Feedback on UCL MSc Mechanical Engineering Course

A Comprehensive Review of
Issues and Recommendations

November 17, 2025

Executive Summary

This report is intended to be used as a source of comprehensive feedback and recommendations for the future handling of the UCL MSc course in mechanical engineering. The issues with the course are significant, and range from problems with the quality of module resources, the attitude and behaviour of lecturers, almost all aspects of the coursework exercises, the difficulty and focus of content, the administration and organisation, and the response to feedback and trust in the department. The problems are described, evidenced, and some suggestions are made on how to respond to them.

The lecture content is delivered via slides, although these are treated as a substitute for lecture notes. This leads to slides that do not function well as presentation aids or as tools for independent revision. The quality of the lecture slides is also very often extremely poor, not even meeting the standard expected of a GCSE student. The Microsoft Office abilities of some lecturers is concerning to say the least, and training will be needed for them to be able to produce decent materials, for example in LaTeX. The shocking state of some of their figures demonstrates a lack of care; lecturers need to be held to a higher standard and pass a quality review.

The coursework marking is extremely sloppy and markers need to be given more time and motivation to mark properly. The pass mark needs to be lowered to encourage markers to use a wider range, and they need to stop arbitrarily capping marks around the 85% mark. Marking feedback is often wrong and almost always insufficient and unhelpful, markers need to put in much more effort into giving decent feedback, for example by annotating the pdf. The department also needs to look into how long each coursework reasonably takes and assign the weights appropriately as currently this is not the case. Exercises should also be made more open to give a higher ceiling and allow for greater individuality and creativity. Review processes are needed in the marking and design of coursework briefs.

The content of the course is lacking in ambition and is far too simple for a univeristy as high ranking as UCL. Many of the modules would not feel out of place as A level courses and the department should focus on making large changes to the specifications to make the course more suitable for postgraduates. Advanced mathematics is missing from the course and this should be a warning sign[1]. Examinations resources are badly organised, and the papers are often poorly constructed. The main issues are the distribution of marks which appear random at times, and the writing of questions where the author does not take the aims of the examination into account. I also have significant issues with the administration rarely listening to our problems.

The group design module was handled extremely poorly and serves as evidence of the lack of oversight into how the module coordinators run the modules. The project selection should be changed to where the students sign up to the projects to decide teams instead of the students deciding the teams and then getting projects based on a first come first served basis. The priorities of the academic integrity policy are confused, and it should be reviewed with a focus on actually malicious behaviour. The department could also reduce academic misconduct via choosing open coursework exercises that are more individual, and online examinations without easily searchable answers.

[1] Matrix multiplication does not count as advanced mathematics

Contents

1 Introduction

This report describes and gives evidence of many of the issues present in the UCL engineering department based on my experience doing the MSc Mechanical Engineering course 2023-2024. While this report is a long way from exhaustive, it is intended to be used as a reasonably comprehensive source to inform future changes to the running of the course.

For additional context, my undergraduate was in mathematics at the University of Oxford. My experience there is used as a point of comparison throughout this report, although my friends went to a wide range of universities and have had very similar comments. Given that UCL is a top ten university with one league table even ranking it as high as fourth place, this should not be an unreasonable comparison.

I have written this report without a name attached, although there is identifiable information here[2], and those in the department would almost certainly know who wrote this from a description of the document alone. I do not care too much about anonymity however as long as it does not influence my grade, and I am perfectly happy for this document to be shared with all interested parties. This includes but is not limited to, the engineering department, the external review board, and the higher level administrators at UCL.

This report has been split into three main sections, reviewing the quality of the resources made available, the handling of coursework, and high level decisions about the course and its administration. The issues with the group design module and academic integrity policy warranted their own subsections and are discussed in section 5. While suggestions are given throughout the document, these are collated and presented in section 6. Much of the justification for these is found in the rest of the report and will not be repeated there however.

[2]For example I reference a post I wrote on Unitu that I wrote non-anonymously.

2 Resources

The resources at UCL provided to students are severely lacking and significant work needs to be done to remedy this. I have split this section into four areas: the belief that lecture slides are a substitute for lecture notes, the shocking quality of the figures and typesetting in the lecture slides, the poor practices of the lecturers and their surprisingly bad understanding of basic concepts, and the specification.

2.1 Lecture Slides and Lecture Notes

Almost all of the content in the UCL engineering department is delivered only via lecture slides, and this is problematic. The lecture slides serve two purposes: to be used during lectures and for students' independent revision. One document cannot be well suited to both purposes simultaneously, it leads to slides that are too energy dense to be used in a presentation, and not detailed enough when used as a standalone document. Below I give details of the problem before providing a solution.

Presentation slides are meant to serve as a visual aid, but the information should be coming almost entirely from the person giving the presentation. If a slide has lots of writing on it, the audience is split between reading the slide and listening to the presenter. Most of the slides in the presentation should have a single large figure and nothing else, all comments about the figure should come from the presenter. Any information that cannot be linked to a figure should be summed up in bullet points, and I personally follow the rule of never going above 20 words on a slide. If the slides make sense without the presenter, then there is probably too much information on the slides. I also believe that mathematical derivations should be written out live on a whiteboard or blackboard as the speed of writing matches the speed of processing each step.

The lecture slides are also insufficient as a resource for independent revision. They are often hard to follow due to their brevity, for example not defining their symbols or not explaining a diagram in sufficient depth. The details that would typically be given in a lecture are usually neglected, and the flow is awkward due to connections and explanations not being included. I would like to make it clear that this is not a request for more detailed lecture slides, and any attempt to fix these problems in the slides would likely make them worse.

As an example of the extra level of detail I would like to see, consider the section from a textbook on thermodynamics featured in figure 1 about the benefits of adding a reheating section to the Rankine cycle. Here they have included a figure to help demonstrate their point and they give the relative importance of their conclusions. They then go on to compare this with other arrangements to further elucidate their point. This is only a short addition, but it finishes up the point very nicely and I find this lacking in the lecturer slides.

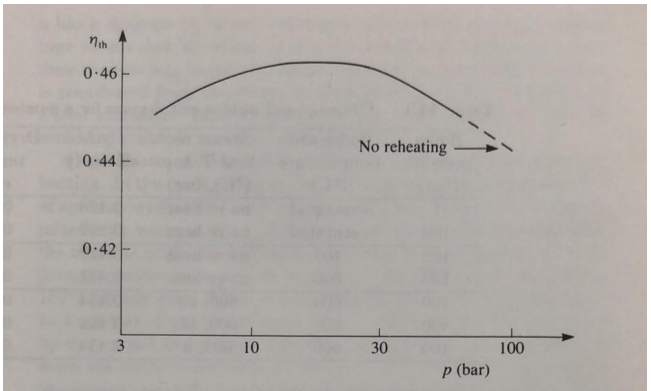


Fig. 14.8 Efficiency of a superheated Rankine cycle with reheat: effect of reheat pressure: boiler pressure = 100 bar, maximum temperature = 600°C

600°C, Fig. 14.8 shows the variation of thermal efficiency as a function of the pressure at the end of the high-pressure turbine. From Fig. 14.8 it can be seen that the use of reheat increases the cycle efficiency. However, the increase in efficiency brought about by the use of reheat is relatively modest. The real benefit of reheat is that is makes the steam at the exit of the low pressure turbine less wet. In Chapter 13 it was emphasized that water droplets at the end of the turbine could damage turbine and decrease efficiency. Figures for the dryness at the turbine exit are given in Table 14.1 for a number of cycles. Cycles having a high efficiency have unacceptably wet steam at the end of the turbine unless re-heating is used.

Figure 1: A good example of how to discuss conclusions. Taken from [1].

The section on gear sizing in MECH0053 is an example of a wasted opportunity to add more detail. The method of gear sizing used in the module uses data about a pair of gears to determine their radius and width to ensure they are strong enough. Figure 2 shows a configuration of gears where a choice needs to be made over which pair is chosen to size the shared gear. When discussing the analysis of this situation the existence of the choice is not even acknowledged, and the general philosophy with this part of the module is to guess. This is not good enough in my opinion, especially as there is an easy way to determine in advance which pair of gears should be used to size the shared gear. I will skip the mathematical details of the method, but the takeaway is that they could have added a few extra slides to derive this method and it would have given a more complete understanding of the topic.

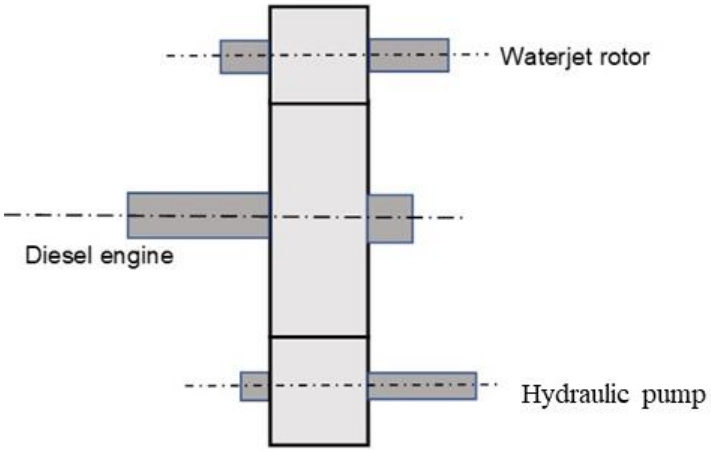


Figure 2: Two gears being driven by a shared gear

The solution is to simply have two documents for the two different purposes. In my undergraduate studies, every lecture series had an accompanying set of notes intended for the students[3]. The lecture notes had the style of a streamlined book, and each 16 hour lecture series corresponded roughly to 70 A4 pages of notes, and covered about 90% of a typical 230 page undergraduate textbook. This space allowed the lecturer to go into sufficient detail, and allows for greater flow than lecture slides.

The structure of the resources also has issues, although this is more of a minor issue. The content should be introduced by first motivating it with the problem it is attempting to solve, then summing up the route through the topic that will be taken. The content should start simple and be built upon, for example by removing assumptions or expanding the theory to cover a broader area. I like to think of technical writing as a journey through the material rather than an information dump, and I think the lecturers would benefit significantly from focusing on the overarching structure of their content delivery.

There was one module where the lecturer somehow found something even worse than slides as a method of communicating the content: they gave us a list of papers to read. The only responsibility of a paper is to include the content, there is no expectation of pedagogical practices and it is up to the reader to do all that is necessary to understand it. This often makes them dense and hard to read and, in my opinion, the worst medium through which to learn something. This is especially true for those who haven't been immersed in a research environment for years, such as students on a taught masters program. A lecturer telling us to read the papers and that they will answer any questions is not how content should be delivered. We have other responsibilities, almost no-one I knew bothered with this.

There are some lecturers who do provide some form of lecture notes, and while this is a step in the right direction there are ways to improve this[4]. The main problem is that the lecture slides still appear to be the authority on what is examined, and I cannot trust the lecture notes to be up to date. I am unsure that content is in the lecture notes if and only if it is in the slides, and this means I would need to revise from the notes anyway. This can be fixed by having the lecture notes as the main document associated with the module, and the lecture slides only acting as a supporting visual aid for the lecturers.

[3]These were not notes used to help the lecturer give the lectures, most lecturers had their own handwritten notes for this purpose that were completely separate.

[4]These comments do not apply to William Suen has full lecture notes for this part of the module, and he deserves a special commendation for this.

2.2 Typesetting and Figure Quality

The quality of some of the lecture slides is inexcusable, and some of the PowerPoint practices of the lecturers is frankly shocking. The main issues are in the writing of equations and the resolution of the figures. I refuse to believe that the lecturers submit papers in this manner, if I ran the journal they used then I would be blacklisting them. In this subsection I present examples of the poor typesetting and figures, and also give comparisons of how it should be done. All figures from the slides presented here have been extracted with a pdf editor to extract their original quality as found in the slides.

When I am doing technical writing and need a figure from a paper or book, I will try and track down the source of that figure until I can find a pdf version, or at least a high quality bitmap version. I do not think the UCL engineering professors even know what vector or bitmap image formats are. I have given some examples of psychotic figure use in appendix A. Figure 14 in particular shows some of the most egregious examples I have come across of pictures that UCL engineering professors thought was acceptable enough to put in the lecture slides. The resolution is often shocking and it seems very little care is put into obtaining high quality figures.

To produce nice plots I use python, although MATLAB and R are also standard for making publication quality plots. UCL engineering professors are willing to whip something together in Microsoft Excel and snip it, and in my opinion this is far below the acceptable standard. If they are going to do this, the least they could do would be to zoom in before snipping to get a higher quality figure. Some of the figures leave me confused as to how the professor even managed to achieve such a figure, a prime example being figure 3. This figure actually appears to be a vector, apart from the lower portion of the sine curve. I have no idea how you would even achieve this accidentally, and in general I am unsure if these bad figures are a result of technophobia or laziness.

