Integrated System Design Project M Project Brief

1.0 Course Aim and Intended Learning Outcomes

ISDPM aims to give you experience in working in a diverse engineering team to solve a problem given by a brief. You have freedom to direct the project to suit the individual skills, experience, and interest of your group. The challenge is to work collaboratively to get the most out of each individuals strengths while supporting each other during challenging moments.

- determine the engineering expertise which the student has which could contribute to a diverse interdisciplinary project;
- solve specific, technical problems and integrate the results within a diverse project team;
- produce robust options appraisals for project initiation, and present as oral report.
- consider major implications of wider aspects of a project including planning application, environmental impact, sustainability and end-of-life issues;
- gain experience of working and communicating in a diverse team of engineers;
- present their team's findings effectively as a written report.

1.1 Key Dates

- Submission of Options Appraisal Presentation: Friday 3rd February 2300.
- Submission of Final Report: Friday 31st March 2300.
- Submission of Peer Assessment: Friday 31st March 2300.

2.0 Project Options

There are **six** project options to choose from. Discuss in a group which option is most interesting to you all, and which project might be best for personal skills development.

In all cases your project should include an engineering component – each project must centre on an engineering problem to which you provide a solution. The projects, as defined below, provide for a great deal of imagination and flexibility. Discuss with your group, and your mentor, to ensure your chosen direction includes a suitable amount of problem solving.

You will also need to investigate logistical, financial, regulatory, and environmental considerations related to your proposed solution.

Option 1: Future Transport in Glasgow: Bringing to life the recommendations of the Connectivity Commission

Glasgow City Council recently commissioned a Connectivity Commission to look at the current state of transport in Glasgow and then come up with a series of recommendations. These recommendations will form the basis of Glasgow's future transport strategy, facilitating low carbon and low-cost movement of people and goods through the city.

Your group will:

- Examine the recommendations of the Connectivity Commission and select those which you want to focus on in your project (https://www.glasgow.gov.uk/connectivitycommission).
    - Note, pick recommendations which contain a strong engineering element rather than the policy options
- **Identify key engineering challenges within those recommendations**.
- **Work as a team to produce designs which solve those engineering challenges.**
- Also consider….
    - The costs of your engineering solution compared with the benefits it brings to the city
    - The wider political, social, environmental, and financial impacts of your project.

Option 2: Decarbonise the University of Glasgow

University of Glasgow reported an estimated carbon footprint of 61,000 tCO2e in 2017/18. Of which 16,000 tCO2e came from emissions related to grid electricity and 19,000 tCO2e came from combustion of natural gas for power and heat. The University of Glasgow aims to significantly reduce the carbon footprint of its energy consumption.

There is a challenge, that University of Glasgow is a research-intensive university with high energy demands but exists within a space-constrained city centre campus. Lowering our energy demand and supplying energy from renewable and low-carbon sources therefor is particularly challenging.

In this project the group will:

- work to understand the energy consumption of the university as a whole.
- Create a detailed plan for reducing the associated emissions as low as possible by 2030.
- **Identify and address key engineering challenges.**
- The group will also consider options to..
    - reduce the amount of energy consumed
    - optimise activities in the university to facilitate reduction and reuse of energy waste
    - consider technologies for low carbon energy generation on site
    - consider, social, environmental, and financial impacts of your project

Option 3: Develop a U*of*G Brewery to facilitate new teaching and business opportunities

As part of the redevelopment of the old Western Infirmary site, The University of Glasgow would like to build a brewery. The brewery is to will act as both a teaching resource (for a new course in brewing science) and as a small-scale commercial entity (selling beer to the student unions in order to offset the cost of its construction and day-to-day operations).

Your group will:

- Study the current Western Infirmary site expansions plans of the University
- Create a plan to construct a brewery on the site, including all of the appropriate equipment, space, water supplies, etc. required for such a venture (the size and scope is up to you and should be balanced between its need to operate as a teaching site while also producing enough beer to pay for itself over its lifetime).
- **Identify and address key engineering challenges (you can choose to concentrate on one particular challenge given this the project has many potential challenges to tackle).**
- Consider how to meet the power demands of the brewery via low carbon technologies.

- Consider how the brewery waste products are responsibly dealt with.

Option 4: Build Scottish biodiversity

Biodiversity—the variety of living things—is important for creating healthy, and resilient habitats. For example, biodiversity can facilitate pollination, promote healthy activities, and support the economy through tourism to natural sites. However, as outlined by NatureScot's 2019 State of Nature report, biodiversity has been declining due to a number of factors, ranging from urbanisation to climate change.

