audio/video) 3) Describe the interdisciplinary collaboration by mentioning the different engineering (and non-engineering) disciplines needed to complete the project (50-100words or 1min audio/video). 4) What is the long-term perspective? Mentioning how the positive feedback loop will be put in place to ensure project adaptability in time (100-200 words or 2min audio/video). 5) Use references to support the statement made		
Synthesis Requirements	For Synthesis, the page should include a section titled "Regenerative Design" includes: 1) The requirements for Application level but completed for all the aspects/factors of the project and taking into account the 4 different levels of the project. The information should be presented as a table. 2) The regenerative design checklist completed for the given project.		
Knowledge Opportunities	During the lecture W26		

Application Opportunities	Workshop W26

3. PCB Design and manufacture

3.1 PCB design for manufacturing			
Skill Category	Medium, Specialist Skill	**Skill Owner**	Dr Ali Mohammadi
# of students	2	**Formative Deadline**	Friday W22
Learning Outcomes	Printed Circuit Boards (PCBs) provide a scalable platform for design and manufacture of electronic systems. Despite massive automation in this technology, familiarity with electronic components and layout design techniques are among the top skills in electronics industries. Creating and editing footprints for electronic components, netlisting circuit schematics, placing the components, routing the copper etches and generating standard design files (called Gerber files)		
Knowledge Requirements	For Knowledge, you should complete the "PCB" Moodle quiz available on this unit's Moodle page.		
Application Requirements	Requirements: 1) Completion of the knowledge requirements 2) To claim this skill, your page should include the following evidence of work carried out in ORCAD. All screenshots of the PCB must show your username in the etch layer. Screenshot of schematic symbols created based on a datasheet using different methods in ORCAD Capture. Screenshot of the created/edited PCB footprint netlisted in accordance with the schematic symbols. Screenshot of the PCB layout and the schematic of the circuit it is based on (e.g., an audio amplifier circuit). Demonstration of the application of appropriate design for manufacturing guidelines. (50-100 words). Screenshot of a generated multilayer board layout. Screenshot of the circuit schematic that the designed board is based on. Justification for the decision to use a multilayer scenario, including performance and cost factors with reference to estimated costs from a PCB supplier (50-100 words).		
Synthesis Requirements	Completing the application requirements for an independent project in combination with all the PCB design skills. 1) Screenshot of the circuit diagram, which needs advanced manufacturing compared with previous levels. 2) Screenshot of the PCB layout, with clear graphical annotation of five DFM rules, (Student IDs in etch layer) 3) Provide brief explanation of necessity for following DFM rules with mapping between manufacturer capabilities and component/system datasheets.		

Knowledge Opportunities	After the lecture W21
Application Opportunities	During lab until W21

3.2 Thermal Design			
Skill Category	Standard, Specialist Skill	**Skill Owner**	Dr Ali Mohammadi
# of students	2	**Formative Deadline**	Friday W30
Learning Outcomes	**Use analytical and computational tools** to model thermal behaviour, validate design choices, and optimize system performance under realistic constraints.		
Knowledge Requirements	For Knowledge, you should complete the "PCB" Moodle quiz available on this unit's Moodle page.		
Application Requirements	1. You should complete the knowledge requirements 2. Screenshot of DC-DC converter board layout designed in accordance with manufacturing guidelines only. 3. Screenshot of a revised layout considering thermal design considerations with graphical annotations. 4. Verification of the design by running thermal simulation in ANSYS or any other Multiphysics tool that allows electrothermal modelling. Screenshots of the imported 3D model and simulation result. 5. Explanation of the rules of thumb and calculations for thermal resistance (50-100 words).		
Synthesis Requirements	Completing the application requirements for an independent project in combination with all the PCB design skills. 1) Screenshot of the circuit diagram which needs advanced thermal design considerations compared with previous levels. 2) Screenshot of the PCB layout, with clear graphical annotation of three thermal design considerations, (Student IDs in etch layer) 3) Verification of the design by running thermal simulation in ANSYS or any other Multiphysics tool that allows electrothermal modelling. Screenshots of the imported 3D model and simulation result. 4) Provide brief explanation of thermal design rules mapped to the proposed design.		
Knowledge Opportunities	After the lecture W23		
Application Opportunities	Lab W29		

