Department of Electronic & Electrical Engineering
Faculty of Engineering Sciences

ELEC0036
Project I

Handbook 2021-22

Dr Oliver Hadeler

September 2021

Welcome

A warm welcome to ELEC0036, your 3rd year project! This project will allow you to showcase your competencies across many areas of electronic and electrical engineering. These include the theory and practice of electronic circuits, the design and build of devices, software simulations, and measurement procedures. You will learn laboratory practices, project management techniques, and develop your communication skills.

A key characteristic of the 3rd year project is the fact that you will be working independently! You will have to take ownership of your project, be responsible for its progress, decide its direction, and evaluate its outcomes against the goals you set in the beginning.

The 3rd year project introduces you to working scientifically. You will investigate a well-defined problem, present new insights that are useful to others, and document your work such that others can reproduce your work and build on it. By the end of the project you should have developed and demonstrated the academic and professional skills that are expected of a competent and independent electronic and electrical engineer.

Your project supervisor, the projects coordinator and the whole team at the Department of Electronic and Electrical Engineering will support you in your progress. But the main responsibility lies with you!

Have fun!

Dr Oliver Hadeler
Projects Coordinator

Purpose of this handbook....4
Timetable....4
Assessment....4
What we expect from you....6
Regular meetings with your supervisor....6
Final project proposal – 20 October 2021....6
Keep a laboratory notebook – throughout the project....8
Progress reports – weekly....9
Interim report – 15 December 2021....9
Poster presentation and viva – week commencing 14 March 2022....11
Final report – 30 March 2022....11
What you can expect from us....12
Support from your supervisor or advisor....12
Workshops....12

Purpose of this handbook

The purpose of this handbook is to provide you with important information and guidance related to your third year project. Please read it carefully and make a mental note of its content so that you can refer to the relevant sections during your project. Please mark the coursework deadlines in your calendars.

Additional material will be made available on the Moodle site as the academic year progresses.

Timetable

You will be working on your project continuously throughout Terms 1 and 2. This module carries 30 credits, so you are expected to work around 300h in total. With a project duration of 20 weeks (excluding reading weeks) **your expected average weekly workload is 15h.** This comprises your practical work, background reading, meetings with your supervisor, tutorials, report writing etc.

The draft project timetable at the time of writing this handbook is

	Summer holidays	Meeting with your supervisor Background reading
Term 1	Week 5: 27 Sep 2021	Project start Introduction talk Safety induction
	Weeks 6 – 14	Tutorial series – exact dates to be confirmed
	Week 8: 20 Oct 2021	Final project proposal due
	Week 16: 15 Dec 2021	Interim report due
Term 2	Weeks 20 – 26	Tutorial series – exact dates to be confirmed
	Week 29: 14 Mar 2022	Poster presentation and viva
	Week 31: 30 Mar 2022	Final report due Project end

Assessment

The 3rd year project is assessed through a mix of formative and summative assessments, each carrying a certain weight of the overall project mark. The aim of the assessments is to evaluate your

- work progress,
- professional skills,
- final project outcome.

Expected professional skills include

- approaching the project in a systematic way,
- employing your knowledge in a flexible and creative manner,
- consulting and evaluating technical literature, and
- selecting and using the appropriate mathematical, analytical and technical methods to solve problems.

The 3rd year projects tackle broadly defined problems, i.e. ones that involve a number of factors or parameters. Depending on your type of project, the final outcome might be a piece of hardware or software, or a theoretical or practical study. Not all projects aim to produce a new device or software, some will be looking at an existing problem from a new perspective. Often there will be no one “correct”

answer or solution. The topics of the 3rd year projects have been carefully chosen such that it should be possible to reach a meaningful conclusion by the end of the project. The supervisor and 2nd advisor will take the nature of the individual projects into account when they mark your project outcomes. However, **as a 3rd year student you should make some academic and professional contributions to your project and clearly state those in your poster presentation and project report.** These will greatly influence your overall mark.

The following table provides a guide to the expected level of achievement.