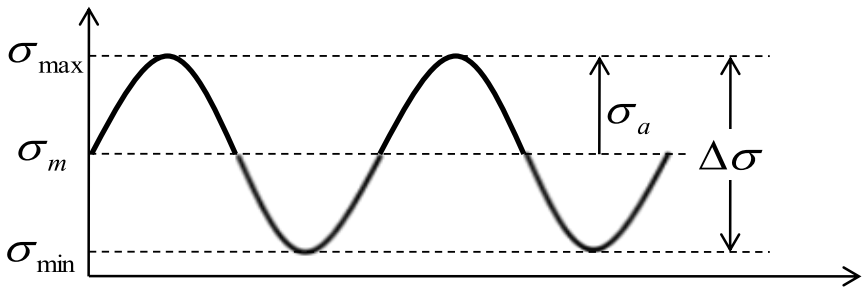


Figure 3: A picture that somehow ended up being half vector and half bitmap

When the lecturers are not playing a game of not-enough-JPEG, they are often found committing crimes against typesetting. One of my lecturers was clearly struggling to place a comma after a subscript, and instead used an apostrophe inside the subscript - this is chaos. Something that I have found in several lecturers slides is the use of a period in a separate text box when they need to denote a time derivative, and in figure 4 you can tell that they added the word "the" but forgot to move the time derivative. It is almost as if this isn't the proper way of typesetting a time derivative. Lecturers also need to understand that a period, "x", or x, are not proper ways to denote multiplication, they should use $\cdot$ instead.

$$\textbf{Power extracted from the wind} = \dot{W} = C_P \,.\, {}^1\!/_2\, \rho\, \pi\, r^2\, V^3$$

Figure 4: A lecturer who used a period as a time derivative forgot to move it when they added a word.

Microsoft PowerPoint has an equation writer so there really is no excuse for these wild tactics. Consider figure 5 where we can see what happens when equations are not input properly. First notice that the 6 has been cut off, and also a mysterious line sticking out to the right of the closing bracket is present. This is because the fraction line is a line from the shapes menu, and the bracket is an image placed in the front. The alignment is poor because every number is in its own text box. The whole equation itself is also an image for some reason as well. Other examples of poor typesetting include using a period for multiplication instead of $\cdot$. The lecturers also seem averse to using superscripts and prefer to concatenate subscripts instead. This is messy, and at the very least they could use a comma[5].

[5]Unless they are working with tensors or matrices where it is convention not to do this and it is clear.

$$\eta_v = 1 - 0.038\left[\left[\frac{7.856}{0.95}\right]^{1/1.22} - 1\right]$$

Figure 5: An equation constructed without the equation writer. The blue background has been added to demonstrate the fact that the brackets are actually images that have been placed on top of the equation.

Technical writing should be done in LaTeX as a bare minimum standard. In my undergraduate studies, LaTeX was used for everything, and even as students we were expected to learn it for our dissertations. The ability to use LaTeX should be completely standard for academics, it is disgraceful that the lecturers don't even know how to use the PowerPoint equation writer. I would be complaining about poor typesetting if I saw practices such as writing degree symbols like 90° instead of 90°, or not vertically aligning their under braces and over braces - details such as this are just basics, and UCL is significantly below this level. The typesetting in the slides falls significantly short of the standard expected for an A-level student, let alone for a high-ranking university.

As an example from which the lecturers should learn from, I point them towards my undergraduate lecture notes on classical mechanics [2]. Figure 6 shows the standard of figures at a university that cares about quality of its resources. This figure was custom made by the author of the lecture notes and is in a vector file format so the quality remains when zooming in. While this seems like a significant time investment, it only needs to be once. Many of my undergraduate lecture notes had several previous owners, and only small modifications were made between lecturers. I would recommend all lecturers to look at those lecture notes.

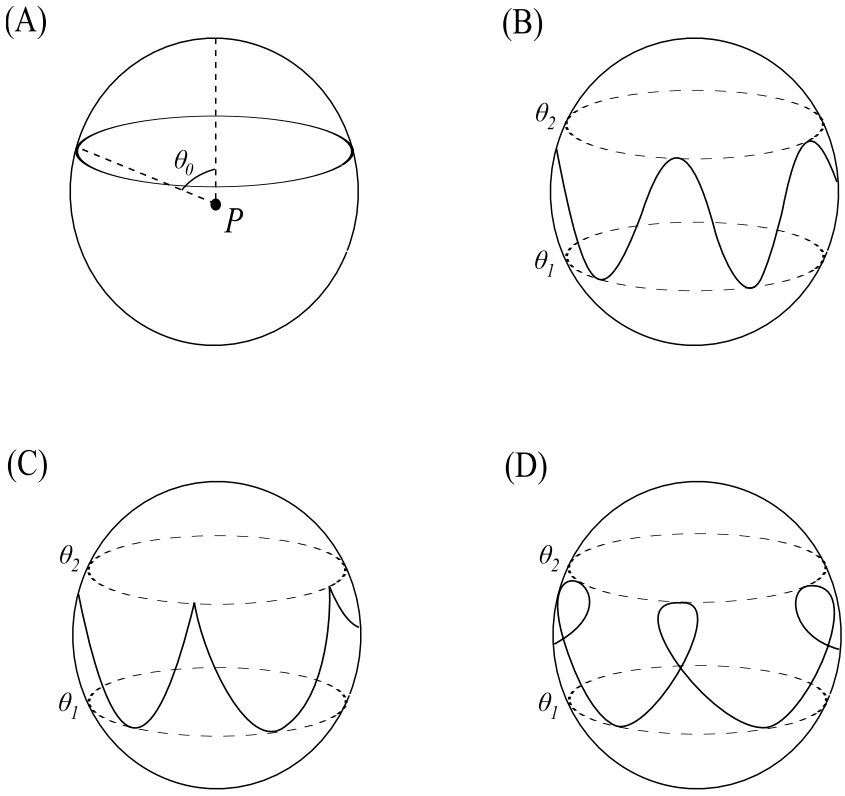


Figure 6: An example a figure[6] from my undergraduate [2]. This quality was the standard, not the exception.

2.3 Lecturer Practices and Behaviour

One of the biggest issues I have personally found with UCL are the lectures, in particular their sloppiness and lack of attention to detail. The notation, use of units, and understanding of significant figures would be poor for an A-level student, and is shameful for a supposedly high-calibre university. I often found areas of ambiguity, and getting answers from many of the lectures was an area of regular frustration. I also want to give examples of behaviours and practices of lecturers that needs to stop.

[6]For those interested, this was showing four qualitatively different behaviours for a Lagrangian top. The curves show the path taken by the axis of symmetry.

Lecturers often use m to denote the mass flow rate, although this is non-standard. m usually denotes mass, and $\dot{m}$ is used for the time derivative of mass, i.e. the mass flow rate. A similar issue is often present for volume flow rate and V, and I am starting to believe this is because the lecturers are just lazy. Equation (1) is a particularly confused example where the meaning of variables changes between lines. In the first line Q and W have units of energy, but in the second line they have units of energy per kilomole. I would also like to note the non-standard use of m instead of n for number of moles.

$$\begin{aligned} \dot{Q} - \dot{W} &= \dot{m}\,(h_{P_0} - h_{R_0}) \\ Q - W &= \Delta h_0 \quad \text{(per kmol)} \end{aligned} \tag{1}$$

There are countless examples where the notation used by the lecturers is unclear or non-standard without explanation. I can understand where there are historical reasons behind conventions, for example the use of m as an eigenvalue in the study of spherical harmonics of the Schrödinger equation, but this should be mentioned explicitly. In my undergraduate they explained at the start of the course that both $\times$ and $\wedge$ were conventions used to denote the cross-product, and throughout the department they use $\wedge$. It was never an issue, and UCL engineering should be able to handle something so simple.

The lecturers are often confusing with their units as well. Equation (2a) gives the number of cycles an object can sustain under a given stress. What units should σ be given in? It doesn't even make sense to take the logarithm of a number with units, the argument has to be non-dimensional. It was intended for students to give the number of megapascals as the value for sigma, although of course this was never stated. I would also like to point out that sigma is wrong, σ is not the number of some unit, σ is a pressure and has units to match. We do not write σ MPa, the units are part of the quantity. The correct way to do this is shown in equation (2b).

$$\log_{10} N = 12.182 - 3\log_{10} \sigma \tag{2a}$$

$$\log_{10} N = 12.182 - 3\log_{10} \left(\frac{\sigma}{1\ \text{MPa}}\right) \tag{2b}$$

The previous paragraph is not just me getting irrationally angry at a single error, the poor practices with units are evident throughout the course. The lecturers seem to have the same understanding of units as a schoolchild, and treat them as a symbol put on the end of quantities at the end of a computation. Another annoyance is using revolutions per minute in equations. It is far cleaner to use revolutions per second or radians per second as these are natural quantities to work with. Lecturers should be far more explicit in the units they are using, and the practice shown in equation (2b) should be standard.

Getting significant figures correct is another extremely basic area that the lecturers struggle with. Quantities are given to wildly different levels of precision with no regard to the context from where they came from. If an equation includes a number precise to only two significant figures then you cannot give an answer to three significant figures as it is not this precise. In general there seems to be a poor understanding of the precision of numbers and what is suitable. For example if we are doing a computation involving a safety factor like in a stress analysis, we should not give the answer to 4 significant figures - such methods are crude approximations and are not that precise. I never expected that I would need to explain this to people with advanced postgraduate degrees in engineering, this is honestly embarrassing.

Ambiguity and precision has been one of my biggest pet peeves throughout the year, and I have regularly had long conversations with coursemates and ongoing uncertainties about what a lecturer meant by what they wrote. The easy solution to this might be to email the lecturers. Firstly, this should not even be necessary, the phrasing should be unambiguous and clear as standard. Secondly, for one of my coursework exercises I needed to send so many emails for clarification that they refused to answer any more[7], and I have included a picture of this in figure 7. Ultimately I think the problem is that the lectures do not care about precise phrasing.

Moazen, Mehran
To: Ginn, Henry

I am sorry but I will not make any more comments on such matters. Have a nice weekend.
Mehran

Figure 7: A lecturer who refused to answer my questions after my ninth email

[7] I will talk in greater detail about issues pertaining to lecturer feedback in section 4.3.

There are not the hours in the day for me to go through every example of unclear instructions, although I want to highlight one particular example where the lecturers intent is unclear. In question 1aii of the 2019 MECH0032 paper they asked "Calculate the maximum incident solar radiation that will be available when optimal conditions exist" for a fixed solar panel. The intended meaning of optimal here was for the solar panel to be normal to the direction of the Sun's rays, although that is not clear to me. I interpreted "optimal conditions" to mean the conditions that generated the most power, and this gives a different result. The power depends on the length of the path from the top to the bottom of the atmosphere, and understanding this is examinable and part of the question.

Taking this into account requires solving a transcendental equation which could not be done in the exam[8]. Given that the arguably correct answer was not possible, the meaning is the question is more of a mystery. A possible but incorrect interpretation is to find the power when the Sun was at the highest point in the sky to minimise the path through the atmosphere[9]. I put a question on the Moodle detailing my findings and was told that I was overcomplicating it, and I only needed to consider the value of the three angles. This question is ambiguous to the point where it is wrong, and it worries me that the lecturer seemingly did not understand this in their reply.

While not a very common issue, I have had a few experiences where we were not treated in an age-appropriate manner. After a break in a lecture, a lecturer expected us to realise that the break was over because he was standing there, but people continued to talk. When everyone quietened down, he gave a talk that one might expect in a year 9 class about how we were wasting our own time. No other lecturers has had a problem with letting students know that it was time to continue, and everyone I spoke to about this did not appreciate being treated like a child in this way. Similar incidents of not being treated like adults have occurred and we do not appreciate being infantilised.

A significant portion of the first lecture of each course was very often used by the lectures to discuss their research. In my undergraduate studies the lecturers would extremely rarely even mention their research, and frankly it is not relevant to us. We know that their research is in a similar area to the content of the lecture series and that is all we need to know. The opening lecture should start with five to ten minutes about the structure of the course, how it is examined, important times and dates, etc. In the opening lecture of control and robotics for example we only spent around 40 minutes of the two hour slot going through the slides, the rest of the time was an introduction to the work of the lecturer. Lecturers should not discuss their research beyond a short sentence.

General lecturing practices can also be improved, but the issues I discuss here are minor and only done by a handful of lecturers. Some lecturers would need reminders almost every lecture to use the microphones as we could not hear them. Writing large enough on the board with a clear pen was also a surprisingly common problem. Lecturers not turning the lights in front of the whiteboard off was also common for some lecturers.

