Preface

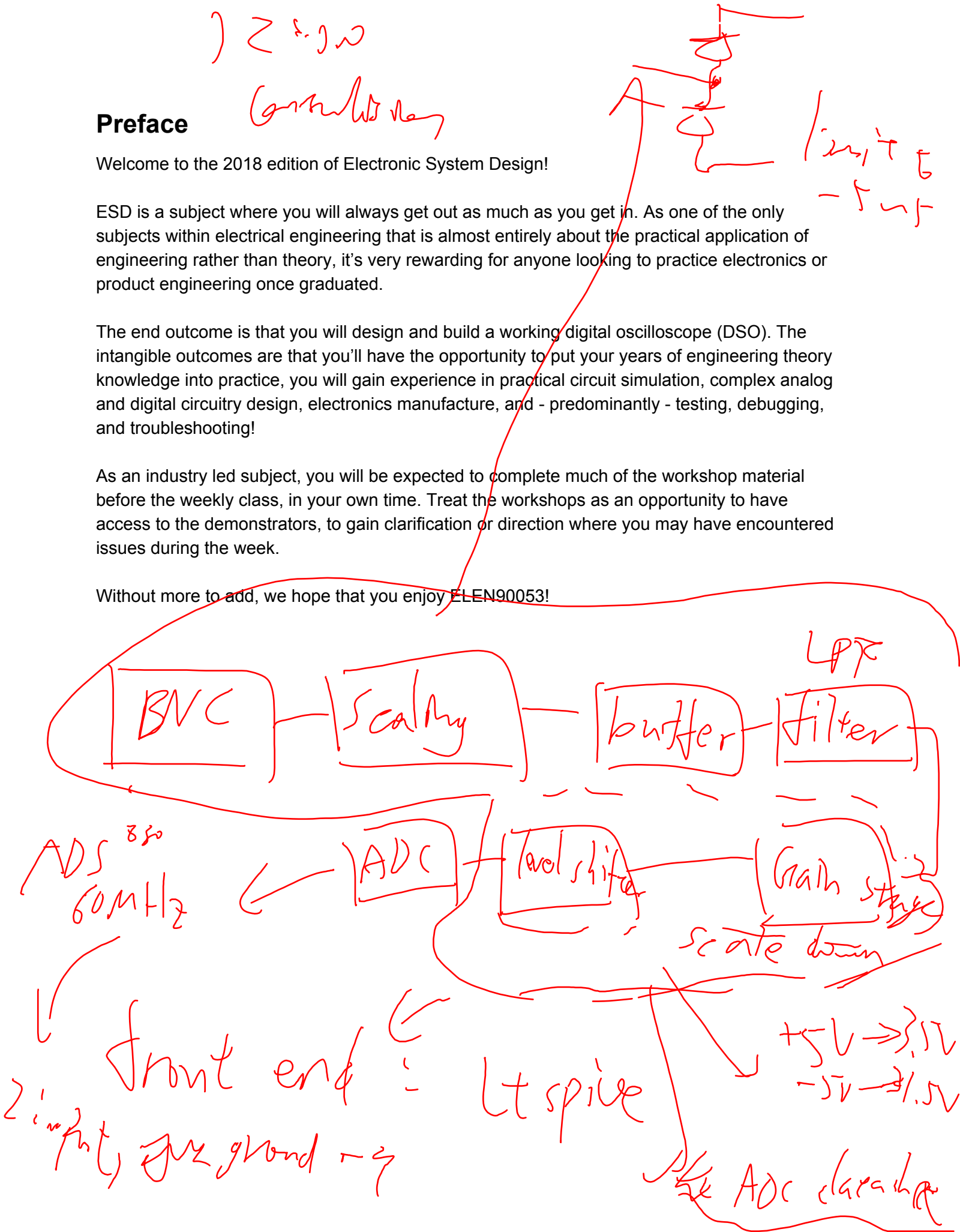
Welcome to the 2018 edition of Electronic System Design!