1.1 Signal Integrity			
Skill Category	Standard, Specialist Skill	**Skill Owner**	Dr Ali Mohammadi

# of students	2	**Formative Deadline**	Friday W26
Learning Outcomes	**Use simulation tools and measurement techniques** to model, diagnose, and improve signal integrity in practical circuit designs.		
Knowledge Requirements	For Knowledge, you should complete the "PCB" Moodle quiz available on this unit's Moodle page.		
Application Requirements	1. You should complete the knowledge requirements 2. Screenshot of the Microcontroller board layout designed in accordance with manufacturing guidelines only. 3. Screenshot of a revised layout considering signal integrity considerations with clear graphical annotations of at least three changes. 4. Explanation of the applied techniques for signal integrity of the system (50-100 words).		
Synthesis Requirements	Completing the application requirements for an independent project in combination with all the PCB design skills. 1) Screenshot of the circuit diagram which needs advanced Signal Integrity considerations compared with previous levels. 2) Screenshot of the PCB layout, with clear graphical annotation of three signal integrity rules, (Student IDs in etch layer) 3) Provide brief explanation of necessity for following SI rules with reference to component/system datasheets.		
Knowledge Opportunities	After the lecture W22		
Application Opportunities	Lab W25		

4. Programming and Embedded Systems

4.1 Hardware Description Language			
Skill Category	Large, Specialist Skill	**Skill Owner**	Dr Uriel Martinez Hernandez
# of students	2	**Formative Deadline**	Friday W5
Learning Outcomes	Programming in Hardware Description Language (HDL) prepares engineers to design, simulate, implement and verify digital systems in software for their deployment in hardware. In year 2 you will design and implement more complex digital systems designs than year 1 including counters, clocks, electronic locks, video controller and a microprocessor.		
Knowledge Requirements	For Knowledge, you should complete the "HDL" Moodle quiz available on this unit's Moodle page.		
Application Requirements	To claim this skill your page will showcase the aspects listed below: Requirement: to have knowledge skill 1 - A brief explanation (20-50 words) of the tasks performed by the digital systems. 2- A video (1-minute video maximum) that demonstrates the correct functionality of your digital system. The video must show the input signals (e.g., switches, push buttons of your FPGA) and the resulting output signal (e.g., on the LEDs and 7-segment displays of your FPGA).		
Synthesis Requirements	To claim this skill your page will showcase the aspects listed below: Requirement: to have application skill 1 - A brief explanation (20-50 words) of the digital systems used in the general application selected for the synthesis skill. 2- A video (1-minute video maximum) that demonstrates the correct functionality of your digital system in the general application selected for the synthesis skill. The video must show the input signals (e.g., switches, push buttons of your FPGA) and the resulting output signal (e.g., on the LEDs and 7-segment displays of your FPGA).		
Knowledge Opportunities	Lab W2		
Application Opportunities	Lab until W4		

4.2 Python Programming			
Skill Category	Medium, Specialist Skill	**Skill Owner**	Dr Jonathan Graham-Harper-Cater
# of students	2	**Formative Deadline**	Friday W19
Learning Outcomes	Attaining this skill represents that you can: - Demonstrate an understanding of python syntax and structure. - Apply flow-control structures to manage python program logic. - Use operators to perform calculations or comparisons in python. - Work with grouped data types and value data types. - Design and implement Python Classes, Functions and Data structures. - Write functional, clear, concise, and well-commented python code, including docstrings and comments for maintainability.		
Knowledge Requirements	Complete the knowledge section of P2.04 and then answer the python programming Moodle quiz.		
Application Requirements	Complete the application section of P2.04 and then create a page that contains: 1. A brief description of the codes purpose (50-100 words). 2. The full, working Python code, with comments and docstrings used throughout. 3. A short video demonstrating that the code functions as intended. 4. A brief critical reflection on the solution, what worked well and how it might be improved in the future (50-100 words).		
Synthesis Requirements	To claim this skill at Synthesis, you should produce a Python program to solve a novel and suitably difficult problem or task. Then create a page section titled 'Programming in Python' that contains: 1. A brief description of the codes purpose (50-100 words). 2. The full, working Python code, with comments and docstrings used throughout. 3. A short video demonstrating that the code functions as intended. 4. A brief critical reflection on the solution, what worked well and how it might be improved in the future (50-100 words). 5. A justification for why the task required a program to be made - and why Python was a good choice for said solution (50-100 words). Any synthesis claim for this skill must also include and claim use of the Software Design, Test, and Validation skill to be considered. Both skills should be present on the same page and be consistant with one another.		
Knowledge Opportunities	Lab P2.04 W18		
Application Opportunities	Lab P2.04 W18		