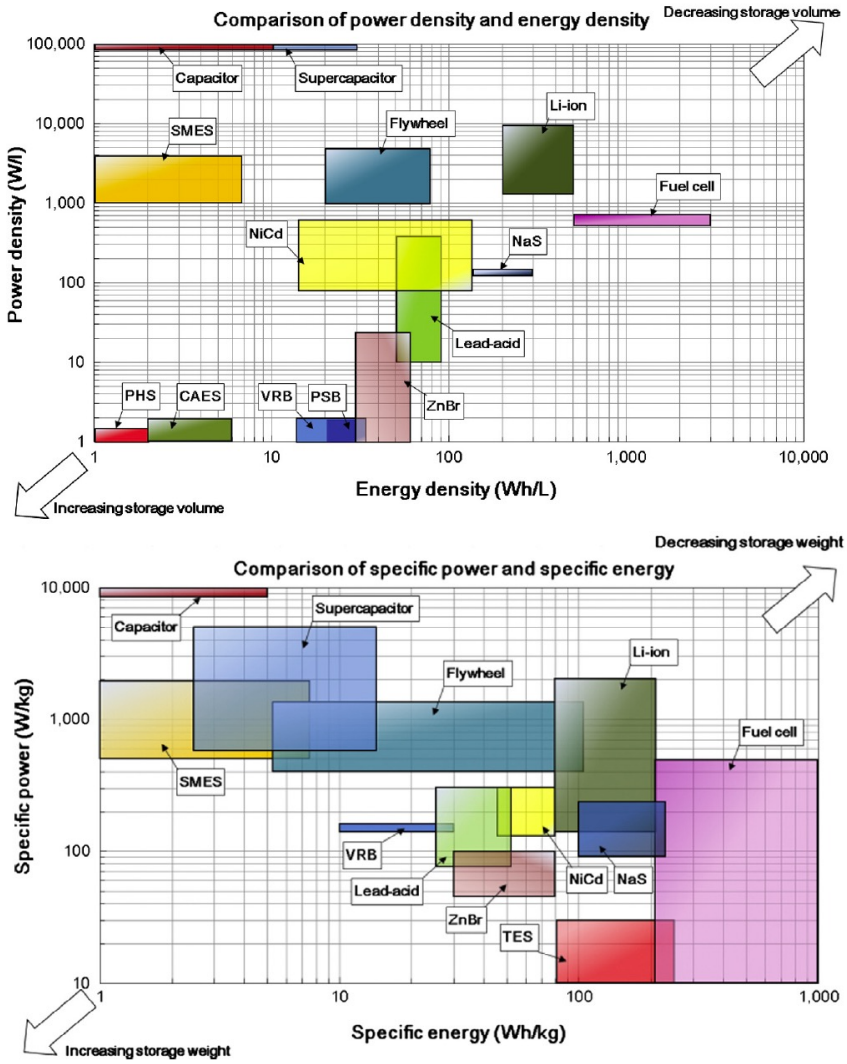
2.4 Specification Uncertainty and Issues

I have found it unclear what material is part of the specification and what is not. There does not appear to be a document laying out the specification apart from a very brief overview on Moodle in the module description. One might assume that the lecture slides are the authoritative source on what is examinable or not, but I am convinced that this is not the case. UCL does appear to consistently include all examinable content in the lecture slides, however the issue lies in the inclusion of material that is not clearly marked as non-examinable.

The main issue comes from technical diagrams and schematics. I understand why lecturers would want to include such diagrams to give some background understanding, and I am not opposed to them being in the slides. Remembering these diagrams can be hard however, and if it is not required to commit them to memory then it would be nice if this was communicated in some way. Some lecturers show drawings of equipment, for example a labelled cross section of a wind turbine, and I don't believe that we are supposed to remember these. Examples of where line of what is examinable is a lot fuzzier are schematic drawings and charts such as in figure 8, where there can potentially be a lot to remember.

[8] If the numbers were changed slightly so that the optimal angle of declination of the Sun was greater than 23.5° then the question could be answered through analytical means.

[9] This is wrong because it ignores the angle of the solar panel, although interestingly this gives a higher power than the actual answer.



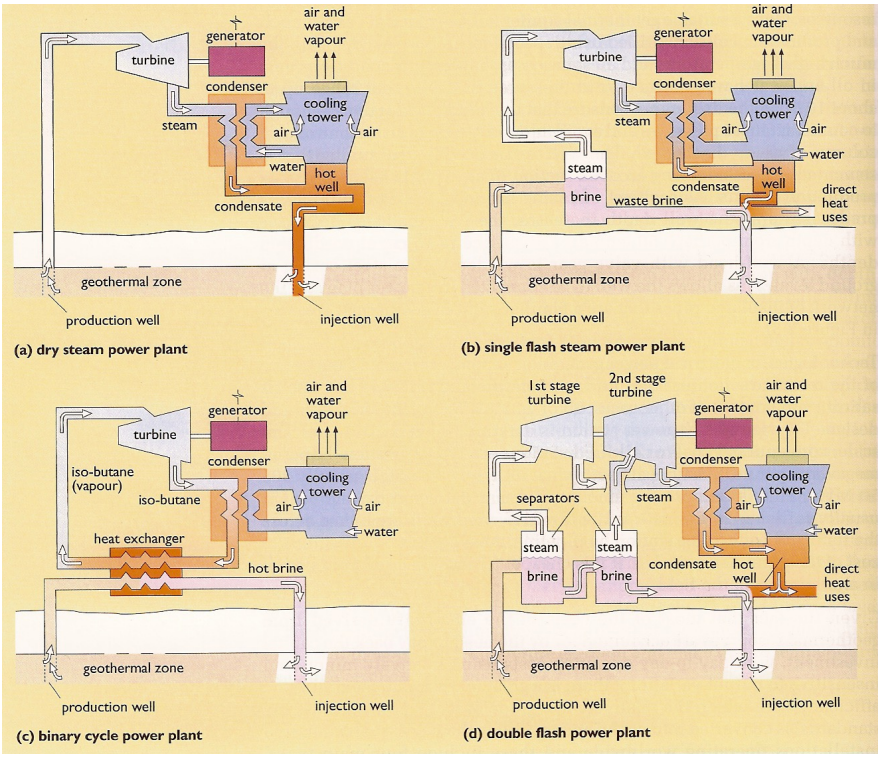


Figure 8: These diagrams show a lot of information and it is unclear how much we need to commit to memory.

Figure 9 is a good example of where it is unclear of how much we are supposed to remember. I would assume that we would need to know that the concentration depends on temperature, the temperature can be controlled to give desirable concentrations, the concentration of methane drops to 0 at 725°C, and perhaps the optimal temperature. In one of the tutorial questions however it asks us to draw this graph, and the tutorials are supposed to be representative of the exams. Does this mean we are meant to remember the shapes of those lines in much more detail to be able to recreate the graph accurately?

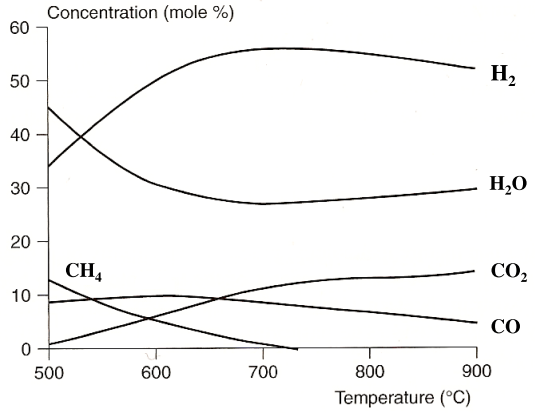


Figure 9: A plot that a tutorial suggested we needed to remember in full detail

This is not a request to remove such slides, we are still interested in engineering and developing this background knowledge. Ultimately however the final grade is what matters most, and as such it is important for students to know exactly what they need to and do not need to remember. Some lecturers include a non-examinable label on some of their slides already, and I think this should be implemented into the department policy for making course resources. If there are some key elements of a figure that are examinable then these should be stated, and everything else could be assumed to be non-examinable, similarly to the example I used in the previous paragraph. In my undergraduate lecture notes, the non-examinable content would be indicated with labels denoting the start and end points, and would be contained to their own subsections or subsubsections.

There are also a handful of areas where I think the specification should be changed, although I will not give an exhaustive list here. While I personally believe the specification should be less broad and more detailed, they are generally quite good, and I just have two recommendations. Lecturers should not include topics if they are not going to cover them in a depth that does the topic justice. An example from MECH0032 is the slide shown in figure 10 on ultracapacitors which was ignored by all those I asked. If a subtopic such as this is to be included then it should be given a proper treatment. Lectures should also look for areas where they can expand on topics more. For example I thought it was strange to omit any discussion about solar panels that change angle in the azimuthal direction, especially given that the analysis changes very little in this case.

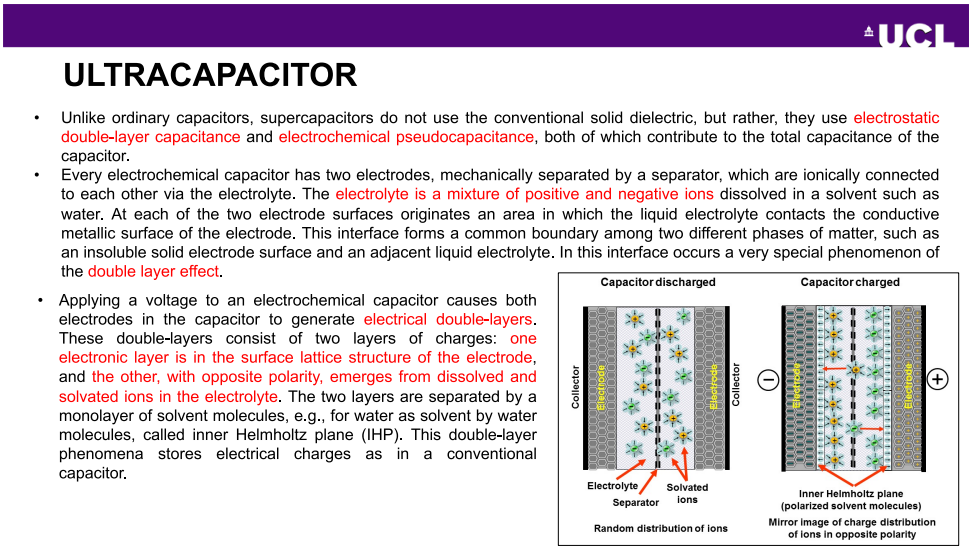


Figure 10: A slide that is not worth reading

3 Coursework

The majority of my time on this course was spent doing coursework and was where a significant amount of problems with the course came from. The biggest issues are to do with the unreliable and unrealistic marking, although I also think the exercises are too closed and restrictive, and their weightings are badly chosen.

3.1 Marking of Coursework

One of the largest sources of frustration for everyone I know was the bad marking of coursework. The marking did not feel representative of the quality of work, there was a strong aversion to giving very high marks, and choices were often unreasonable. I have particular qualms with the marking of presentation quality. My opinions in this subsection will be based mainly on my own work, but also from where I proof-read the work of my friends and knew their marks.

I have several friends who started most of their coursework exercises a few days before the deadline, and the marks they attained were similar to my friends who spent weeks, only losing a handful of percentage points. I know that the work is marked based on its quality and not the time and effort put into it, but I proof-read some of their work and I can confirm that these rushed coursework submissions were significantly worse than the polished ones. While there was some correlation between effort and mark attained, this was far weaker than it should be given the good correlation between quality and effort.

I believe that part of this problem is due to the very narrow range of marks given. I can understand why a marker would be incentivised against giving out marks below 50% (the pass mark), so half of the range is already lost. Lecturers do not like giving out high marks, so for all practical purposes they are marking in the range from 50% to 85%. This is not wide enough, it means that the difference between something done in a single night is only 35% away from somebody's passion project. I would change the pass mark to 20%, and make sure that the entire range from 0% to 100% was used.

Attaining extremely high marks seems to be impossible at UCL, and this is not due to the coursework exercises being difficult, it is entirely down to pointless battles against the markers. Most of my friends and I went above and beyond when it came to coursework. I regularly spent three to four times longer than I was meant to on coursework, exploring every detail. They required very little conceptual understanding or skills, and you would struggle to find any evidence of a lapse of understanding in the work I submitted. Why do I still lose a fifth of the marks available?

In the marking of presentation I would consistently lose around 20% of the marks available for presentation which I think is ridiculous. My grammar is not perfect and I am not a professional typesetter, but the presentation quality of my work definitely meets and exceeds the standards that can be expected of a masters student. It frustrates me that the same people who use pictures so blurry you cannot even read them would deem my presentation to be lacking. Before the reader judges me based on the sloppiness of this document, I would like to note that this has been quickly slapped together so it is not up to my usual standard.

The lack of comprehensive and precise style guides is also an issue. I understand that some parts of presentation are uncontroversial (high resolution or vector figures, sensible font and margins, correctly cross-referenced equations and figures, etc.), but some lecturers have many personal preferences that they do not state. For example in my undergraduate we were told to write actively instead of passively, and this is the opposite of many UCL lecturers preference. From my experience lecturers seem to believe that they are far more comprehensive and precise than they actually are, and so they should start with a template guide. I recommend lecturers modify a version of the IEEE style guide to their liking [3].

Lecturers are also occasionally unclear in their rubrics, especially for presentation. Personally I believe presentation should cover the aesthetics of the document, the layout, and writing style, for example eliminating widows, orphans, and runts and using vector images. I have seen many other qualities being included in presentation however, such as the quality of the introduction, or even "anything that is not mentioned elsewhere in the rubric". Anything to do with the content itself should not fall under presentation, this can be fixed by a review of the marking rubrics.