ESD is a subject where you will always get out as much as you get in. As one of the only subjects within electrical engineering that is almost entirely about the practical application of engineering rather than theory, it's very rewarding for anyone looking to practice electronics or product engineering once graduated.

The end outcome is that you will design and build a working digital oscilloscope (DSO). The intangible outcomes are that you'll have the opportunity to put your years of engineering theory knowledge into practice, you will gain experience in practical circuit simulation, complex analog and digital circuitry design, electronics manufacture, and - predominantly - testing, debugging, and troubleshooting!

As an industry led subject, you will be expected to complete much of the workshop material before the weekly class, in your own time. Treat the workshops as an opportunity to have access to the demonstrators, to gain clarification or direction where you may have encountered issues during the week.

Without more to add, we hope that you enjoy ~~ELEN90053~~!



Workshop Syllabus and Structure

The process you will follow throughout the duration of the ESD workshops will roughly follow that of the development process in the real world:

- Circuit simulation
- Schematic Design
- PCB design
- Manufacture
    - Hardware
    - Software
- Testing, Debugging and Troubleshooting

You should reflect each week on which stage you believe you are up to, given the above. Furthermore, there is a table available in the LMS which outlines the weekly milestones you should be meeting in order to be on track for successful completion.

Workshop Timetable: Available in LMS

There will be **3 milestones** where assessment will occur:

1. Core Schematics and Front End Simulation Report
2. PCB Gerber Files (manufacturing files), Final Schematics and BoM
3. Final presentation

Recommended Reading
If you're a serious electronics enthusiast, you should read the following resources daily:
http://hackaday.com
https://www.allaboutcircuits.com/
http://resources.altium.com/altium-blog

Finally, make sure you have a copy of the Art of Electronics - Third Edition.

Workshop Coordinator and Demonstrators

This year there are over 100 students taking ESD. There are 6 workshops - one every weekday of the week (Two on thursday) - and each workshop will have two demonstrators present. It is highly recommended that you **do not** attend a workshop that you are not enrolled in.