4.3 Software Design, Test, and Validation			
Skill Category	Medium, Specialist Skill	**Skill Owner**	Dr Jonathan Graham-Harper-Cater
# of students	2	**Formative Deadline**	Friday W22
Learning Outcomes	Attaining this skill represents that you can: - Analyse complex engineering problems and decompose them into smaller, testable components and data structures.		

	- Produce clear software designs, including flow diagrams and detailed function specifications with defined arguments and return values. - Plan and document a robust testing strategy that covers normal operation, boundary conditions, edge cases, and error handling. - Create structured test specifications with unique identifiers, defined inputs, expected results, and explicit pass/fail criteria. - Validate that implemented code meets the original design and functional requirements through systematic testing. - Communicate design decisions and test outcomes clearly so that another competent engineer can implement and verify the solution.
Knowledge Requirements	Complete the knowledge sections of P2.05 and P2.06 and then answer the software design, test and validation Moodle quiz.
Application Requirements	Complete the application sections of P2.05 and P2.06 and then create a page that contains the following elements for these labs: 1. A brief definition of the problem being solved (50-100 words). 2. Both flow diagrams and UML diagrams to describe the code flow and data structures needed to solve the problem. This should be suitably details for a competent engineer to come in and create your solution according to your design. 3. A defined and Comprehensive test plan (and associated test table) to verify that the solution is working as expected - including edge cases, exceptional scenarios and nominal operation. 4. A brief critical reflection on the solution, what worked well and how it might be improved in the future (50-100 words).
Synthesis Requirements	To claim this skill at Synthesis, you should design a program to solve a novel and suitably difficult problem or task. Then create a page section titled 'Software Design and Validation' that contains: 1. A brief definition of the problem being solved (50-100 words). 2. Both flow diagrams and UML diagrams to describe the code flow and data structures needed to solve the problem. This should be suitably details for a competent engineer to come in and create your solution according to your design. 3. A defined and Comprehensive test plan (and associated test table) to verify that the solution is working as expected - including edge cases, exceptional scenarios and nominal operation. 4. A brief critical reflection on the solution, what worked well and how it might be improved in the future (50-100 words). 5. A justification for why the task required a program to be made - and why Python was a good choice for said solution (50-100 words). Any synthesis claim for this skill must also include and claim use of the Python Programming skill to be considered. Both skills should be present on the same page and be consistent with one another.
Knowledge Opportunities	Lab P2.05 and P2.06 W21
Application Opportunities	Lab P2.05 and P2.06 W21

4.4 Machine Learning			
Skill Category	Medium, Specialist Skill	**Skill Owner**	Dr Dorian Florescu
# of students	2	**Formative Deadline**	Friday W26
Learning Outcomes	Upon successful completion of this skill, students will be able to: - Demonstrate familiarity with core concepts in machine learning. - Apply appropriate machine learning methods—classification, regression, or unsupervised learning—to analyse new datasets beyond those covered in the taught material. - Synthesise multiple analytical approaches, including classification, regression, and unsupervised learning, to comprehensively evaluate new datasets beyond those covered in the taught material		
Knowledge Requirements	You will need to have competed all four courses at the link below, namely: 1. Classification Methods with Machine Learning 2. Regression Methods with Machine Learning 3. Cluster Analysis with Machine Learning 4. Dimensionality Reduction Techniques https://matlabacademy.mathworks.com/details/machine-learning-techniques-in-matlab/lpmlmlt Please upload the pdfs of all four Course Completion Certificates generated after each course is fully completed.		
Application Requirements	To claim this skill, you will use a single Machine Learning (ML) model to perform a task on a new chosen dataset, beyond those covered in the taught material, using Python or MATLAB. The task should be in **one of** the following categories: classification, regression or unsupervised learning. Before attempting to claim this skill, you need to have competed all four courses at https://matlabacademy.mathworks.com/details/machine-learning-techniques-in-matlab/lpmlmlt, and uploaded the corresponding Matlab certificates. You should show: 1. The pdfs of all four Course Completion Certificates generated after each course is fully completed. 2. A brief description of the aims of the study, and the choice of the particular ML model (50-100 words). 3. A brief explanation (50-100 words) of what makes the chosen dataset suitable for the category of task selected (classification/regression/unsupervised learning). 4. Screenshots of the training process clearly marked with the student's username, accompanied by a brief description of the results, including relevant error metrics (50-100 words).		

