

Amalthea Trust Kyambogo University Project

Week 2 (10th – 16th October 2011)

On Monday morning, I reviewed the electronics that were taught last week and then in the afternoon I taught more on power electronics and AC to DC convertors.

On Tuesday morning, I taught basic digital electronics, including logic gates and truth tables, binary numbers, and analogue to digital converters. This took a long time to go over as most of the students had no concept of digital electronics; we therefore spent a long time going over the reasons for needing digital circuits and the difference between binary and analogue signals.

During this morning's sessions, we found out that the University had some electronic training equipment that had been donated about 7 years ago but not used. As a result, we decided that after lunch we would have a look at some of this training equipment and see if we could use any of it to enhance our teaching and give the students a more practical understanding of what they were learning.

Initially I thought that this equipment would contain just basic electronics, such as logic gates and resistors, but upon finding it in the new bioengineer workshop storeroom, it became clear that there were a large number of different items and they were much more diverse than I was expecting. Following is a list of training equipment, aka "trainers", most of which we have or will be able to make use of:

- Kit containing bread-board and basic components - resistors, capacitors, inductors - and a basic multimeter for creating and testing very basic electronic circuits
- Power electronics trainer ó includes step-down transformer, half-wave, full-wave, and bridge rectifiers, smoothing filters, and various voltage regulators
- Logic chip trainer, including most major logic gates, and LEDs to visualise the logic state
- Analogue-to-digital and digital-to-analogue converter trainers
- PIC programming trainer
- Basic oscilloscope with basic functions, excluding freezing and changing the x-y position of the signal
- ECG and EEG trainers along with probes and oscilloscope signal output
- NIBP monitor trainer, including cuff and BP readout
- Ultrasound trainer, including curved-linear probe and VGA output for screen. This is very useful for training engineers and includes most functions such as time-gain-compensation but excludes Doppler. It is a 3.5MHz transducer with a resolution of about 3mm.

Once we'd been through all of the trainers, we logged them and placed them in the locked cupboards in the lab alongside the medical equipment.

From Tuesday afternoon until the end of Thursday, we split the students into two separate groups (sometimes 3 or 4) and slowly went over the trainers. We gave the students practical knowledge of what was covered in lessons and also gave them plenty of time to use the trainers themselves. We made sure that during the 3 days, all of the students had a chance to personally use the equipment and ask any questions that they had about it, or about what we covered during lessons.

Some of the students took quite a long time to fully understand the theory and how to put it into practice. One example was when one or two of the students almost short circuited the output of a transformer while trying to connect it to the bridge rectifier; however, due to our close supervision of the students' experiments, we were able to stop this in time and explain what was about to happen and why it shouldn't be connected like that before showing them how it should be done. There were a few small instances like this but, in the end, all of the students were confident about both the theory and the practical application of what they had been taught.

These trainers have made teaching electronics (and to a lesser degree, medical equipment) much easier for both the teachers and the students. When creating future modules, I will incorporate the trainers into lesson plans so we use them as much as possible. It would also be good for us to look into the possibility of making a couple more of these trainers for different applications but I will do this when I create the next modules. We also went through electrical safety testing using the Rigel 266 testers and got the students to use the safety testing on some equipment.

On Friday morning, John took Satish and 3 students to Mulago Hospital to show them around the x-ray departments and to see the state of the x-ray machines around the hospital. I stayed at the University and taught the students the basics of ultrasound using the ultrasound trainer mentioned above. I chose to teach this because the students had previously shown a lot of interest in learning ultrasound, especially after they saw the US trainer. I very briefly went over what sound and ultrasound are and how they propagate through air, solids, and liquids. Then I quickly went over sound reflections and how this is what shows up on the screen. The students were then divided into two groups and went over the different functions of the US trainer, using items placed in a bucket of water, on the screen as examples.

We finished early on Friday in order to bring the students back to the garden at Norfolk Garden Guest House to get some feedback and so the students could say goodbye to Satish. This feedback session was very useful as we learnt what we had got wrong during the first week and gained a much better idea of what to teach in the next semester and the final year of the course. Below is a list of the main points raised during this information session:

- Almost all of the students had struggled to understand what I was saying for the first 2 or 3 days! Luckily I realized this myself quite early and adjusted the speed and pitch of my voice. Now all of the students are able to understand what I'm saying
- Almost all of the first year of the course was completely theory; therefore, the students were very happy that we had designed the rest of the course to be more about practical than theoretical knowledge. They were also very happy with the trainers and stated that they learnt more experimenting with them than they did during the lessons