Grade	Examples of achievements
1st – Very good - exceptional	• You competently delivered a project that is near or at the forefront of knowledge. • You consistently provided strong original academic of professional input of your own. • Your project delivery is complete and without gaps. • You critically assessed your work against state-of-the-art or contemporary knowledge. • Others will be able to use your work to take research into new directions.
2.1 – Good	• You competently delivered your project and clearly provided original thought of your own. • Your project delivery is mainly complete, some small gaps might be present. • You critically assessed your work throughout, e.g. when placing your work in context, justifying your methods, or interpreting your results. • You made some academic or professional contributions. • Others will be able to reproduce your work and build on it.
2.2 – Fair	• You delivered your project with regular help from your supervisor. • You provided some original thought of your own. • There are clearly some gaps remaining in the project delivery, e.g. in the description of your methods or the data analysis. • Your work shows limited critical assessment, e.g. when placing your work in context, justifying your methods, or interpreting your results. • You made little academic or professional contributions. • Others would have some difficulty to reproduce or verify your work.
3rd – Adequate	• You mainly reproduced a previous piece of work and only added a minimum level of original design. • Your project contains significant gap, e.g. in the project delivery, methodology and analysis. • You demonstrated only a minimal level of critical evaluation, e.g. when placing your work in context, justifying your methods, or interpreting your results. • You made no or very little academic or professional contributions. • Others would have significant difficulties to reproduce or verify your work.

Fail – Insufficient	• You did little or no work. • Your work is irrelevant to the project.

The project assessments and their weighting are as follows:

Coursework	Mode of assessment	Weight
Final project proposal	Formative feedback from supervisor	0%
Interim report	Marked by supervisor	10%
Poster presentation and viva	Marked by 2–3 assessors from the department	15%
Final report	Marked by supervisor and advisor	50%
Project work, incl. work done, laboratory notebook, progress reports	Assessed by supervisor	15%
How to change the world	Marked by the Faculty of Engineering Science	10%

You will be asked to submit your assignments online. Instructions will be given nearer the due dates.

What we expect from you

Regular meetings with your supervisor

Your project supervisor will be your main contact throughout your 3rd year. She or he would like to know what you are doing. Arrange weekly or fortnightly in-person or online meetings with you supervisor where you can discuss your progress and potential obstacles. These meetings should last approximately one hour. Use your laboratory notebook and the weekly reports as a discussion basis. Supervisors are busy, they are likely looking after several projects, not just at 3rd year level, they run research groups and give lectures. Try and arrange meetings as far in advance as possible.

Final project proposal – 20 October 2021

You chose your 3rd year project during 2nd year and should have met with your supervisor towards the end of the summer term to discuss it and agree on your summer work. You will need to finalise that proposal at the beginning of your 3rd year using the work that you have accomplished over the summer.

The outline of the final project proposal is:

a) Project information – title, student and supervisor names
b) Brief project description – briefly describe the project in your own words (250 words maximum)
c) Goals and objectives – list expected outcomes and concrete steps to achieve those (bullet points with a maximum of three goals and 2–3 objectives per goal)
d) Bibliography of the relevant literature – list the literature and state in one sentence each why it is relevant (up to ten references, see below for more information)
e) Project schedule – use a Gantt chart to visualise your project schedule (see below for more information)
f) Failure risks – describe potential risks that your project does not go to plan and how you might mitigate them (250 words maximum)
g) Safety risk assessment – in your own words, list the safety risks associated with your project (see below for more information)

A template for the final project proposal will be provided on the Moodle site.

Project description

Briefly describe your project in your own words. You should include the wider project area, explain where how your project relates to this and why it is important. Your supervisor's project description will already include some of this information and it might have become clearer to you over the summer. Do not just copy and paste from your supervisor's description and avoid paraphrasing.

Goals and objectives

Every project has some goals, something you will be working towards. This could be a working device, a piece of software, a simulation or an investigation into some problem. The goals describe what you want to achieve in your project in a specific yet broad way. It is possible that you will state them if somebody asks you what you are doing in your 3rd year project. The goals might already have been listed in the project proposal your supervisor submitted. Possibly they became clearer to you while you were discussing the project with your supervisor or during your background reading. Try to state the goals in your own words. Two or three goals should be enough for a project of this size.

In order to achieve your goals you need to carry out a list of concrete objectives. These are measurable steps or detailed actions, e.g. what to do when. Limit the number of objectives to 2–3 per goal.

Relevant literature

At this stage of your project list the literature that gets you started. This is not a literature review. Instead, it offers a brief insight into what others have done in your project area, the theory behind the project and general challenges and ideas. It is possible that the literature provides you with a starting point for your project, a setup that you want to replicate or a piece of software that you want to try out.

Project schedule

Please include a brief schedule indicating when you intend to carry out your objectives. A frequently used method is the Gantt chart. It visualises the duration, sequence, and dependence of individual task. You can include the dates of milestones and deliverables. It might seem helpful to use a dedicated project management software to generate a Gantt chart, but it is probably simpler to use Excel. You can make use of a suitable template.