	5. The equation representing the weight/parameter update rule for the model of choice, including values for all constants. If not applicable, a brief (50 words) explanation of why it is not. 6. A description of the hyperparameters that were optimised, the corresponding ranges, and brief interpretation of why the final hyperparameters might be a better choice (50-100 words). 7. A concise discussion (50-100 words) will also be included commenting on further analyses/improvements could be made to the chosen approach. An additional requirement is that the skill is claimed using the Mahara template entitled "Y2 Machine Learning Application Template".
Synthesis Requirements	To claim this skill, you will use a single Machine Learning (ML) model to perform a thorough analysis on a new chosen dataset, beyond those covered in the taught material, using Python or MATLAB. The analysis should cover **all** the following categories: classification, regression or unsupervised learning. Before attempting this, make sure that you have fulfilled the skill requirements at application level. You should demonstrate the application-level requirements 2-7 for all the three analysis categories (classification/regression/unsupervised learning). An additional requirement is that the skill is claimed using the Mahara template entitled "Y2 Machine Learning Synthesis Template".
Knowledge Opportunities	Lab W22
Application Opportunities	Lab W25

5. Computational Simulation

5.1 Circuit Simulation			
Skill Category	Large, One compulsory in this section	**Skill Owner**	Dr Jamie Gawith
# of students	2	**Formative Deadline**	Friday W27
Learning Outcomes	Circuit simulation helps engineers understand, design electrical circuits. A simulator allows the designer to create a complex circuit using non-ideal and non-linear components, loads and power sources and understand the behaviour of the circuit over time or across frequency. This is an essential skill for engineers working on all electronics and electrical systems, including power electronics, grid systems, communications and signal processing.		
Knowledge Requirements	Complete the Matlab/Simulink Power Electronics Simulation Onramp and upload the certificate to your Mahara Webpage: https://matlabacademy.mathworks.com/details/power-electronics-simulation-onramp/powerelectronic		
Application Requirements	Claiming this skill at Application level will involve simulating a more complicated circuit with a MINIMUM of 2 Active Components (BJTs, MOSEFTs, OPAMPs etc) like a full bridge inverter. This will be demonstrated in the lab using the freely available circuit simulator LTspice. To claim the skill, you must include: 1) The circuit diagram of the circuit being modelled 2) Key circuit waveforms that demonstrate correct circuit behaviour - with your username clearly visible 3) A brief explanation of the circuit (type, working principle) and description of how the waveforms show the correct function of the converter (50-100 words). 4) A brief explanation of the relevance of the simulation to a particular application and explain why it is useful (50-100 words).		
Synthesis Requirements	Claiming this skill at Synthesis level will involve simulating a more complicated circuit being used as part of a larger system - for example a three-phase inverter for a brushless DC motor drive. To claim the skill, you must include: 1) Circuit diagram of the circuit being modelled 2) Key circuit waveforms that demonstrate correct circuit behaviour - with your username clearly visible 3) A brief explanation of the circuit (type, working principle) and description of how the waveforms show the correct function of the converter (50-100 words). 4) A brief explanation of the relevance of the simulation to a particular application and explain why it is useful (50-100 words).		