The rest of the marking has similar issues, and if I were to have logged every grievance I had then this document would be ridiculously long. Many people I know have already complained numerous times to lecturers about marking and only exceptionally rarely got anywhere, and the student reps have also held meetings about this. We are not unreasonable and we are not making these issues up, the department cannot deny the problems with the marking as they have significant evidence.

One of my friend's was told by a lecturer that they were removing a few marks because they were too close to 100%. Lecturers do not want to give high marks, and once they find an excuse they will cut off a huge portion of the marks. We are simply up to the whips of the markers here, and I imagine even an expert would not

get 100% on these coursework exercises even if they dedicated their life to it. The lecturers appear to have the attitude that if we get above 70% then we should be happy. Some of us are pouring our lives into these coursework and working 70+ hour weeks, so no, we are not happy with just 70%.

I would like to see the module coordinators attempt each coursework exercise and I guarantee they would only be getting around 90% or less. This is not a hypothetical argument, I think it would be a good test of whether the marking was reasonable, and should be implemented for future years. Perhaps this would even define the 100% mark, and all marks would be scaled accordingly. If the department has a problem with this system then they are either accepting that their lecturers are not capable or that it is too hard to get 100%. Their submission should also be published after results are released.

There are also far too many mistakes in the marking. I have seen people marked down for not including things that they included, the marker is objectively wrong in these instances. I have also seen two people with similar coursework submissions get wildly different marks, and someone who submitted code that did not even run get a first. I have also had situations where the module coordinator suggests something, and then get marked down when I followed their advice.

3.2 Style and Nature of Exercises

The coursework exercises we are given are often boring and unvaried. I believe they could be improved by allowing for longer form styles with less of a focus on being concise, and more of a focus on depth and narrative. The exercises are also not open enough and do not encourage originality and deep exploration. They are not the type of exercises I expect from a high-ranking university and are too simplistic.

Almost all of our coursework exercises have been in a form similar to a paper or a report. UCL engineering has an obsession with being concise, and do not seem to appreciate the benefits of longer forms of writing that go into more detail. I would appreciate it if a few of our coursework exercises were in the form of technical essays where you have more room to explore ideas in more detail and motivate ideas. Not to say that there are not benefits to being concise, but currently it feels like there is too much pressure to cram as much information into each sentence as possible. There is too much focus on stating what is the case without explaining why something is the case, and there is not space to freely explore a topic.

For an example of what I mean by an exploration into a topic, consider the video essay on splines by Freya Holmér [4]. If the only goal was to just deliver content about the different types of continuity in splines, the end result would be very different and much shorter. This video has a narrative, it is framed as a journey of discovery into the topic, and this is what is missing when too much focus is put on being concise. When I write about technical topics recreationally, I create something much closer in style to this video on splines. I think there is utility in including such forms of writing as part of the course, especially for the longer individual project. We should at least be given the choice to do this if we want to.

Many of my friends and I have had issues with page limits. I cannot remember where from, but many of my friend group were under the impression that our individual project would have a 50 page limit. We thought that might be a bit tight but we could make it work, and when we found out the limit was actually 20 pages including appendices, we were shocked. We complained to the departmental tutor about the 20 page limit on the individual project, and they were insistent that this was not a problem, and that writing concisely was important. They said that sometimes academics could spend years on a paper and fit everything they covered into ten pages[10]. I understand the desire for us to write concisely, but this seems needlessly restrictive and makes it much harder to demonstrate the effort we have put in.

For example in our new and renewable energy systems coursework, I found the optimal tilt angles for a solar panel where the tilt angle was changed twice per year, and when they should be changed. I explored 10,000 configurations with Excel to cover the three dimensional configuration space, something that no one else bothered to do. The only mention of this analysis ended up as in a single line footnote due to the very tight requirements on space enforced on us. Despite having a similar level of brevity throughout the document, the marker still complained multiple times about how I was not concise enough.

My other main complaint about the coursework exercises is that they are extremely closed. My friends and I would try to find any opportunity to take things further and go into depth, but this is not encouraged. Firstly, there simply is not enough space to include content that strays any distance from the brief due to the very tight page and word limits. Secondly, we get no additional marks for this, there is no incentive for being creative or having original ideas. With the calibre of students that UCL attracts, the department should expect to get students who want to fully engage in the material and they should support this. The coursework exercises feel claustrophobic and stifling.

[10] I am highly skeptical an academic could produce one paper in several years without getting fired for lack of output, this seems more like an attempt to dismiss our problems.

The finite element methods coursework was a good example of this. I was hoping to learn about hp-adaptive schemes or dynamic meshes, and at the very least use higher order elements. Instead we worked with the second simplest element (a first order quadrilateral) and used only three elements. We studied an extremely simple bracket and performed the most basic analysis into the deformation and strain on it. The scope was very narrow and the brief allowed for very little deviation. Most of the coursework exercises were similar with no room for imagination, and each submission would be very similar. This is a very boring way to do coursework.

If I were the author of the finite element method coursework, I would have made it much closer to a real-life situation. The students would be given a picture of a bracket and be told to use finite element modelling to suggest improvements. Here the students would need to decide for themselves what analysis they wanted to do, how they wanted to model it, and what direction they wanted to take it in. It is extremely open and allows students to be more ambitious in their approach. I would have thought the markers would be really bored reading essentially the same submission over and over, I do not understand why they would not want to have a wide variety of answers.

I understand that the markers are under pressure to mark quickly, but it has fallen below satisfactory. While frustrating for the department and the markers, they need to accept that marking takes as long as it takes and more time needs to be dedicated. The department has a rule of getting results back within some fixed time period, but it would be better if they relax that policy and mark our work properly. Pushing results back to the end of the year when exam results are released would even be reasonable in my opinion if this time is necessary.

3.3 Coursework Weightings and Timings

The weightings of the coursework exercises do not feel like they have been thought through very well. The amount of time we are supposed to spend on each coursework is unrealistic and some coursework is barely worth doing. Here I expand on how the engineering department gets the balance wrong, how they are confused about coursework, and how to fix it.

Some coursework exercises are simply not worth caring about. Each module is worth 15 credits out of a total of 180 which is 8.33% which is already quite small. As part of the thermodynamics and turbomachinery module we have a literature review which is worth 8.7% of the module, which means the whole thing is worth 0.725%. Given that a low effort will get around 60% and a huge effort will give around 80%, this means the affect on the total grade will be 0.145%. We have other stuff to do, many of my friends and I just took the 0.145% hit and did terribly, why would we do anything else? This problem is made worse by the points I made in section 3.1 where the range of possible marks is very narrow, and could be alleviated by using the full range from 0-100%. This coursework deadline was also very close to another coursework deadline, this pushed it even further down the list of priorities.

The thermodynamics and turbomachinery weightings were strange beyond this one coursework exercise. We have a presentation based on the literature review which is worth 8.8%, and a coursework about fuel cells worth 17.5%. The fuel cells coursework was due on the Monday after a Friday deadline for the group design project. Everyone I know did this in a hurry over the weekend[11], and it does not seem like there was any plan on when we would do this. Given that there was only one lecture on fuel cells, it was unrelated to the rest of the module, and fuel cells were covered in the new and renewable energy systems module, what was the point of this coursework? They should have just made the literature review and presentation worth more and got rid of the fuel cells coursework. I'm not sure how this made it past a peer review process or if there is a peer review process at all.

The lecturers do not understand the perspective of the students when it comes to coursework. In a conversation with one of the lecturers, they said they did not anticipate us caring as much as we did about the task, it was just meant to be a quick little thing. At any given point, there is only one thing that we can control that affects our grade, and that is the current coursework exercise that we have been assigned. Of course we are going to dedicate all of our time and effort towards it, of course we are going to agonize over every little detail.

The result of this way of thinking is that lecturers and the department have a strange idea about deadlines. One lecturer casually mentioned how they were going to release the coursework two weeks before the deadline, and they were shocked when we all immediately pushed back against that. This coursework was worth 25% of the module, they should not have been surprised that we wanted more than two weeks. This has been an issue with other coursework exercises, and one time a lecturer even got into some trouble with the administration when they released a coursework too early (we had asked them to do this as the original timeline was absurd).

The coursework weightings do not line up well with how long they take either. Apparently one unit is meant to correspond to 10 hours of work, and after subtracting lecture time that means a 50% coursework should take

[11] The group design project was worth far more than the fuel cells coursework.

around 50 hours to complete. This means that something such as the finite element coursework should have been finished in well under a week, although if you were to try this then your submission would be terrible. It turns out we are not meant to care that much about coursework, and I fully wasted my time spending over 200 hours actually submitting something of high quality[12]. It was not just me spending this much time, almost all of my friend group spent several times longer on each coursework than we were meant to as well.

Based on the data from my friend group, the marks gained per unit time drops off to almost 0 past a certain point. In conversations with the departmental tutor it was revealed that the length of a coursework only has a very small correlation with how long it takes, its weighting, and the page limit. A sentiment I have got from several staff members is that we should not expect marks to correspond to effort which seems strange to me. While it is true that effort can be spent on something terrible, I still maintain that this is a disconnect from the experience of the student and is a problem.

I would like to see the coursework exercises weighted much higher and less of an emphasis placed on assessment through examinations. The number of hours of study would not change significantly as the exams would still require preparing for the same amount of content, the stakes would just be lower. The weighting of the coursework exercises is too low to match the time investment, and this would bring it more in line. Coursework also have a much higher ceiling than examinations[13], and much more advanced concepts can be covered. Personally I would make the contribution of coursework to examinations in a 4:1 ratio.

3.4 Marking Feedback and Lecturer Interactions

The feedback we get with our coursework results is often wrong, insufficient, and does not help us improve. Some lecturers are particularly frustrating to deal with when trying to get clarification, and unhelpful when we follow up on the marks and feedback we have received.

When we complain about issues with the feedback to our coursework submissions we very rarely get our marks changed. This is the case even when we are objectively correct about issues with the marking. By accepting that significant errors were made in our work, they are implicitly accepting that the marking process allows such significant errors. I believe that they just do not want to remark everything, and therefore the decision to reject the evidence of poor marking is a foregone conclusion.

In my finite element method coursework I lost marks for using inline maths such as "The Pythagorean theorem is given by $a^2 + b^2 = c^2$" instead of "The Pythagorean theorem is given by equation (#)", and including an equation outside the body of the text. This is incredibly standard in technical writing and there was no mention about this in the brief. If lectures are going to pull moves like this then they need to give a comprehensive style guide as otherwise they are asking us to read their mind. I did not even attempt to challenge the marking for this coursework despite my strong case as I knew I would get nowhere.

I ran into numerous nonsense problems such as this where the only way around it would be to send hundreds of emails to the lecturers asking about every detail. I knew the finite element method lecturer would give me problems so I did ask about details, and this resulted in him telling me he was not answering any more questions after only nine emails. The lecturer telling me something is in the brief when it demonstrably is not is frustrating and not helpful. Either they have terrible reading comprehension skills, a poor grasp on reality, or more likely they are just lazy. I would not be so annoyed about this if the lecturer did not care about these details, but the stupid thing is that they did.

Even when the feedback we receive is not incorrect, it is often not useful. Very often my friends and I have been given feedback such as "very good" or "excellent", yet have still lost marks. If an answer did not get full marks then there must be some flaw in it, the marker's feedback needs to state what that flat is, and justify the mark given. Feedback that translates the numerical score into a very brief description does not help us determine what went wrong or how to improve. It also puts us at a disadvantage when attempting to dispute our marks as we do not know the logic behind the mark and we cannot judge whether it is reasonable for ourselves. Please give us more detailed feedback.

The poster coursework for the materials and fatigue module had a review process that I want to discuss. We had the opportunity to send a single draft of our posters to the module coordinator, Chu Lun Alex Cheung, and also the teaching assistant for a review. This was very useful, and UCL should try to do more like this in the future. While this was greatly appreciated, there were still issues with this however. I asked a question about whether a section was suitable and got an answer that heavily suggested getting rid of it, although in my final feedback apparently I should have included such a section. This is an example of the random number generator marking at UCL where you are at the mercy of the whims of the marker. When I emailed about this along with several other issues I did not get a satisfactory response.

[12] I only got 76% on the coursework, although this is 4% higher than anyone else I know.

[13] This is true if the coursework exercises have been designed well, something that is not currently true at UCL.

4 Course Overview and Administration

The standard of difficulty in the engineering department is a long way off where it should be, and doesn't provide the expected level of academic challenge. The general organisation of almost all aspects of the course from the Moodle to examinations is a mess, and needs to be fixed. Perhaps most importantly, I also discuss the poor handling of feedback, and the lack of trust that we are able to have in the department.

4.1 Course Difficulty

This course is too easy for a university that ranks as high as UCL does. Here it is possible to waltz out with a first class degree, something that should not be the case for a high-calibre university. In my undergraduate course I felt intellectually capped at a high 2:1, and I actually preferred to be in that situation as attaining a first actually meant something. If UCL wants to be talked about in the same breath as Oxford or Cambridge then they need to seriously reevaluate the difficulty of the course. Below I outline some of the reasons why this is currently not the case, such as the lack of depth, problem solving, and advanced mathematics.