Failure risks

Very often projects do not go to plan. By their very nature research projects aim to find out something new and therefore their outcomes are less predictable. This does not mean failure as such, but you have to prepare for the risks that your project does not go to plan. Think about the main obstacles you might face during your project, e.g. equipment not being available, experimental data being unreliable or simulation algorithms being unstable or slow. Describe what you could do to mitigate the potential impact of these obstacles. Could you use existing data? Is there a fall-back algorithm you could use? Are there alternative measurements you could do?

Safety risks

Risk assessments are an integral part of all engineering projects and workplaces. The aim is to identify potential risks to yourself and others, as well as to equipment, while carrying out the work. Typical risks in an electronic and electrical engineering context include high voltages, solder fumes and burns, eye injuries, and pains related to working with computers. Each identified risk has severity and likelihood scores associated with it. Mitigating measures might reduce the severity and likelihood to acceptable levels. UCL's RiskNet is the formal mechanism to record risk assessments. You will receive training in conducting risk assessments, and your supervisor will be able to help. **You will not be allowed to work in any laboratory without an approved risk assessment.**

Keep a laboratory notebook – throughout the project

Every engineer and scientist should use a laboratory notebook to keep track of their projects. Depending on your project, use your laboratory notebook to write down ideas, log experiments, document design and development steps, perform data analysis, and record results.

A well-kept laboratory notebook is a valuable resource for writing your project reports or to demonstrate your thinking to your supervisor or other engineers. The laboratory notebook should allow you and others to reproduce your work. This might be important if you need to re-run specific steps of your project to verify results or to test alternative hypotheses. The laboratory notebook enables you to go backwards and forwards in time, re-visiting old ideas, tracing the progress of your work, keep data for future use.

Good engineering design and experimentation should be verifiable through the academic peer review process or industrial quality control. Both rely on detailed, legible, and true documentation.

Your supervisor will use your laboratory notebook as evidence of your progress and your professional skills.

Physical laboratory notebook

Please use a physical laboratory notebook. Electronic alternatives on your own computer or in the cloud are emerging but no standard has been agreed, so it is impossible to say what will continue to work in future. Here is a list of things to keep in mind when starting a laboratory notebook:

- Use a pen to write in your laboratory notebook.
- If you make mistakes cross them out and write the correct information nearby.
- Write your name, email address, and your supervisor's name on the front or inside cover of your laboratory notebook. On the first page state the project title and indicate that it is a 3rd year project.
- Number the pages to prevent them being torn out of the laboratory notebook and work being destroyed.
- Date every entry.

Laboratory notebook entries

Everything that is of importance to understand, document, and reproduce an experiment or design should go into the laboratory notebook. The exact types of entries depend on the nature of the project or task.

For an experimental project you might

- Write down the underlying theory or equations governing your experiment.
- Carry out preliminary calculations before you go into the lab.
- Sketch the experimental setup.
- Describe the method you are following.
- Record the equipment and their settings you used.
- Note down the collected data, include error estimates – make sure to include the units.
- Draw a rough graph of your data to evaluate if your experiment performs to plan – make sure to label the axes.

For a software project you might

- Describe the function of the software or code snipped.
- Make notes on the underlying algorithm to be used or tested.
- Draw a flow-chart.
- Record the values of any input variables or test conditions.
- Evaluate the software performance, e.g. execution time.
- Make note of required debugging or potential future improvements.
- Record the execution speed, memory requirements etc.
- For a simulation draw a rough graph of your data to evaluate if it performs to plan.

For a desktop study or design project you might

- Summarise and connect the literature you are consulting.
- Write down your research questions.
- Summarise your answers.
- Sketch your designs.
- Carry out statistical calculations

It is good practice to summarise your findings at the end of a section of work. This allows you to gauge whether you are on track and where you might go from there.

Progress reports – weekly

In industry and academia engineers will report regularly to their supervisors to inform them of the project progress and obstacles. Your supervisor, like any manager in industry, will have many simultaneous tasks to keep track of, including supervising several undergraduate and postgraduate projects. Short written progress reports could form a sound basis for discussions with your supervisor around your 3rd year project.

Use bullet points to

a) Summarise the outcomes of your meeting with your supervisor
b) List the main outcomes and results of the week, supported by a figure, photo, screenshot or equivalent, if possible – did you meet your objectives?
c) List the objectives for the following week.