	5) A reflection on the utility of the modelling approach and its limitations (50-100 words).
Knowledge Opportunities	Lab W10
Application Opportunities	Lab W10 and Project Week 3

5.2 Computational Modelling			
Skill Category	Large, One compulsory in this section	**Skill Owner**	Dr Jamie Gawith
# of students	2	**Formative Deadline**	Friday W30
Learning Outcomes	Computational modelling of physical systems is indispensable to modern engineering. While analytical methods can be useful in simple cases, most real-world systems are complex, non-linear and require computational/numerical techniques to model and understand. Physical system modelling is used to analyse electric machines, sensors, and thermal design. Appreciating the fundamentals of computational techniques is important for engineers to understand the utility, pitfalls and limitations of modelling.		
Knowledge Requirements	Complete the Simscape Onramp and upload the certificate to your Mahara Webpage: https://matlabacademy.mathworks.com/details/simscape-onramp/simscape		
Application Requirements	To claim this skill at Application Level you will use a a commercial Finite Element Analysis tool like Ansys to model a 2D/3D system. You must include: 1) A brief explanation about the system you are modelling, including the physics/equations you are solving and how you have set up the model (50-100 words). 2) Screenshots of the model setup, showing the solution type, boundary conditions, mesh settings and excitations. 3) A screenshot of the 2D or 3D geometry being modelled, showing materials in each region 4) Screenshots of relevant outputs/results from the model, for example the temperature in different parts of the model or the maximum magnetic field on a surface. 5) A short explanation commenting on the outputs/results of the modelling and why these are relevant and useful for design or analysis purposes (50-100 words). All screenshots must show your username.		
Synthesis Requirements	To claim this skill at Synthesis Level you will use a a commercial Finite Element Analysis tool like Ansys to model a 2D/3D system as part of a wider engineering project. You must include:		

	1) A brief explanation about the system you are modelling, including the physics/equations you are solving and how you have set up the model (50-100 words). 2) Screenshots of the model setup, showing the solution type, boundary conditions, mesh settings and excitations. 3) A screenshot of the 2D or 3D geometry being modelled, showing materials in each region 4) Screenshots of relevant outputs/results from the model, for example the temperature in different parts of the model or the maximum magnetic field on a surface. 5) A short explanation commenting on the outputs/results of the modelling and why these are relevant and useful for design or analysis purposes (50-100 words). 6) A reflection on the utility of the model and its limitations. All screenshots must show your username.
Knowledge Opportunities	Lab W26
Application Opportunities	Lab W29

6. Signal and Communication

6.1 Spectrum Analysis			
Skill Category	Medium, Specialist Skill	**Skill Owner**	Prof Martin Fullekrug
# of students	2	**Formative Deadline**	Friday W8
Learning Outcomes	Spectral analysis is an important skill for Engineers to detect signals in time series, to quantify the amplitudes of signals at specific frequencies, and to determine the frequency content of signals. Mastering this skill requires expertise in spectral analysis and its numerical implementation. The main result of spectral analysis is the calculation of a spectrum which shows how the amplitudes of a signal depend on frequency, known as the spectral content.		
Knowledge Requirements	To claim this skill, the page includes a username, characterisation of a time series, and a figure of a spectrum, along with a descriptive figure caption stating 1.1-1.4. 1. The characterisation of the time series includes the 1.1 sampling time interval 1.2 number of samples in the recordings 1.3 total time of the recordings 1.4 fundamental frequency of the recordings 2. Screenshot of spectrum of a signal used in the lab includes a 2.1 frequency axis 2.2 amplitude axis 2.3 spectrum of the signal		
Application Requirements	To claim this skill, the page includes a username, characterisation of a real-world time series, and a figure of its spectrum, along with a descriptive figure caption ~50-100 words. 1. The characterisation of the time series includes the 1.1 sampling time interval 1.2 number of samples in the recordings 1.3 total time of the recordings 1.4 fundamental frequency of the recordings 2. The screenshot of the spectrum a real-world signal used in the lab includes a 2.1 frequency axis labelled with the unit of frequency used 2.2 amplitude axis labelled with the unit of amplitude used 2.3 spectrum of a real-world signal 3. The figure caption includes the 3.1 dominant frequency of the spectrum shown in the figure 3.2 amplitude of the dominant frequency shown in the figure		
Synthesis Requirements	To claim this skill, the page includes a username, characterisation of a time series, and a figure of a spectrum, along with a descriptive figure caption ~50-100 words. 1. The characterisation of the time series includes the 1.1 sampling time interval 1.2 number of samples in the recordings 1.3 total time of the recordings 1.4 fundamental frequency of the recordings 2. The screenshot of the spectrum includes a 2.1 frequency axis labelled with the unit of frequency used 2.2 amplitude axis labelled with the unit of amplitude used 2.3 spectrum of a signal from an independent project		