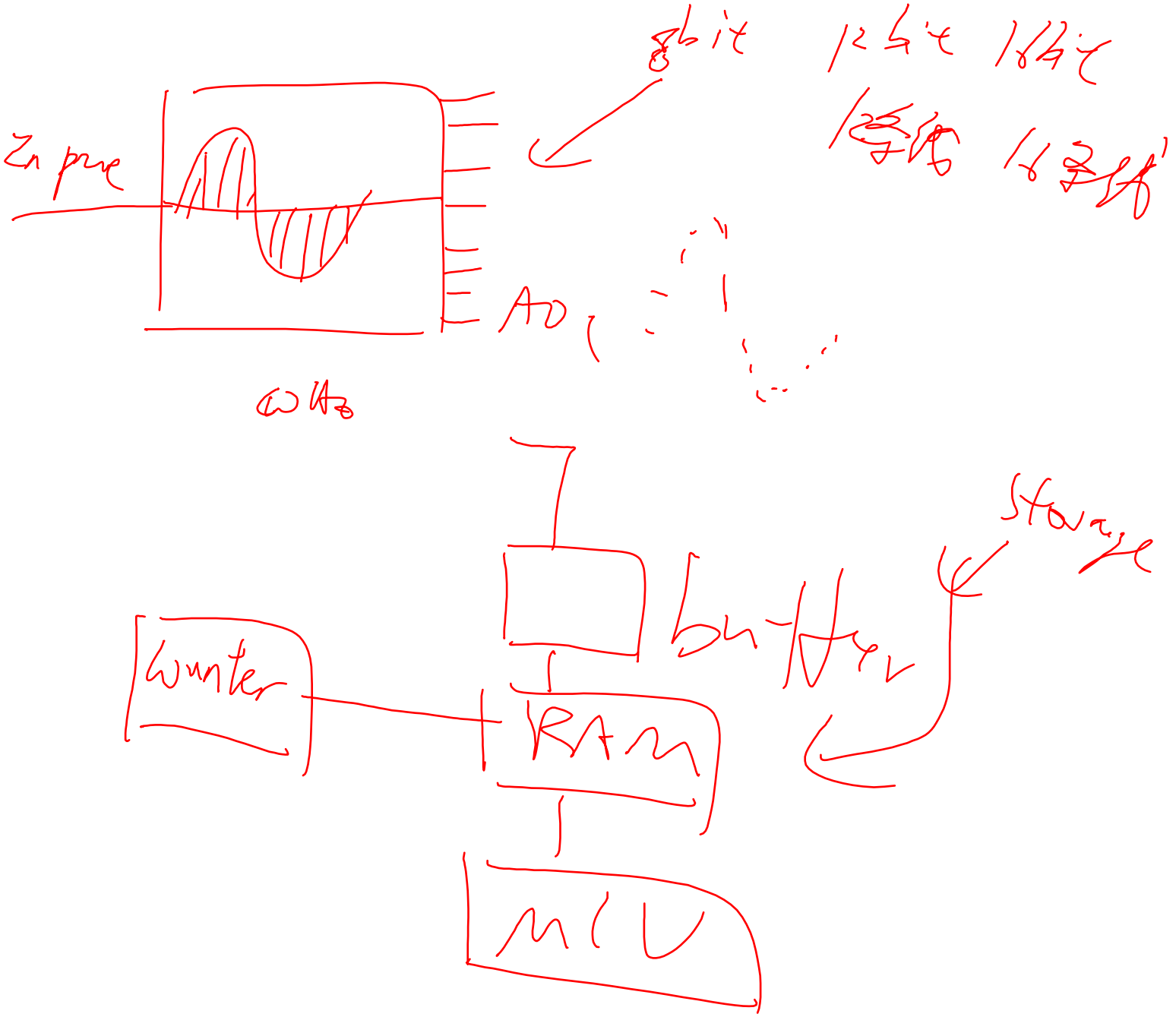
Selection of Electronics Components

Throughout this subject we will provide you with a restricted selection of electronic components for designing and building your devices. You will need to become intimately familiar with all

datasheets, just as in real life, to make sure you have designed for an appropriate and available component.

If you have the capacity, I strongly suggest you attempt to purchase your own components. This will help you tackle the project as if it were not a university project. You will have a much larger selection of components - which can be a double-edged sword - and it will allow you to progress much faster, including the potential to iterate over a couple of different designs - just as you would do in real life.

You can purchase components from services like DigiKey, RS Online and Mouser, and you can have cheap PCB designs made using services such as PCB Wing and Itead.



Digital Storage Oscilloscope (DSO) Brief

Overview

During this semester long assignment, you will individually design, simulate, build, and test a PC based Digital Storage Oscilloscope capable of acquiring data at 40 Msps. A PC based DSO is similar to the DSO used in the labs, except instead of displaying the signal on an embedded LCD display the data is transmitted to a PC and the data is displayed there.

Advanced Track: Some students will have a reduced semester load and might want to consider taking the “Advanced Track”. The advanced track is to promote students to take their DSO one step further. Consider designing and 3D printing a custom enclosure for your DSO, attempt to include an LCD display and battery to avoid the need for a PC connection, purchase your own components to have a greater selection and order your own PCBs early to spend more time building and testing.

This project will involve:

1. Circuit design and schematic capture (3%)
2. Circuit front-end simulation (5%)
3. Design and layout of PCB (20%)
4. Develop embedded software for microprocessor
5. Develop software for the PC
6. Hardware assembly
7. Debugging, testing and characterising
8. Project demonstration (12%)
9. Advanced track (5%)

The DSO takes an analog signal as an input, scales the input, and feeds it to an Analog-to-Digital Converter. The output from the ADC is then stored in RAM. The RAM buffer is filled upon a trigger event. When the RAM is full, a microcontroller reads the contents of RAM and transmits the data via USB to a PC for waveform visualisation. A CPLD will be programmed in-system using a JTAG header allowing for the replacement of 5 discrete logic ICs with a single 44-pin TQFP IC.