- Some of the students expressed concern that all of our training is being done in the General Theatre at Mulago Hospital so we are looking at taking the students to a different department within the hospital, most likely ICU. The main problem, however, is space as not many places in the hospital can take all 17 students. We are also looking at taking students to different hospitals but this will probably have to wait until next semester
- All of the students are happy with what we are covering in this first semester. However, the following is a list of modules that the students would like to cover. I hadn't thought of doing these but agree that it would be a good idea to place them into the next semester and the final year:
 - PIC programming. This did surprise me but having listened to their explanation, that some of the simpler equipment could be fixed if they were able to create and program a simple PIC board, I agree that we should cover it in the next semester. Therefore I think it would be good to bring some basic PIC chips and boards next time, along with software for programming the chips. From this we could create a couple of simple projects for the students to work through. I would be able to create these projects while in the UK and, as most of the PICs now use C programming, I would easily be able to teach this myself. I could then get the students to create a board and program to control a stepper motor, for example
 - General hospital equipment, such as microscopes, blood analysers, and theatre beds. I will look into adding these to the final year of the course
 - They also wanted some basic knowledge of radiotherapy equipment but I'm unsure of whether this would be a useful subject. I will look into it further

Week 3 (17th – 21st October 2011)

On Friday night, Jas arrived from Birmingham via KLM.

On Monday morning, we introduced Jas to the students and then went over what we will be covering during his time here - blood pressure monitoring and general patient monitoring. Jas brought along a couple of NIBP monitors, an ECG simulator, and some teaching materials such as computer slides and handouts for the students. Given the delay in the arrival of the medical equipment donated by the Amalthea Trust, the equipment will be useful for teaching and Jas said that he would leave it here for future training.

After introductions we went through some online notes from the MHRA website which covered invasive and non-invasive blood pressure monitors. The slides were useful and went into a large amount of detail concerning the physiology of the heart, blood pressure, and how blood pressure is measured and calculated either manually or automatically. However, the slides could not be skipped over so we had to go through them one-by-one. This was fine for normal teaching but it's no good for teaching individual sections of slides as you would have to go through all of them before reaching the relevant ones. We went through the notes about blood pressure and this took most of the morning. The slides also included tests which had to be passed in order to get onto the next section. We made the students answer the questions and I think this made them pay more attention.

During Monday afternoon, we took the students to the lab and went through the procedures for measuring blood pressure with the NIBP monitors. We also went over the basic sub-systems of the NIBP monitors. Once again the students were very keen on the practical knowledge gained during this lab session.

We spent all of Tuesday in the lab doing practical work. This involved further experimentation with the NIBP monitors and also going into greater detail regarding electrical safety testing. At the end of the day, all of the students had individually practiced running through a full list of electrical safety tests and understood the differences between different classes of medical equipment. They were also aware of the appropriate tests surrounding them.

On Wednesday, we covered some of the information on general patient monitoring equipment assuming that we would be getting the equipment late this week or early next week and we planned to then spend that week going over the equipment. In the morning we covered SPO2 monitoring, basic ECG monitoring, and heart rate monitoring. We went over the MHRA slides again, and these went into detail regarding the anatomy and physiology of what was being taught, although some of the information was geared more towards clinical rather than engineering staff. We also went through these slides in the afternoon and did some more practical work using the NIBP monitors that Jas brought with him.

On Thursday and Friday, we went to Mulago Hospital General Operating Theatre with all of the students. Once again we split the students into two separate groups, each in a different room. During our time at the hospital, we got the students to perform some safety testing on the medical equipment, including power and extension cables. During these tests it became clear that a large number of the equipment being used - perhaps about 10% - failed the electrical safety tests, and many of the power cables were actually burnt through but still

being used. With the students we were able to fix about 4 different types of equipment, including 2 defibrillators, a NIBP monitor, and an electrical heater.

After initially being a bit distant with us, most of the medical staff in the theatre now realise that the students are there to help and are now starting to ask us to fix equipment during our visits.

On Friday evening, we went to Entebbe Airport to pick up the donated equipment. On arrival, we met with a clearing agent who informed us that we would need to get a tax exemption form from the Tax Commissioner though he never mentioned any of this when we rang him up earlier in the day. He also told us that we would be able to get this on Saturday morning.

When we visited the Tax Commissioner on Saturday morning, it became clear that nobody was working. We managed to get the phone number of a person supposedly dealing with import tax who told us what documents we would need to get the tax exemption form. Over the weekend we collected all of the equipment, a list of the equipment still to be sent, a letter of donation from the Amalthea Trust, and a letter of contract between the University and the Department of Health.

We will be going back to the tax office to look at getting this tax exemption form on Monday.