Your group will:

- Identify a specific habitat where biodiversity is being lost, and how it is being lost
- Identify the key drivers of these changes
- **Generate engineering solutions to address this biodiversity loss**
- Consider a broad range of factors in developing your solutions—such as logistics, and feasibility, societal, and financial impact.
- This project is designed to give the group the flexibility to address a biodiversity challenge of interest to them. You may choose to focus on a single issue affecting your chosen habitat, or consider multiple issues in parallel – just be sure to solve an engineering problem.

Option 5: A Floating Village

Global warming is making the sea level rise and some islands in Scotland will see their habitable surface reduced. Devise a plan for creating a small-scale floating "village" trial off the coast of Scotland.

Habitable, floating communities have recently been identified by the UN as a potential engineering solution to rising sea levels, https://oceanixcity.com (https://oceanixcity.com/news/, https://www.un.org/press/en/2019/dsgsm1269.doc.htm).

It is your chance to come up with innovative, ground-breaking engineering ideas for a green, sustainable city.

Your group will consider:

- Where and how you will build the city from a structural point of view, as well as an architectural perspective.
- How you will make sure that the plan is sustainable, both from an environmental and economical point of view
- What the optimal size of the city and number of habitants will be (which will inform the city's energy requirements)
- How to connect the city to the mainland
- **Generate engineering solutions to address one of the above considerations (you can choose to concentrate on one particular challenge given this the project has many potential challenges to tackle).**

Option 6: Robotic System for Hospital Services

NOTE – this project is restricted to a MAXIMUM OF 5 GROUPS. First come, first served.

If you would like to choose this project please contact Euan.McGookin@glasgow.ac.uk

Over the last couple of decades robots and robotics systems have become more frequently used in many aspects of modern life. Applications range from robots to do domestic chores to those that are used in product manufacturing. One key area of utilisation has been in the health sector where robots are used in many different ways, such as surgery and patient health care. Another robotic system that is used extensively in large hospitals is based on Automated Guided Vehicles (AGVs). These robots are used to provide porter services throughout hospitals, delivering meals to wards, transporting surgical waste safely out of the hospital, transporting equipment, etc.

The focus of this project is for your group to create a sustainable and trustworthy AGV based service system for the Queen Elizabeth University Hospital (QEUH). To do this your group should consider:

- Identify existing providers of such a system (i.e. the main competitors to your system)
- Determine which services should such a system should provide
- What the requirements are for such a system
- The specifications of the AGV design
- Operation requirements for the system e.g. computing and software requirements
- Power and recharge system requirements
- Cost considerations for system installation and maintenance
- Product life-cycle considerations, particularly end of life considerations.
- The cost of your solution

3.0 General Advice

- You have a good degree of freedom regarding your choices of technologies, how you implement these technologies to solve the given problem, where you site the technologies, how various aspects of the project are integrated, etc.
- There are a large number of good solutions, rather than a single ‘correct’ answer. Having done your research, you will probably all come up with different recommendations.
- We encourage innovative and challenging solutions, as such there is risk that during the project you will find that your ideas and concepts are not feasible. This is not a problem; we expect this when trying something new. But if so, explain why not e.g. regulatory constraints, environmental impact etc. and whether there are changes that could make your project feasible.
- As is very often the case in industry it may not be possible to find all the information required. You may therefore need to make a number of assumptions and estimates. However, it is important that all assumptions are clearly stated and justified, sources of information are provided and, where possible, calculations given to support any conclusions.
- This project will require YOU to do a lot of independent research. The vast majority of questions we get from students during this course can be answered by the student themselves through collaborating within your group and researching possible solutions.
- Each group has been provided a PhD student as a Mentor. Meet AT LEAST once per week as a group with your mentor present.

- Your mentors are your first point of contact for any questions.
- Lastly, **ensure there is a significant engineering problem being addressed in your project.**

4.0 Class Timetable

- Week 1: Class introduction from Prof. Alasdair Clark (recorded lecture on the Moodle page). Options Appraisal guidance from Dr. Ali McCay (recorded lecture on Moodle page)
- Weeks 2-4: 10 minute online catch up with Prof. Alasdair Clark (if requested).
    - *This is just for us to check that you have managed to start working as a group*

- Feb 3rd: Submit Options Appraisal videos – these will be assessed by Prof. Clark and the group mentors. Feedback will be provided.
- March 31st: Submit final written report
- March 31st: Submit Peer Review

As a group, you should plan and coordinate your own meetings.

There should also be regular, weekly meetings with your appointed mentor. The spreadsheet with the mentor details is on Moodle. **IT IS YOUR RESPONSIBILY TO CONTACT YOUR MENTOR** directly and set up an appropriate meeting schedule.

This is a team project and will work successfully only if all students fully participate, including being present for all meetings. If you are unable to attend a meeting for good reason it is important that you inform your team in advance. As well as being important for successful completion of the project, attending meetings means that you will be able to affect the design choices.