	3. The figure caption includes the 3.1 dominant frequency of the spectrum shown in the figure 3.2 amplitude of the dominant frequency shown in the figure 3.3 main conclusion from what is shown in the spectrum in the context of the application in the independent project
Knowledge Opportunities	Lab W7
Application Opportunities	Lab W7

6.2 Finite Impulse Response Filter Design			
Skill Category	Medium, Specialist Skill	**Skill Owner**	Dr Jonathan Graham-Harper-Cater
# of students	2	**Formative Deadline**	Friday W9
Learning Outcomes	Mastering this skill means that you can: - Understand the role of filter design in enhancing signals and supressing noise/interference. - Select a suitable filter class for a given problem (e.g. High-Pass vs Low-Pass). - Derive equations to define the coefficients for an ideal filter. - Apply the windowing method to design a practical FIR filter from an ideal specification. - Implement FIR filters in software. - Extract meaningful data from noisy signals.		
Knowledge Requirements	For Knowledge, you should complete the "FIR filter" Moodle quiz available on this unit's Moodle page.		
Application Requirements	For application, the page should include a section titled 'FIR Filter Design', which provides the key details surrounding the design of an FIR filter and should therefore include: 1. The sampling frequency of the system/signal. 2. The target filter properties, including: a. The target filter class (e.g. Low-Pass, Band-Pass, High-Pass) b. All Cut-off Frequencies c. The Acceptable Pass-Band Ripple d. The Acceptable Stop-Band Ripple e. All Pass-Band Edge Frequencies f. All Stop-Band Edge Frequencies 3. The filter window properties, including: a. The Maximum Peak Approximation Error Allowed b. The Chosen Filter Window Type (e.g. Rectangular, Hamming, etc.) c. The Required Window Width. 4. Plots with correctly labelled axis showing the pre- and post- filtered signal in both: a. The time domain b. The frequency domain. A tool to produce a concise image containing this data is provided as part of the FIR lab, with error checking to ensure that no elements are incorrect. This should allow automatic self-verification of this skill at application level.		

Synthesis Requirements	For synthesis, the page should include a section titled 'FIR Filter Design' which includes: 1. A summary of a suitable problem requiring filtering (i.e. not removing noise manually added to a signal), with justification for why filtering is required (100-200 words). This should be an original problem, not previously provided by the Filter Design labs. 2. All previous requirements for Application-Level claims of this skill. 3. A review of the filters performance and resulting outcomes (100-200 words). A tool to produce a concise image containing this data is provided as part of the FIR lab.
Knowledge Opportunities	After the lecture W8
Application Opportunities	Lab SC2.02 W8

Mapping skill sot labs and formative points (Academic weeks)

#	Skill	Knowledge Opportunities	Application Opportunities	Formative point
1.13	Continuous Professional Development	1	1	2
4.01	Hardware Description Language	2	4	5
1.07	Quality management system	2	6	7
1.08	Advanced Time management	4	6	7
1.09	Advanced Project management	4	6	7
1.11	Scientific communication to a non-technical audience	2	6	7
1.17	Standards and regulations	5	6	7
2.01	Engineering design for circular economy	3	6	7
6.01	Spectrum analysis	7	7	8
6.02	Finite Impulse Response Filter Design	8	8	9
1.14	Market analysis (competitors)	11	11	15
1.15	Product Production Costing	11	11	15
1.01	Feasibility study	9	17	19
1.02	Ethics for engineering	9	17	19
1.06	Investigation of complex problems with practical laboratory skills	17	17	19
1.16	Efficient referencing	8	17	19
2.02	Sustainable materials management	10	17	19
4.02	Python Programming	18	18	19
1.04	Being security minded	21	21	22
3.01	PCB design for manufacturing	21	21	22
4.03	Software Design, Test, and Validation	21	21	22
1.03	Risk mitigation	21	24	25
1.05	Team leadership	19	24	25
1.10	Change management	20	24	25
1.12	Write an executive summary	22	24	25
2.03	Sustainable energy management	23	24	25
5.01	Circuit Simulation	10	24	25
3.03	Signal integrity	22	25	26
4.04	Machine Learning	22	25	26
2.04	Regenerative design	26	26	27
3.02	Thermal Design	23	29	30
5.02	Computational Modelling	26	29	30