Your supervisor will use your progress reports to assess the progress you made during your 3rd year project.

A template will be provided on Moodle that will allow you to keep these reports short.

Interim report – 15 December 2021

The interim report describes your progress so far. It serves as a milestone at which you and your supervisor can assess if your project is on track, identify obstacles and plan the way ahead. Your laboratory notebook should provide you with the material to write the interim report. You should convert your hand-drawn circuit diagrams, graphs, and designs into neat figures, professionally type-set equations, and tabulated data, order and review your literature in a logical manner, and describe your methods and results in an academic style[1].

The structure of the interim report is:

a) Cover page – a template will be provided
b) Abstract (100 words maximum)
c) Introduction and literature review – describe the broad subject area of your project and the motivation for your work, summarise what has been reported in the literature, and describe how your work relates to previous work. (1000 words maximum)
d) Goals and objectives – list expected outcomes and concrete steps to achieve those. (bullet points with a maximum of three goals and 2–3 objectives per goal)
e) Work performed to-date – describe the work you have done (background theory, methods, results) in a scientific way, support your progress and results with diagrams, graphs, tables etc. (3500 words maximum)
f) Conclusion and future work – summarise your main results and briefly outline your work for term 2. (500 words maximum)

[1] Additional material will be provided to help you with academic writing.

g) Project management – present an updated Gantt chart, critically evaluate your progress to-date against your original plan, justify changes to the original plan, and identify potential obstacles. (500 words maximum)
h) References – use standard IEEE format, use a referencing system such as Word, BibTeX, Mendeley etc. to format your references consistently and to keep track of the order in which they appear.
i) Appendices – include supplementary material, if necessary, e.g. updated risk assessment, computer code.

The total word count of sections b) to g) must not exceed 6000 words. Your report may be shorter, do not include unnecessary or irrelevant information to reach the maximum word count.

Abstract

The abstract summarises the contents of your report. It is often written last, i.e. after you have finished writing the main part of the report. Only then will you have a clear idea of what you have presented in the report. The abstract will tell the reader what to expect from the content of your report, e.g. the research questions you are trying to answer, the methods you have used, and the main findings of your research. You have used the abstracts of journal papers to decide whether a particular paper would be relevant to your research. Put yourself in the reader's position when writing your abstract.

Introduction and literature review

The introduction sets your work in context. Describe **in your own words** what your project is about. This part can be difficult to write because it might rely heavily on texts that you will have read. You will find asking yourself how to reformulate already well written sentences in your own way. One way is to cite other people's work, i.e. you acknowledge where your information comes from. **Do not re-order the words or sentences from a text that you have read.** Doing so does not add any of your own thoughts while at the same time you are disguising the origins of your text. This is bad academic practice[2].

The literature review should provide the reader with an overview of what others in your field of research have done. As a minimum summarise the main points from the literature that you have consulted. Describe how your literature selection is related to your project. A good literature review will critically assess existing work, e.g. identifying the gaps and shortcomings in other people's research that your project is trying to address.

Goals and objectives

Provide a list of your goals and objectives in form of bullet points. These might be the same you stated in your final project proposal, or you might have updated your goals and objectives due to the results of your project so far. Please state if your goals or objectives have changed since the final proposal and describe what brought about the changes.

Work performed to-date

This is the main part of the interim report. It summarises your work to-date. Present your work in a logical order, not chronological. Depending on the nature of your project, this section should include a summary of the background theory, a description of the research or design methods you are using or intending to use, and any results that you have obtained, whether they are simulated or experimental results or design drawings. Summarise and support your findings with data tables, graphs and diagrams. You need to decide what work is important and what can be left out. **If you have worked diligently throughout the term, you should have something to say – do not just try to fill the word limit.** Negative results, if explained well, offer valuable information about your thought process.

Conclusion and future work

Briefly summarise your main results. A good conclusion will **include numerical information or clearly justifiable statements**. If there are open questions you should state them and briefly describe how you

[2] Additional material covering plagiarism and paraphrasing will be provided.

will address them in future. Do not include anything new in the conclusion but restate the main findings from the previous section. Often people will only read your abstract or introduction and your conclusions. If these sections are informative and well written, chances are that the reader will look at the rest of your report.

Project management

Project management is not a one-off activity at the start of the project. Instead, present an up-to-date project plan in form of a Gantt chart. Explain and justify any changes between the present Gantt chart and that of the final project proposal. Critically evaluate your progress to-date, e.g. is your project going to plan, are you meeting your goals and objectives? Describe any new risks to the project and how you intent to mitigate these.