You should notify any major absences on MyCampus in accordance with University procedures. Students who miss meetings without a good reason or otherwise do not contribute to their team will be penalised and could even be refused credit for the course.

5.0 Assessment

This is primarily a *team* project and 80% of the marks are allocated to the team, leaving only 20% for individual contributions. It is therefore important that your team works and that everyone is involved. This will both enable you to work effectively and help you get a higher mark. Rather than thinking that it is unfair that some team members will get a good mark without doing much work, focus on getting all team members fully involved in the team and doing their fair share of the work, so that the whole team gets an excellent mark.

We will assess the project as below:

%	Type	Name	Details
20	Team	Options appraisal	Project planning & progress
60	Team	Final report	Full report and recommendations, assessed for content & style

20	Individual	Peer assessment	Confidential assessment of effort and competence of team members.

We will consider these aspects in our judgement of your performance:

- Evidence of critical thought regarding the technology and the likely outcome for the project
- Evidence of lateral, creative thinking, innovative or simple solutions
- Evidence of business-like realism – the chosen technology should be within suitable cost limits, for example
- Effective use of resources available within the team and appropriate division of labour
- Integration of all students' work into a coherent whole
- Evidence that all team members have made a significant contribution to the project
- Well-structured and clearly presented reports (both written and oral)
- The ability of team members to defend the ideas and choices they have made

We reserve the right to adjust the final mark for each student to reflect their contribution to the work of the team. This should happen only rarely but we will penalise any student who behaves as a 'passenger' and does not contribute fully.

6.0 Options Appraisal Presentation Guidance – due Feb 3rd.

In this presentation (submitted as a video to Moodle) you will need to:

- Clearly state the options you have investigated
- Explain the criteria and methods you have used to critically compare the options
- Justify key reasons for your decision

This simulates a scenario where you are presenting to a company board of directors who won't all have engineering expertise, but still need to understand your decisions and be satisfied that you have made the best possible decision. You do not have time to present all information, so you need to decide what is most important.

Each team will make a ten-minute online presentation. It is up to each team to decide how many students should make the formal presentation, though 10 minutes is probably too short for all team members to be involved. Submission links will be available on Moodle near the week 5 submission deadline.

Below are the marking criteria for the presentation.

Descriptor	Excellent	Very Good	Good	Satisfactory	Weak	Poor
Grade	A1-A5	B1-B3	C1-C3	D1-D3	E1-E3	F and Lower
Presentation (weight 1)	Very well structured presentation. Audio and figures are well aligned. Key details are clear after one viewing.	Presentation with clear structure and clearly presented information. Key details can be understood after one viewing.	Clear presentation with audio, but a structure that can be confusing at times. Viewer might need another watch to fully understand key details.	Presentation can be understood but information arrives in confusing order. Presentation would need another watch to begin to understand key details.	Presentation is not clear with written aspects hard to read, and not clear audio or subtitles. It is not clear at all after one watch what the main points are.	Lack of structure in presentation making it very difficult to understand.
Technical content (4)	At least three clear options are presented with consistent critical appraisal applied. Best option is clearly highlighted with plan to mitigate any risks identified in appraisal process.	At least three clear options are presented with critical appraisal applied. Best option is highlighted and explained with risks noted.	Options are explained but appraisal method is not clearly robust or critical. Best option is highlighted and explained.	Options are presented and appraised but method lacks clear consistency. Best option is highlighted and explained.	Options are presented but no clear consistent method. Best option is merely highlighted.	Options are presented but not clear consistent method. It is not clear which option is being taken forward.

7.0 Final Report Guidance

The page limits are strict. **Anything over the limits will not be read. You will also lose marks if you go over the page limits.** The minimum font size is Arial 11 pt and margin size is 2.54 cm. The report should contain the following:

- Title page, which must contain the team number and list of group members, their matriculation numbers and team roles.
- Executive summary: **strict two-page limit**
- The report: **strict 30-page limit**, including contents list and references.
- Appendices (optional): strict 15-page limit. They are for supporting material only e.g. details of a calculation summarised in the main text. You should not put vital points in an appendix.

Below are some tips specific to the report for this project. Further support and advice are available from the *Writing for Results* Moodle site.

- Be sure to devote most space to the most important points. You need to cover all the main issues at least briefly and discuss the more important ones in slightly more detail. If you provide a lot of details about something which is not particularly important, you may not be able to cover all issues or provide sufficient details about important issues. In deciding what goes in the report you need to think about what will produce the best report, not try to get as much space as possible for your part of the work.
- Each of your points should be justified and explained. For example, why did you choose a particular technology for the project? Any assumptions made in the project should be justified in the report. The body of the report should contain only a summary of the justification, including a brief overview of any calculations you made, possibly in the form of a table. Supporting material, including detailed calculations, should go in an appendix.