I want to first discuss UCL's confusion between mathematical ability and numerical competency. Being able to use some relationships, rearrange equations, and substitute numbers are skills tested in A-level physics, this is not what it means to do mathematics. The "mathematics" at UCL could be done by anyone vaguely numerically literate who knows how to use a spreadsheet, and the wrong skills are tested. While there is a place for those skills in the course, the main focus in my opinion should be on the development of the mathematics used. Producing a mathematical model to describe situations requires a strong command of the underlying concepts and strong problem solving abilities, and such an engineer is far better equipped to handle new situations.

The problems always seem to be the same - apply some equations, plug numbers in, get answer. This is really boring and makes the examinations very limiting as the questions have likely been encountered before, just with different numbers. UCL could make things far more interesting if the questions had some spice to them and demanded actual problem solving skills. In my undergraduate course if you did not have an intimate understanding of the topics and could not come up with something original in the exam then you would do really badly, there were no free rides there. As an example of a more complicated question, a change to a model that was studied in the course could be proposed, and candidates would be asked to derive similar results to those found in the course when working with the new model.

I was surprised by the lack of more complicated mathematics in this course, there were barely even any differential equations or integrals. Given the huge preponderance of phenomena that are modelled by differential equations, this seems really odd. Linear systems are one of the only classes of problems where solve large problems can be solved and therefore many problems are coerced into being linear, so the almost complete lack of linear algebra was also unexpected. Probability and statistics are other areas that an engineer needs to be well-versed in, and these topics barely featured at all in the course. UCL would benefit from including more advanced mathematics into the course, especially as this also allows for more complicated material. Here I am talking about mathematics that goes beyond what is learned in A-level further mathematics.

I once mentioned the difficulty of the course using the computational fluid dynamics (CFD) coursework as an example, and I asked what was actually intellectually demanding about the exercise. They told me that lots of students had reported that it was too hard, and without trying to sound pretentious, those students just need to get good. UCL needs to stop catering to the lowest common denominator in this way, if people are not capable of working at the highest level then they should not be at a top university. The excuse that it needs to be accessible to those who have not done CFD before is weak as I am one of the people who had not done it before and it was still basic[14]. I am perplexed at how UCL can maintain a reputation of being a top university when offering such little challenge.

If UCL feels that they are limited by the calibre of their students then they should consider stricter entry requirements, or additional steps such as an entrance exam. Passing the admissions process at Oxford was a very reliable indicator that a student was capable of handling the difficulty of the course, these systems work. I would also like to note that many of my friends and I already do not feel as academically challenged as much as we should be. UCL already has students who are more capable, and is currently leaving us disappointed. From my experience I also suspect that many of the international students would have not have been accepted if they were not paying extortionate fees, this needs to be reviewed.

4.2 Examinations

The organisation of past papers in the engineering department is extremely chaotic. The questions on each paper are sometimes split up which further adds to the mess, and makes finding answers harder. It is evident that any attempt at organising them is either very weak or non-existent, and I have found no logic to the

[14] This is not because of any intelligence on my part, I only got a 2:1 in my undergraduate course and am not exceptional.

structure. Figure 11 shows all the examination resources provided for one of my modules as evidence of the lack of structure. In my undergraduate course all the past papers were stored in one place, organised by academic year, module, and finally year. Could UCL implement something similar please? The link to past papers on the Moodle just searches the library for the module code and did not return anything when I tried this.

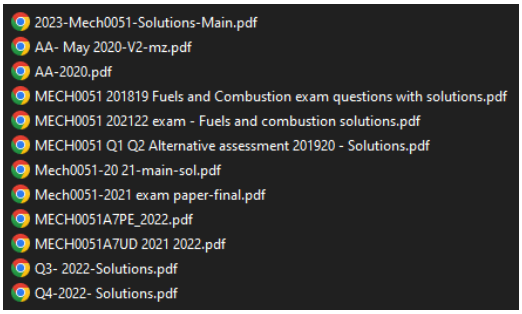


Figure 11: An example demonstrating the lack of structure in the organisation of past paper resources

The structure of the exams themselves have issues. In my undergraduate course each exam had the same structure: 90 minutes per paper, three questions where candidates pick two, and 25 marks per question. This was almost universal across the department[15], and this practice went back at least ten years. All papers were written in the same style with the same template, and again this was universal throughout the department. At UCL there is no such consistency between modules, or even for the same module between years. I had no idea what the structure of my examinations would be apart from a handful of small details. Please can UCL pick a format they like and stick to it, this is more than possible to do.

The number of errors in the past papers and solutions that we were provided was inexcusable. I can only hope that those were the first drafts and were not actually used as otherwise this would be a very serious error on UCL's part. Examples of errors were things such as giving a power when work was asked for, forgetting to multiply/divide by efficiencies, substituting in the wrong numbers, and errors in the questions that make it ambiguous or impossible. In general they were sloppily done and I refuse to believe that they passed a peer review process. UCL needs to address this immediately and ensure there is a robust system in place to lower the error rate to near zero in both question papers and mark schemes. The corrected versions should also be supplied as resources for following years. For comparison, in my undergraduate the only error was an incorrect number which was corrected before we started the paper.

The way the papers are written is often poor and shows bad understanding of how a test should be constructed. For example if someone has already been tested then it does not need to be tested again. There are two reasons for this, firstly because it is unnecessary, and secondly because someone who does not know that part gets penalised twice. There is more than enough content in the course to fill a paper, they do not need to cover the same knowledge or competencies twice. The prime example of this would be the power trains and auxiliary machinery examination where 42% of the paper was dedicated towards using one method of duct sizing for an HVAC system. This is especially perplexing given that we learn two methods of doing this, and they could have very easily had one question for each method rather than two questions on one method.

The second reason why the papers are badly written is harder to fix, and will probably require training of staff. If a student has a partial understanding then they should still be able to make some attempt at the question. For example if a student was unable to do the first part of the question and the second part relies on the first part, they will lose the marks for both sections. This situation could be fixed by having the first part show that something is true. The question remains unchanged and the student still needs to do the work, although now they can attempt the second question using the given piece of information. If a very long computation is asked for as a single question then this suffers similar issues. In general the question authors should keep in mind how much they want to penalise student for each failure of understanding, and structure the questions to match.

Something that caused confusion during revision and in the examinations was the strange distribution of marks. The number of marks is meant to be indicative of how long an answer should be, in terms of word count or steps in a computation. This regularly did not hold however, leading us to believe we were either overcomplicating or oversimplifying answers. This is bad form for a question writer as each mark should take around the same amount of work. It is acceptable for marks to not be equal in difficulty however, for example in my undergraduate exams the difficulty increased throughout the question. The marks were still allocated to how many units of work were needed to answer each part.

[15]In the first year there were slight deviations to this due to the structure of the modules.

UCL does not understand the online format for examinations. As students have unrestricted access to the internet and all their resources the papers need to account for this, but UCL goes about this in the wrong way. They did this by significantly increasing the time pressure, and making a very intense experience. These were not hard due to the content, they were hard to the lack of time, something that should not be the case for an examination. I had some online examinations in my undergraduate due to COVID-19, and they were made suitable by ensuring that the answers were not be easily accessible on the internet. The reason that ChatGPT is a threat to online examinations at UCL and not at Oxford is because the latter are actually hard, and ChatGPT does not have the problem solving abilities to do them.

One of the issues I faced with online examinations at UCL was with prepared materials. For one of our modules we are reliably asked to carry out something called the rainflow algorithm, and I had prepared a program to do this for me. I asked the module coordinator about the legality of this and got a politician's response, and overall they were very uncooperative. They told me that I needed to show all my working, although I had described the output of the program and how it showed all the steps of working that the lecturer did. When asking if they could tell me what steps of working I had missed, they were not helpful. They also said that they could not answer without revealing the content of the examination, although this does not hold water. I was asking a hypothetical question, "If P, does Q follow", they did not need to reveal the truth of P in order to answer this.

Personally I do not think they anticipated that anyone would do this and I was throwing a spanner in the works. There would be nothing stopping me sharing my code with the whole cohort before the examination started. If they answered yes, then the question becomes completely redundant as all difficulty is removed. If they answered no, then there would still be nothing stopping me from copying the output of the program by hand. My answer would be indistinguishable from someone who did the whole question as intended, and the question is still redundant. I did eventually get a sufficiently straightforward answer and used it in the examination, but I think this is a good example of the lack of planning or foresight of UCL. The actual resolution to this problem would be to not include this algorithm in an online examination at all.

UCL does not appear to do examiners reports and personally I think they should. In my undergraduate course the would publish a document a few months after the results, and this would be available as part of the past paper archive. This included a description of the curving process, an anonymised ranking of results[16], and some statistics about gender breakdown of results, comparisons with previous years, etc. These documents were not just interesting to those who did the examinations, they were useful for future years as the markers gave their comments about the performance on each question.

4.3 Administration and Feedback

The Moodle pages are extremely badly organised and they were a source of constant frustration to me. Lecturers often split the resources up lecture by lecture, but this was really annoying and just meant that we had to scroll more. If we needed to find some information, we may have known what topic it was but it was hard to remember what week of lectures it was. Having all the lecture slides in one document eliminates these issues, and I would usually download them all and combine them myself anyway. While my undergraduate course was not always perfect in this regard, figure 13 shows what almost all module pages would look like. For comparison the Moodle pages at UCL would not fit in 10 figures, but figure 12 shows a snippet demonstrating the mess.

Scrolling through the new and renewable energy systems page requires pressing page down 21 times, yet in my undergraduate we often did not even need to scroll at all. I appreciate the supplementary material that the lecturers provide, although this either belongs in an appendix, a reading list, or in a section giving references to additional resources. The occasional lecturer were also strangely protective of their resources and insisted on releasing them week by week. A few lecturers also uploaded content in the announcements tab which is separate to where all the other content is. The reading list links on the side rarely work either, and the exam resources never work as previously mentioned. These are a minor issues, but makes using the Moodle awkward, and can be easily fixed.

The way the lecturers use the question and answer section on Moodle needs to improve. Firstly, the forum is designed to be a communal space, and I see no use case for the private response feature. Lecturers should stop using this completely, and personally I think the feature should be removed. The response rate from some lecturers was also poor[17], with a worrying number of questions getting ignored[18]. In general some lecturers were very hard to contact. I have a friend who took weeks trying to contact a lecturer, including daily emails and waiting by their office - this is not good enough.

[16] This was the cumulative total of people who got more than each percentage value.

[17] I want to give credit to Richard Bettany here. He asked us to contact him via email and he was very responsive, even after usual hours and on weekends. He went far above the standard that I would expect.

[18] One exception I want to make to this is William Suen who did not respond to me on Moodle, but instead dedicated 90 minutes for a one-on-one meeting with me to discuss my questions. This is also going above and beyond what I expect from the lecturers.

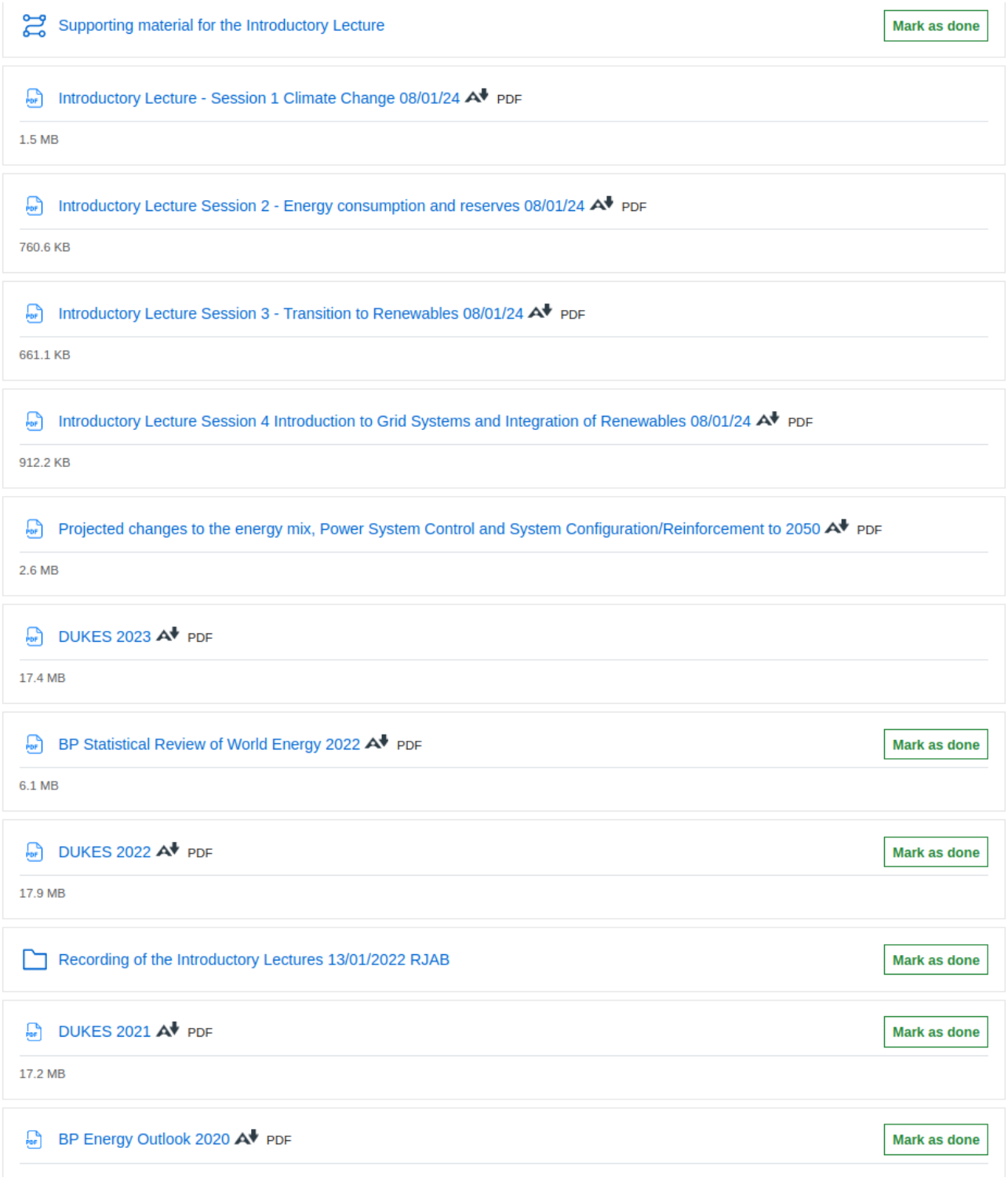


Figure 12: The organisation of resources at UCL. This is for two hours of lectures.