References

List the literature you have used to support your research. Clear, complete, and consistent formatting is key. Avoid relying on internet resources for your references as these are not peer reviewed and you cannot be sure of their correctness. Instead consult journal papers and textbooks.

Appendices

Appendices contain supplementary material that would interrupt the flow of the main text, is not critical for the understanding of the main text or is too long. Examples are circuit diagrams or graphs that are not of direct importance to the understanding of the report, information from data sheets, long tables of data and programme listings.

Poster presentation and viva – week commencing 14 March 2022

Communication is a key part of an engineer's work. Whether it is talking to colleagues in a company, presenting results to stakeholders of a project, sharing ideas with researchers in academia, or explaining one's work to the general public. A poster is one way of communication that is often used by academics in the natural sciences and engineering.

A poster presentation consists of two parts: 1) the physical poster and 2) you talking about it and discussing its content with an interested audience. A good poster is visually attractive and contains the one or two most important aspects of your project. While the content needs to be understandable on its own, i.e. without you being present, text on a poster needs to be kept to a minimum. As a poster presenter you need to engage with your audience, e.g. point out key aspects of your research, explain your methods, highlight the results, answer questions, and discuss future work.

More detail on how to design a good poster will be given nearer the time. You will also be given the opportunity to discuss your poster before submitting it.

Final report – 30 March 2022

The final report marks the end of your 3rd year project. It documents the work you have done over the two terms – your journey from project proposal to final project outcome. However, do not write it as a chronological account but follow the outline below.

a) Cover page – a template will be provided
b) Abstract (maximum 150 words)
c) Introduction and literature review – describe the broad subject area of your project and the motivation for your work, summarise and critically evaluate what has been reported in the literature, and describe how your work relates to previous work.
d) Goals and objectives – list expected outcomes and concrete steps to achieve those (bullet points with a maximum of three goals and 2–3 objectives per goal).
e) Theoretical, mathematical, and/or scientific background for your work – present and explain the mathematics, science, and technology that forms the basis of your project in your own words.

f) Methods or experimental setup – describe your scientific methods and/or experimental setups so that others can recreate your work and assess the suitability of your approach.
g) Results, analysis and discussion – present your results in form of graphs, tables etc., critically analyse what your results mean and discuss how they might add to the knowledge in your field.
h) Conclusion and future work – summarise your main results and briefly outline future work that might arise from this project.
i) References – use standard IEEE format, use a referencing system such as Word, BibTeX, Mendeley etc. to format your references consistently and to keep track of the order in which they appear.
j) Appendices – include **useful** supplementary material, if necessary, e.g. computer code that might be useful to others, long derivation of equations if they add to the understanding, additional photos or diagrams of the setup, questionnaire responses (not included in word count).

You are free to rename the headings for sections e), f) and g) to suit your project. While no individual word count is provided in the outline above, **the total word count of sections b) to h) must not exceed 12000 words.** Your report may be shorter, do not include unnecessary or irrelevant information to reach the maximum word count.

What you can expect from us

Support from your supervisor or advisor

Your supervisor and advisor are there to support you during your project. Your relationships with your supervisor and advisor are important for a successful completion of the project. While you are working independently your supervisor would normally expect a weekly update to provide you with feedback and support. Your supervisor's feedback might be very specific, e.g. strongly suggesting you to carry out specific tasks. It might be generic, e.g. suggesting to carry out more background reading or to investigate a new avenue of research. Every student and supervisor are different, so you need to discuss with your supervisor what the best approach might be in your case.

Your advisor might be a specialist in a related or in another topic. They might be able to provide a second opinion or a different perspective in relation to your work.

Supervisors and advisors will assess your coursework and progress, e.g. the reports. Some assessments will be in the form of formative feedback, others will be a numerical mark (see p. 6). Generally, you should receive feedback and marks within one calendar month after submitting your assignment.

If you have persistent difficulties getting hold of you supervisor or you are not receiving any feedback, please inform the projects coordinator.

Workshops

We will run a series of workshops throughout the duration of the project to help you with specific aspects related to the module. These workshops will be in-person according to UCL guidelines. Online workshops or recordings will be made available for students who cannot attend in-person.

Workshops will last about one hour We will limit the number of in-person participants and re-run workshops at different times. Please consult the module timetable or Moodle site for exact dates and time.

Topics will include project management, scientific working, and writing skills. Pre-workshop material will be available from the Moodle site.