- Some important conclusions will depend on poorly known data. For example, if you choose to work out a financial return this may depend on interest rates, which are unpredictable over the lifetime of a major project. You should therefore carry out a sensitivity analysis of any outcomes which are dependent on uncertain data e.g. how the outcomes vary with the interest rate.
- There are a number of different ways of organising writing the report. Since each team member has a particular responsibility you may decide that each team member should write the section(s) related to their responsibilities. You then need to leave sufficient time to merge all the sections into a coherent document.
- You also need time for proof reading, checking for errors, making sure everything makes sense and that the style is consistent. Someone other than the team member who combined the sections into a single document should preferably do the final proof reading.
- Graphics are an effective way to illustrate points and should be referred to in the text. They need to be big enough and of sufficiently good quality to be easily understood. Graphics that need a microscope to be easily read should be enlarged to removed.

Marking Matrix for ISDPM report

Grade Range	A	B	C	D	E	F	G	Grade Awarded
Descriptor	Excellent	Very Good	Good	Satisfactory	Weak	Poor	Very Poor	
Writing (weight = 1)	*Clear, precise and concise English. Excellent spelling & grammar, few typos.*	*Clear and well written, easy to understand, and mostly free of errors.*	*Most of the text is clear and easily understood. There are some issues with grammar and spelling.*	*The text can be understood, but some elements are not entirely clear. A sizeable volume of errors noticeable.*	*Hard to understand much of the text. Significant spelling errors and grammatical flaws.*	*The volume and nature of the grammatical errors, combined with poor writing makes this report difficult to read.*	*Unintelligible. Impossible to read due to exceptionally poor use of English.*	
Presentation and Figures (weight = 1)	*Professional standard of presentation. All illustrations are well formatted and presented.*	*A clear and consistent presentation style making it easy to read. Most of the figures are clear and well presented.*	*There are some minor flaws in the presentation and the clarity of the figures, but overall a well presented report.*	*A number of basic errors present, inconsistent use of styles, margins etc.* *Figures are satisfactory.*	*Significant flaws in the presentation detracting from the overall report. Flawed figures; badly drawn and* *untidy,*	*Unacceptable presentation: untidy and inconsistent use of styles. Figures are messy & unclear.*	*A messy report; no evidence of any effective effort on the quality of the presentation.*	
Organisation and Structure (weight =1)	*Structure entirely correct with all sections correctly placed. Reading contents gives clear overview.*	*A well organised report with all sections logically placed enhancing understanding of work.*	*A report which is sufficiently well organised to make reading the report easy.*	*There may be some issues with the structure, but these do not detract from overall quality.*	*There are flaws in the way the report is structured which damages the overall quality of the report.*	*A structure which makes it difficult to read and understand the report.*	*No discernible structure. Illogical placement of sections* *Impossible to follow argument.*	
Literature Survey (weight = 1)	*Exemplary range of references used and discussed in great depth, indicating comprehensive background reading.*	*An appropriate range of relevant references used and discussed suggesting substantial background reading.*	*Sufficient references used and discussed to indicate a good level of background reading.*	*Perhaps just enough references used and discussed to suggest some background reading was undertaken.*	*Too few relevant references used and discussed and possibly an over reliance on www sources indicating insufficient background work.*	*Only a few references used and discussed and majority are irrelevant. Little evidence of background reading.*	*Very few (or no) references used or discussed. No evidence of any background reading.*	
Technical Content (weight = 6)	*Well informed and Authoritative discussion and a Comprehensive analysis of a significantly complex technical problem.*	*Clear and reasoned arguments backed up with a significant analysis indicating a very good grasp of a difficult technical problem.*	*Arguments presented are of a reasonable technical level, supported by a good quality analysis, and have been well considered and clearly stated.*	*The arguments presented are of reasonable technical depth, supported by some analysis and show a satisfactory understanding.*	*Only limited critical discussion of the technical problem studied. Little analysis or a low level of analysis. Suggests limited understanding of problem.*	*Very little evidence of critical discussion of technical work or results. Superficial understanding of problem. Minimal analysis included.*	*The lack of quality of the technical argument suggests that the student has very little understanding of the problem. No analysis.*	

7.1 Peer Assessment Guidance

You are required to submit a document that covers self-assessment and peer-review. One document per person. Submitted via a Moodle link which will be provided towards the end of the course. Details below.

Peer assessment (worth 20%)
Using a sentence or 2 for each member of your team, describe their contributions to the group, their strengths, and their weaknesses. Assign each individual a score out of 10.