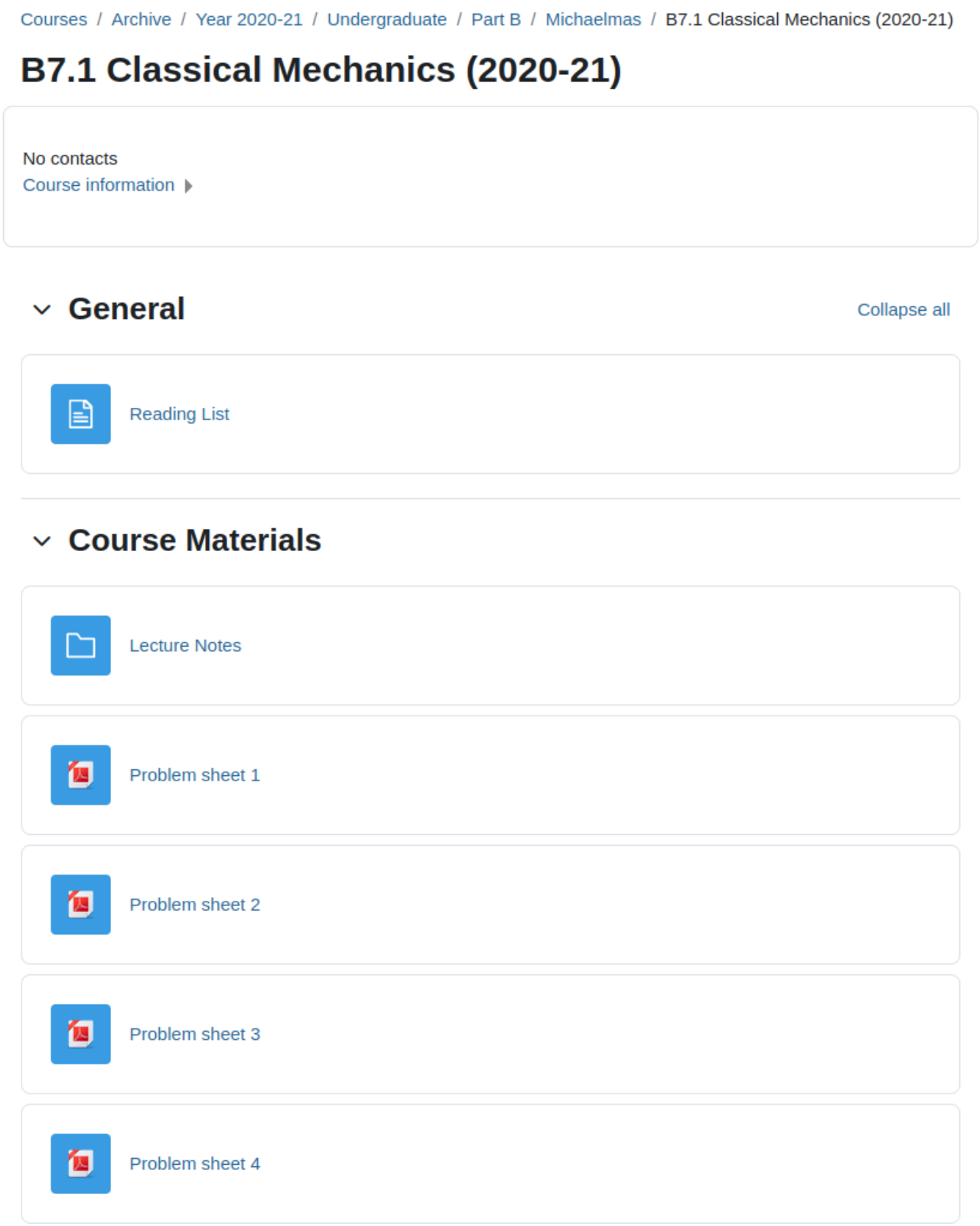


Figure 13: The organisation of resources for the Oxford undergraduate mathematics course. This is for a 16 hour lecture series.

Access to the Roberts building should be extended. Currently it opens at 7:30 am, and the basement opens half an hour later than that. This is not a staffing issue, security are in the building before this time and academics are allowed in. Another study room, 410, is also often locked at 7:30 am. I travel off-peak and arrived around 7:20 am, I would not be able to access the work rooms for an awkward 40 minutes. They could fix these issues by trusting the students and letting us in at the same time as academics, including when the basement opens and room 410 is unlocked. These problems are worse on the weekends and bank holidays.

I was surprised by how few modules were on offer at UCL. There were only five choices where we pick three, and the other five were compulsory, and as a comparison my undergraduate course had around 35 modules to choose from each year. I understand that this course is designed to be accessible to those who have not come from a mechanical engineering background, although even with this restriction the selection could have been wider. We were also not allowed to take additional modules which I thought was odd and needlessly restrictive. Again in comparison to my undergraduate, we were allowed to take as many extra modules as we wanted if we were capable, and I knew someone taking on a 50% additional workload. At UCL we can still attend these lectures, but you would not be allowed to take the examinations. This policy seems unacademic and unnecessary.

While this only affected a few students, there were some who were not allowed to take advanced computer applications in engineering. These students were from another MSc degree offered by the engineering department and had lower priority over mechanical and power systems students. I think this is disgraceful and the department should have been flexible enough to allow them on the module, for example by adding an extra row of chairs at the front of the lecture hall[19]. In my undergraduate studies the modules would be run no matter how many people were doing them.

Feedback from the department is a key issue that needs to be a focus. Out of all my complaints, the fact that the department seems unwilling to change or listen in any meaningful way is the largest of them. They regularly deny the existence of our problems and seem completely disconnected from the student experience. I have no evidence for this beyond hearsay, but I have even heard of the department fabricating good feedback results for a form that we never received. I have little to no confidence in the department to enact positive changes, and I do not trust them. They have received significant amounts of feedback which they seemingly have not acted on.

Beyond listening to feedback, I do not trust the department in general. I feel that I cannot rely on basic things such as unambiguous question phrasing in exams or for coursework briefs to make sense. Permeating through everything there seems to be a sloppiness and lack of care that is not acceptable. Given that this course cost £18,000 it feels like a scam, and I cannot imagine how angry the international students must be. UCL is raising the price to £19,300 next year which I think is disgraceful. As a part of a prestigious university UCL engineering should be striving to be the best, but instead they have a "that will do" attitude that makes it seem like a cash grab. They should start by implementing stringent peer review processes and holding themselves to significantly higher standards.

[19]This would not have been an issue anyway. In the first lecture the large hall had standing room only, but a few weeks in there was only around 20 students who turned up as these lectures were extremely boring and useless

5 Particular Issues

5.1 Group Design Module

The following is some feedback I wrote to the student representatives about the running of the group design module by Suwan Jayasinghe. I believe that the department are actually planning on doing something about these issues, although after his involvement with the review process for the module has concluded. I am including it here because I highly doubt that we are the first year group to have had issues with this module, and something should have been done earlier. I also want to highlight the clear lack of a peer review process that allows these problems to occur.

Suwan is the author of chaos and confusion, and I have absolutely nothing positive to say about his handling of the group design module. Without exaggeration he has managed to go wrong at almost every single turn which is honestly impressive given that his one and only job is to tell us about this module. I have no idea how he has been running this module for 10 years and is still so unbelievably incompetent. I would also like to note that his superiority complex is first of all not helpful, and secondly it is completely and utterly unwarranted. The group design module is a train wreck and it is entirely his fault.

First of all there was the requirement that there are an equal number of power systems engineers and mechanical engineers in each group. Anyone can see the immediate problem with this, if there are not the same number of power systems engineers as mechanical engineers then this is mathematically not possible. When this was pointed out to Suwan he was rude, acted as if we had no common sense, that this was somehow our problem, and ultimately he did nothing to resolve the issue. He seemed surprised when it was revealed that this had caused chaos and that some people had to break this rule in order to form groups. Suwan wanted to completely remove himself from any group selection drama[20] which did not help the situation.

The next major blunder was how the group topics were chosen. We were told that they would be given out on a first come, first served basis, although we would not know what the list of projects was in advance. In my opinion this was the biggest mistake in project selection as it meant the optimal strategy would be for one member of the group to pick what they thought were the best projects and submit. This would be significantly faster than any group that decided to discuss the choice amongst themselves and ensure the whole team was in agreement. This was a big decision and we were forced into reading all options and decided as fast as possible.

Another issue was that the topic selection was also done via a form where you could not see which topics had already been selected by others, and therefore it was likely that a group would unknowingly pick options that were already taken. As part of the form we also had to enter all of our student numbers which was an unnecessary source of stress in an extremely time sensitive environment. There should have been a group selection form submitted beforehand where we stated our groups without any time pressure to remove this issue.

One part of the form asked if we had received permission from the supervisor to do this project. Clearly Suwan had not bothered to read the form as at this stage we were not meant to have messaged the supervisors, or even known who the supervisors were. Over a week later many of us were becoming concerned as determining which group had which project should have been a trivial task given that it was determined by who submitted first, yet we had not heard anything.

Suwan's lack of communication on this matter was a problem. There was a message on the Moodle forum that was never answered by Suwan saying that two groups had received confirmation from the same supervisor. This caused considerable confusion and panic, firstly because we had no idea where they had found this information, and secondly because we were under the impression that it was due to timing, and not supervisor confirmation. I contacted the supervisor for one of my projects who told me that another group had contacted them first so they were the group they had gone with. I heard many stories about people contacting supervisors and hearing similar things, yet Suwan would later claim that all the supervisors had been briefed on how the group selection worked which was clearly false.

Almost two weeks after we had submitted the form I had a meeting with Suwan where he revealed that 25 students were still not even in groups, and that was causing the delay. If this was the situation then it should have been communicated to everyone, yet no emails or Moodle announcements were given, and the question on the Moodle was also ignored. I would like to note that 25 students not being in groups is further evidence of how poorly run this module was.

Another factor that significantly contributed to the confusion was the out of date Moodle page that gave instructions on how to choose a problem. It said we needed to arrange meetings with the supervisors and get confirmation from them, in contradiction to what we had been told, but in agreement with how the supervisors

[20] I should point out that almost all group drama was caused by Suwan in the first place.

appeared to understand the arrangement. I later found out that Suwan is not in charge of the Moodle page which I think is a strange choice by the department. Even thought this is the case, as module coordinator he should still be responsible for ensuring that the correct information is on the Moodle page.

Once the projects were allocated another issue arose where some projects were more focused on mechanical engineering but had more power systems students, and other projects had the opposite problem. A solution suggested by a friend of mine was to have individuals sign up to the projects directly. Supervisors would then submit their choices of who they wanted, perhaps based on a small statement provided by the students. While this is a more complicated system, it would significantly help ensure that students were assigned to suitable projects, and that each group had the right mix of skills to give an even workload.

Suwan's attitude is also a large problem. He seems to think he is the only one with common sense, and if you say or ask something that he things is stupid then he will react as if you had three heads. For example, in the second group project briefing there were several questions about formatting of the report. Many students have had experiences of strict formatting requirements in the past, some even losing marks for things such as using the wrong font size. Suwan was apparently completely unaware of this extremely common experience, and instead of realising that this needed significant clarification he continued to act in disbelief that we asked such questions. There was a similar response when asking about how the peer review process works, even though it is different to the standard at many other universities where groups review the work of other groups.

Suwan likes to clear himself of any blame by hosting question and answer sessions where he gives people the opportunity to ask any questions. This would be nice, apart from the fact that he assumes that this means everyone understands everything perfectly after the session. He does not seem to be aware that many people may not want to ask a question that may sound stupid in front of an entire room of people, especially given the anticipated reaction by Suwan. That people may think of more questions later on was also not considered by Suwan, and it was extremely rare to get answers from him on the Moodle or via email.