A kit will contain the basic parts used by a single channel DSO.
C or Processing code written to display captured waveforms and control the DSO will not be directly assessed nevertheless it is a **must** you get familiar with it. The basic code will be provided.

Plagiarism

Plagiarism is a serious offence. You are strongly encouraged to undertake the hardware of this project individually. Please ensure that you protect your work as in the past people have had their work copied without their knowledge. If your work is similar to others and you have not cited them as sources you will face serious consequences. Marks will be further awarded for explaining why you did things, so copying without understanding what you are doing will not get you any marks.

PCB, Simulation Results, and Schematic Submission

- *Core Schematics and Simulation Report Due Date: 1st September 23:59 PM (3% + 5% = 8%)*
- *Gerber files, Full Schematics and BoM due date: 15th September 23:59 PM (20%)*

PCB Gerber output files, schematics and your BoM will be submitted for marking and feedback generation. Simulation results for your analog front-end performance must be submitted as a report. Requirements for this report will be given on the LMS.

Note that LTSpice **must** be used for the simulation component. Marking of the PCB design will be done and feedback given in a timely fashion for those who provide their design files on or before the early date specified so that those who need to modify their designs (also in a timely fashion so that they may function) can do so.

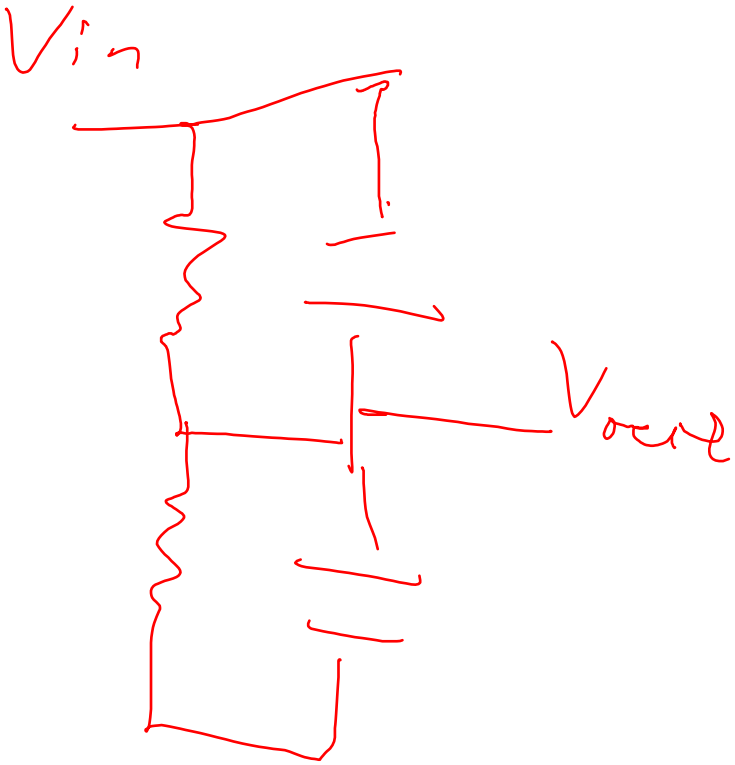
No PCB files will be accepted after the 15th of September. You must fabricate your own board if you do not submit before this date.

Final Presentation

Final presentations will be held in the final week of workshops. We suggest that students make every attempt to complete the project before the SWOT VAC period. Students who do this will be eligible for bonus marks, however we understand that some of you may need additional time due to competing commitments.

The following criteria will be used to grade your presentation:

- Your ability to communicate design intent and fault finding processes
- Functionality of your DSO and competence with test equipment
- Understanding and justification of the design choices made
- Presentation and explanation of bonus/extended functionality



$$H(s) = \frac{\omega_0 s + a_1}{s + \omega_0}$$