5.2 Academic Integrity Policy

The following is a slightly revised version of a post I put on Unitu about the department's policy on academic integrity and collusion. I am including it here because I have received no response from the department. In my opinion, the current academic misconduct policy is no more than a box ticking exercise by the university, and a weak attempt at trying to prevent the worst of academic misconduct. It is confused about what behaviour is important to stop and is also almost completely unenforceable.

As an example of where the policy makes little sense, consider what it says about use of AI. When we are allowed to use ChatGPT we are meant to say what prompts we used, what output it gave us, and how we used it. If everyone were to actually follow this, that section of the appendix would be at least half the size of the whole document. Does anyone actually do this? There are coursework questions that are so well suited to ChatGPT that the lecturer may as well tell us directly "I want to read more ChatGPT drivel, can you help?".

When the lecturers see that barely anyone at all has a section explaining the use of AI in their work, do they assume that no ChatGPT was used by any of the students? The students do not care and the markers do not care, but ultimately why should they? Suppose I use ChatGPT to explain the difference between "practise" and "practice", am I meant to put a footnote after I use either of those words telling the marker to see the appendix for details on how I learnt this from ChatGPT?

UCL also has a very strict collusion policy, although it is completely unenforceable. From my understanding, doing much beyond a very surface level proof-read of someone else's work counts as collusion, and this seems absurd to me. My takeaway from the academic integrity lectures was that UCL would prefer it if we entered into some sort of pod at the start of the year and emerged at the end, doing all work in complete solitude.

I think UCL is confused on what is important and what is not when it comes to collusion. Helping a friend fix a bug in their code, seeing if your numbers are in the same ball-park, getting opinions on a figure they have made, or even explaining a concept are all examples of behaviour that is completely acceptable in my eyes. These do not change the difficulty of the task, everyone still has ownership over their work, and they still learn the things they were meant to learn from the task. This is what the collusion policy should be about, and actions that challenge this such as copying and editing sections of work, or allowing someone to appear as if they understand something when they don't are what should be the focus.

As an example of an attempt to stop collusion, consider the FEA coursework where one of the geometry parameters depended on our surname. Firstly, this was a single parameter, you could easily check results with friends by changing a single character in your code. Secondly, a quarter of the cohort would have the same parameter value as you anyway meaning you could easily find someone with the exact same task as you anyway. The tasks were far too similar meaning it could not be effective as a way of stopping collusion.

I'd also like to note that for one value of this parameter, all elements would be rectangular. This meant that the maps from the reference element to the practical elements would be significantly simpler than the map to a general quadrilateral, and resulted in a constant diagonal jacobian that was the same for all elements. Even though I was in this group and did it in full generality anyway, I will moan about this. Measures to stop collusion should not make the task easier for some students over others. Overall this measure was half-hearted, ill thought out, and had extremely negligible effects on preventing collusion. Other modules do not have any measures at all.

There is also very little done to stop poor academic practices. If I were to spot an extra factor that changed a number by 5% early on in a series of calculations, I would have to update all the equations that were influenced by that. Alternatively, it would be much easier to just change one number in one equation, and not bother updating anything else. No one is actually going to bother checking that. I'd never do this because I would not be able to sleep at night, but you could, and students almost certainly have done this.

For another example, consider the FEA coursework again where we had to put our code in the appendix. If it looks legitimate then the markers are not going to check it, and there was at least one student who submitted code that did not even run and they were not caught. They should have asked us to submit our MATLAB files directly. References can also be extremely sloppy as realistically they are not going to be checked. Referencing badly is significantly faster than referencing properly. Many students will go to Google Scholar, pick any of the top three results of their search, and no one will ever know.

I'd like to speak more broadly about UCL's attitude to aids and resources available and how it relates to academic misconduct. For example, at UCL we are not even allowed the more advanced calculators in exams. A calculator capable of single variable integration would only be cheating if we were being tested on our ability to integrate simple functions, and on a masters level course why would we be tested on that, we are not back at A-level. This is an example of where UCL seems confused on what is appropriate to test us on.

My undergraduate course provides a good comparison. For online exams there was no calculator restriction and we were allowed to use Wolfram Alpha, but it was only useful for checking answers or general grunt work that was irrelevant to the difficulty of the task. We were even allowed complete access to the internet for online exams, although it was not very helpful. This was because the questions were not standard and could not be easily found on the internet. It was understood that these were assistive tools, and the difficulty, problem solving, and effort had to come from you. This is not understood at UCL.

This attitude worked at my undergraduate university because the difficulty, problem solving, and effort could only come from you, it was not feasible to get it from somewhere else. This brings me to my final point about the core of why UCL's academic misconduct policy is bad – the tasks we are given lend themselves to academic misconduct. If we are given a question where it is possible to generate a bunch of waffle from ChatGPT and then remove obvious ChatGPTisms like, "this underscores xyz" or "enhancing abc and promoting xyz", then many the students are going to do just that. The issue here is that we should not be given questions like this in the first place, it should be the case that if you do not understand then it will be obvious, no matter how much you poke and prod an AI.

The unenforceability of many aspects of the policy is also a huge problem. There needs to be an understanding that a deterrent depends on the immediacy, magnitude, and likelihood of consequences. The department cannot expect even the majority of students to comply when the chance of getting caught is zero for all practical purposes. For example, collusion will not be detected unless they find sections which are nearly identical between two submissions. As we are not completely stupid, any students who are colluding would not do this. I would not be surprised that the only real check that is done is Turnitin, and as we have access to this ourselves this will only catch the most foolish of plagiarisers. This policy reminds me of the BBC's TV detector vans and other fruitless efforts to enforce TV licensing.

UCL should reevaluate their priorities and also what they are capable of enforcing. Personally, I think they should stop caring about regular behaviour between friends working together, and focus more on the more important issue of students acting in bad faith and getting higher marks than they would otherwise. In particular I think the issue is with coursework exercises with a very narrow solution - if you ask everyone to do the same calculation, they are going to compare answers.

I would prefer to see coursework exercises that are more open and allow students to take them in different directions. In this case engineering intuition and understanding of concepts would be tested more heavily, and students would not be able to collude as easily on these more important parts of the assessment without ending up with extremely similar submissions. Failing this, could UCL please drop the facade that they care about trivial details such as telling a friend what Excel function to use when they ask for help? Engineering and university work should be more collaborative than what the policy suggests. Please note that this is not a request for more group design work.

6 Conclusions and Recommendations

This section draws on the evidence presented in the previous sections, summarises recommendations for future policies, and also gives additional suggestions. The main ideas I discuss here are the implementation of review processes, a larger focus on teaching over research, and an overhaul in the approach to the specification and resources. Some of these proposed changes involve significant time and money investment, but they are made on the assumption that the department is serious about improving the quality of the course, and wants to justify UCL's position as a top university.

There are several processes that the lecturers cannot be trusted to do on their own. These include the production of resources, writing and construction of coursework briefs, marking of work, and writing examination papers. Reviewing processes should be put into place for all these documents and tasks, and this should be done to minimise conflicts of interest. For example, a lecturer is less likely tell another lecturer that they should make their own figures if they are going to be held to the same standard as their reviewee later on. The reviewers should not hold an attitude of "good enough", but aim to find as many flaws as possible within reason[21]. There are some review processes in place already, for example the marking needs to be signed off by someone else. Given the huge number of errors that pass the review, the standards of review need to be increased significantly.

The resources in the department need such significant changes that it is almost worth starting again from scratch. Firstly, lecture notes should be produced, typeset in LaTeX to a near publishable quality. These notes should be the main source of information for each module, and the lecture slides should be redesigned as presentation aids. Lecturers will almost certainly benefit from training on the design of presentation slides, and will likely need training in the use of LaTeX and typesetting[22]. Construction of these resources is not a quick job, and requires significant dedication[23]. Most figures should be in vector formats and will need to be custom made, for example in Python, MATLAB, or R for plots, and Inkscape for other figures. An example all lecturers should follow is found in [2]. Lectures should also watch a Paul Hellier lecture to see how lecturing should be done.

The specification and focus for all modules needs to be changed significantly as currently the material is very surface level and basic. The calculations performed feel like the back of the envelope calculations done in the first few minutes of the design stage in a project, and should be made much more complicated. The scope of each module is very broad, and while that has its benefits, some breadth should be removed in favour of going into detail on a selection of topics. The difficulty is also a problem, and needs to be increased considerably. More focus should be put on the development of sophisticated mathematical models, and the advanced ideas at the cutting edge of the industry. This is the level of challenge I would expect at a university asking for BCC at A-level, not A*AA, make the content harder.

Coursework at UCL needs overhauling, in terms of the nature of the exercises, weighting, and marking. Currently it feels like busywork that could be done by any somewhat numerically competent person, and ChatGPT is able to answer the questions. Make the coursework exercises more open to allow us to be creative what direction we take them, and also to take the material as far as we want to. The marking of coursework needs an intensive review, and more time needs to be dedicated to it. The way marking is done leaves students playing a game with unreliable rules is unfair and needs to be remedied. Markers should stop skimming, make comments on the documents, and give much more detailed feedback. More time needs to be allocated to the marking of work, and more effort spent in review, perhaps even double marking all work. The department will not find a quick fix here, the problems are systemic and significant.

Coursework weightings need to be increased substantially as the current weightings do not represent the time effort needed. The importance of examinations should be reviewed given their numerous issues, for example some people are highly competent but do not perform well on examinations. I recommend a 4:1 ratio for the weighting of coursework and examinations respectively. For example I spent over 200 hours on a coursework that has half the weight of the individual project presentation. While presenting is important, I think the department does not understand the time investment necessary to produce a high quality coursework submission. An attitude shift needs to occur, as it appears we are not meant to care much at all about our coursework. LaTeX should also be a requirement for at least one coursework as knowing the tools required to typeset a technical document properly is important. Learning more software would also improve the utility of the coursework exercises.

[21] For example, when I am proof-reading the work of my peers, I point out when a non-breaking space should be used, such as 3 cm, but not when they have split an infinitive.

[22] I want to point out that in my undergraduate course we received very little training in either of these, yet everyone was still more than capable of figuring it out on their own. I do not trust the same thing to be the case with UCL engineering lecturers.

[23] If the department want to be lazy, they can ask the students to create a section of the lecture notes as part of a coursework exercise. I guarantee this will result in higher quality notes than if the lecturers had to do it themselves.

All examination resources should be centralised and conveniently collated. UCL's current system using the library does not work and the resources uploaded to the Moodle are a mess. The past paper resources should also be the up to date version of the paper and mark scheme, and not the first drafts. Examinations should also follow the same format between years, and preferably standardisation between modules would also be nice. Being given a choice of questions would also be a change welcomed by students. The weighting of questions should be reviewed to ensure the same level of effort is required per mark. Question writing needs to be improved, and training for this will almost certainly be needed.

The department should do much more to listen to feedback[24]. Their current attempts are pathetic and the administration needs to do a lot more to keep the lecturers in line. When students collectively come to the department with a problem, the department should not simply dismiss it. A lot of work needs to be done if the department want students to trust them and the systems in place. For example, I know that new staff are split into research focused and teaching focused roles, but the main problems are with the current staff. It is clear that many of the current staff do not care about teaching, and I think they should be left to do their research if they want. More needs to be done to incentivise teaching roles, including training and extra pay.

The academic integrity policy needs to be rethought. The priority should be on malicious behaviour that would lead to students getting higher marks than they deserve. Checking results, asking for help from peers, and using tools such as ChatGPT should be recognised as assistive, but the students still have sole authorship over their work. The lack of being able to demonstrate any individuality while remaining within the scope of the coursework briefs also allows for collusion as everyone has to do the same thing anyway. The lack of care in marking means that dodgy references and lazy mathematics are almost certainly going to be missed. The department should either admit that they are too lazy to bother checking, or stop the facade that they care. In online examinations, collusion can be significantly reduced by curving the results[25].

In summary, the department has many issues to fix. I think most of their problems come from a lack of caring, and not holding themselves to high enough standards. The department needs to recognise the problems, listen to feedback, and be prepared to take significant action in order to fix them.

[24] Merely collecting feedback does not count, it must be acted on and the response communicated

[25] Firstly, one person doing better via cheating means everyone else does worse, but without curving everyone is completely independent and there is no effect on anyone else. Secondly, there is a selfish reason, as if a person helps another, that person does worse.

A Examples of Unhinged Lecture Slide Practices

Here I give examples of the weird things I have seen lectures do in lecture slides. It is far from exhaustive.

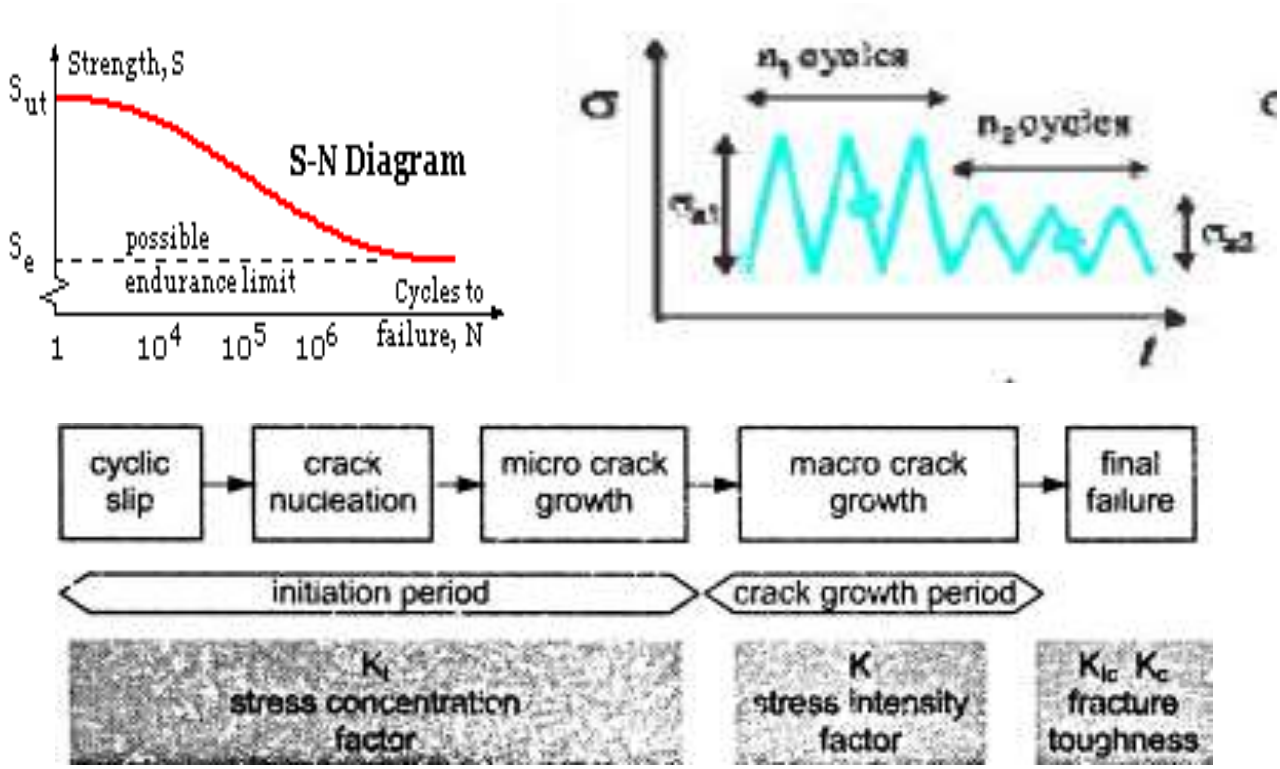


Figure 14: A small sample of figures with terrible resolution found in lecture slides.

m	E (W/m^2)
1.1	832
1.2	805
1.3	779
1.4	753
1.5	729
1.6	706
1.7	683
1.8	662
1.9	641

Figure 15: Microsoft office supports tables and they do not need to be snipped. This one even has has a cursor in it.

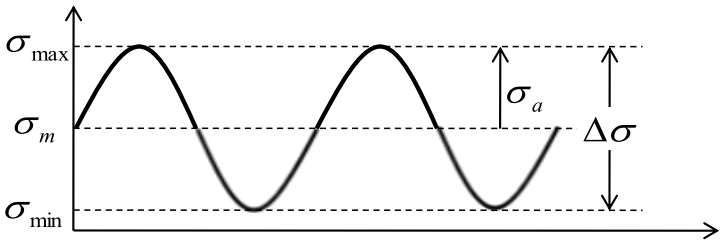


Figure 16: A picture that somehow ended up being half vector format and half bitmap format.

$$K_I = \frac{P}{B}\sqrt{\frac{\pi}{W}}\left[16.7\left(\frac{a}{W}\right)^{1/2} - 104.7\left(\frac{a}{W}\right)^{3/2} + 369.9\left(\frac{a}{W}\right)^{5/2} - 573.8\left(\frac{a}{W}\right)^{7/2} + 360.5\left(\frac{a}{W}\right)^{9/2}\right]$$

Figure 17: This is a low resolution image of an equation. The aspect ratio has not been altered from where it was found in the lecture slides.

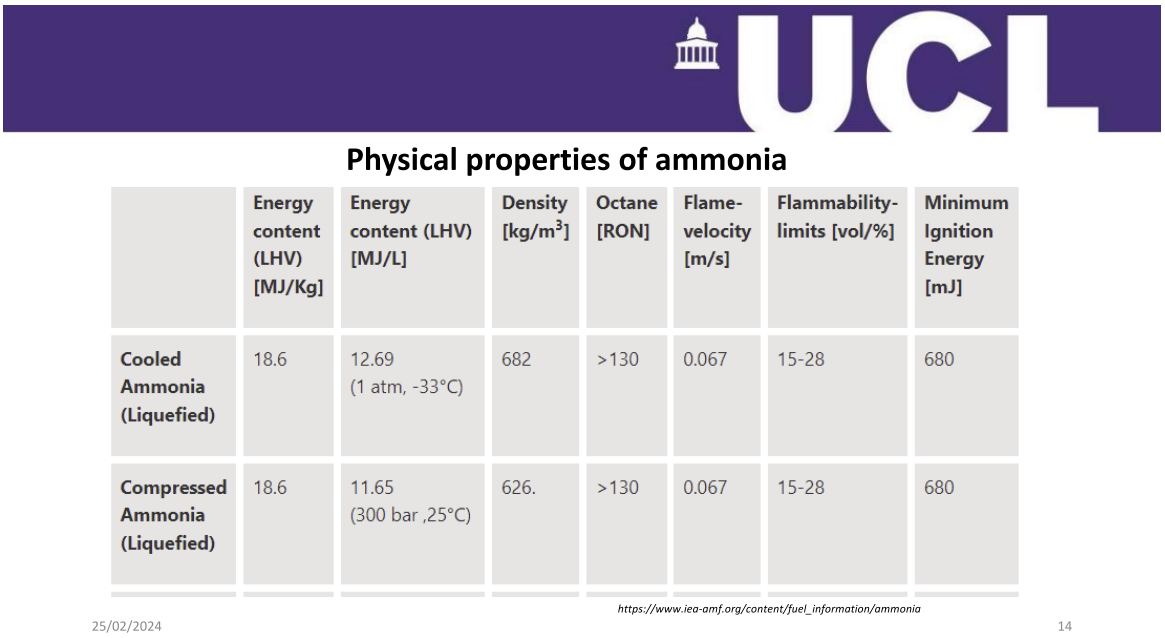


Figure 18: It may make sense for this data to be in a table when there are many rows, but when restricted to two rows it looks really stupid. This is lazy.

Figure 19: This figure came somewhere from Reddit, how useful. I am not against using non-academic sources, but they should be cited properly.

Fatigue Crack Growth: number of cycles to failure

Paris law

$$\frac{da}{dN} = C(\Delta K)^m \qquad K = Y_{(a)}\,\sigma\sqrt{\pi a} \qquad \Delta K = K_{max} - K_{min}$$

$$\Delta K = Y\Delta\sigma\sqrt{\pi a} \qquad \Delta\sigma = \sigma_{max} - \sigma_{min}$$

$$\frac{da}{dN} = C(Y\,\Delta\sigma\sqrt{\pi a})^m \qquad \frac{da}{C(Y\,\Delta\sigma\sqrt{\pi a})^m} = dN \qquad \frac{1}{C(Y\,\Delta\sigma\sqrt{\pi})^m}\frac{da}{\sqrt{a}^m} = dN$$

$$\frac{1}{C(Y\,\Delta\sigma\sqrt{\pi})^m}\int_{a_o}^{a_f}\frac{da}{\sqrt{a}^m} = \int_0^{N_f} dN \qquad \int\frac{da}{\sqrt{a}^m} = \int a^{-\frac{m}{2}}da = \frac{1}{-\frac{m}{2}+1}a^{-\frac{m}{2}+1}\Big|_{a_o}^{a_f}$$

$$= \frac{1}{1-\frac{m}{2}}\left[a_f^{1-\frac{m}{2}} - a_o^{1-\frac{m}{2}}\right]$$

$$N = \frac{1}{C(Y\,\Delta\sigma\sqrt{\pi})^m}\frac{1}{1-\frac{m}{2}}\left[a_f^{\frac{2-m}{2}} - a_o^{\frac{2-m}{2}}\right]$$

$$N = \frac{2}{(m-2)CY^m(\Delta\sigma)^m\,\pi^{\frac{m}{2}}}\left[\frac{1}{a_o^{\frac{m-2}{2}}} - \frac{1}{a_f^{\frac{m-2}{2}}}\right]$$

For cases where Y depends on crack length, the integrations generally will be performed numerically.

Hints

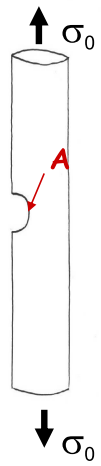
$$\sigma_{local} = \left(1 + 2\sqrt{\frac{a}{r}}\right)\sigma_0 \qquad \sigma_{th} = \frac{E}{10}$$

$$\sigma_{local} = \sigma_{th}$$

Case 1: a = r = 1 micron

Case 2: a = 1 micron, and r = 20 Å

$$1\text{Å} = 10^{-10}m = 10^{-4}\mu m$$



$\sigma_{local1} = ?$

$\sigma_{local2} = ?$

$$\sigma_{local} = \sigma_{th} = \frac{E}{10}$$

$$\sigma_{o1} = \frac{E}{30} \qquad \sigma_{o2} = \frac{E}{460}$$

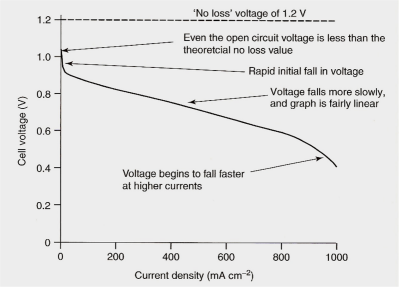
Figure 20: The layout of the equations on these slides is extremely chaotic.

UCL

FUEL CELL LOSSES

There is a difference between the voltage that is expected from a fuel cell operating reversibly (ideally) and the voltage that is observed in practice. Five names are commonly used to denote the voltage difference:

- **Overvoltage** is a term often adopted by electrochemists to describe the nonideal behaviour of electrolysers, fuel cells and batteries. Unfortunately, the form of the word overvoltage tends to imply that the observed voltage is larger than the value predicted by theory, whereas in fuel cells the observed voltage is smaller.
- **Polarization** is another term that has been employed by electrochemists, but it is misleading on several counts and is generally best avoided.
- **Irreversibility** is the best term from a thermodynamics point of view. Nonetheless, it is perhaps not sufficiently specific to fuel cells and does not connect well with the main effect under consideration here, namely, that which gives rise to a reduction in cell voltage.
- **Voltage loss** may be taken as a simple way to indicate that a practical fuel cell exhibits a voltage that is less than would be expected from thermodynamic considerations.
- **Voltage drop** is certainly not scientifically precise, but it does convey the effect observed and is readily understood by electrical engineers.



Voltage versus current density performance of a typical fuel cell operating at low temperature and air pressure.

Figure 21: This slide is just the lecturer moaning about the terminology of electrochemists.

UCL

POWER vs ENERGY

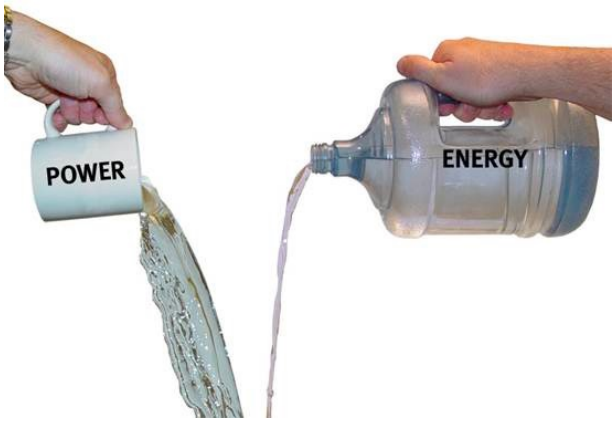


Figure 22: What is this slide even trying to communicate?

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	System Description	Capability	Unit	No of assets per substation	MTBF	MTTR	No of Men	MTBS	MTTS	No Men	Maintainability	Total Mtce Hrs pa	Total	Total Life
2		Index (CI)	Manufacturing		MTBF	(Repair Duration)	Per Repair		(Service Duration)	Per Service			Mtce Cost (OPEX)	Cycle Cost (LCC)
3			Cost (CAPEX)		*Operating*			*Operating*			*Total Mtce Hrs/*		5 Substations for 40 years	5 Substations for 40 years
4			*£k*		*Hours*	*Hrs*		*Hours*	*Days*		*Op Hr*		*£m*	*£m*

Figure 23: Evidence of a lecturer who does not know how to wrap text in Excel

References

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[4] Freya Holmér. The Continuity of Splines, December 2022. url: `https://www.youtube.com/watch?v=jvPPXbo87ds`, date accessed: 19/05/2024.