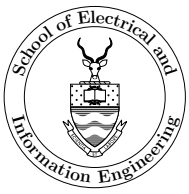

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG
School of Electrical and Information Engineering
ELEN224—Electronics I

Course Brief and Outline—2003

Course Co-ordinator:

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1 Course Background and Purpose

Electronics is an all pervasive discipline, being used in so many objects of common use, from the smallest items consuming a few microwatts of power to the ubiquitous computer to the control of multi-megawatt machines. Electronics *simply* ***cannot*** be viewed in isolation from the rest of the curriculum, it is used in every sphere of Electrical Engineering.

This course has been designed to give the student a good basic understanding of what electronics is all about, what its limitations, strengths and weaknesses are, and *to instill a proper design approach to electronic* ***systems***.

By its very nature, much of the emphasis of the course has to be on the physical devices, and their basic modes of operation—hence this course is quite dependant on the technology which drives the present electronics scene.

Thus a larger emphasis will be placed on Operational Amplifiers, for instance, as opposed to the more traditional emphasis on transistors, etc. Except in rather specialised situations, todays engineer reaches for a pre-packaged (perhaps special-purpose) Op-Amp, or even a pre-packaged Instrumentation Amplifier, rather than actually designing an amplifier using discrete components. In many ways, the main role of the discrete transistor seems to have been relegated to that of a simple switch!

In a similar way, microcontrollers and Field Programmable Gate Arrays are taking over from much of the traditional combinational and sequential logic (although, of course, an FPGA or a μC is simply a collection of combinational and sequential logic!)

2 Course Outcomes

After **successful** completion of the course students should be "electronics literate". They should be able to understand basic electronic circuits, be able to design a concrete electronic circuit from a perhaps vague specification, and be able to avoid many of the design pitfalls that exist.

In particular, on successfully completing this course, students should:

1. demonstrate knowledge of electronics terminology;
2. have had experience using standard electronics simulation software such as SPICE;
3. be able to design simple electronics circuits that actually work;

4. have had some exposure to basic electronic components, built up some simple circuits with prototyping equipment, and had exposure to correct debugging and measurement techniques etc.
5. have let the carefully encapsulated smoke out of at least one transistor.

3 Course Content

Op-Amps Basic configurations of Op-Amps. Effect of non-idealness of Op-Amps. Large Signal model, and biasing considerations.

Logic Basic gates. Combinational Logic. Sequential Logic. Logic reduction techniques.

Diodes Silicon Diode. Reverse Breakdown and small signal models. Rectifier circuits. Other diode types.

Bipolar Junction Transistors *npn* and *pnp* transistors. Biasing, amplification, switching.

Field Effect Transistors Enhancement MOSFET's. MOSFET's as switches. MOSFET's as amplifiers.

Applications Differential inputs, current sources/mirrors, audio amps, Precision Rectifiers, Peak detectors, Oscillators, etc

4 Prior Knowledge Assumed

Circuits I, with special emphasis on a modular approach to design. The student needs to be able to analyse a complex circuit by breaking it up into logical modules, and then determine the effect of each module on the next.

Although it sounds rather facetious, the student must have a thorough understanding of exactly what voltage and current are! It is important to know the limitations of a circuit model, and to know the difference between a supply and a signal!

5 Assessment

5.1 Components of the Assessment

The final mark for Electronics I is made up as follows:

Test:	20%
Project:	20%
Final Exam:	60%

5.2 Assessment Criteria

In assessing the student's performance, the ability to logically design simple circuits in a modular fashion will be emphasised. The ability to sucessfully communicate the design is also important.

For the project component, the circuit design, simulation, prototyping, neatness and soldering ability is assessed, as well as the communication of the design in the report.

5.3 Calculators in Examinations

The examination will be of 3 hours duration and will cover *all* material covered in the course. It will be a closed book exam, allowing a type 2 calculator (ie an engineering calculator) and an A4 *handwritten* information sheet. The standard statement on these sheets follows:

An A4 information sheet may be brought into the examination. Both sides of the sheet may be used for text, figures and equations, but it must be hand-written. No printed or photostatic copies are allowed. No additional reading aids are allowed.

Obviously, the test is under similar jurisdiction.

6 Teaching and Learning Process

6.1 Teaching and Learning Approach

My lecturing style is highly interactive, and largely of the "chalk and talk" variety. This means that the emphasis during lectures is upon understanding, and not on "transferring the lecturer's notes to those of the student, without passing through the minds of either". Interaction on the part of the student is required. Participation in small group activity in lectures is also required.

The prescribed text book represents the course notes. Frequent use will be made of it, and references to sections will be given.

One negative consequence of an interactive lecturing style (as opposed to a transfer of notes style), is that the student actually gains *an* understanding in the lecture. If it assumed that this initial understanding is all that is required, disaster occurs. Learning is an *iterative* exercise, and requires constant re-inforcement. My lecturing style can thus lead to a complacency which is rudely interrupted at examination time. HENCE:

Tutorial exercises are designed to complement and probe material currently being taught. They are not necessarily designed as examination questions. Doing these exercises only just before the exams will not help. They are to be done concurrently with the taught material.

6.2 Arrangements

Lectures:

There will be four lectures per week, on **a double on Wednesday at 08h00, a double on Thursday at 10h15**

Tutorials:

There will also be a tutorial on **Friday at 12h30**. All will held in CM2.

Laboratories

There will be 5 laboratories associated with this course held on **Tuesday at 14h15 SHARP** in the Basic Laboratory, covering topics taught in the course, as well as topics not formally dealt with in lectures.

Students who have not done the lab preparations will be asked to leave the laboratory.

The class will be split into two groups, thus a student has a lab every other week. Students are strongly encouraged to attend the lab on their "off" week to consolidate the previous week's lab, especially the weaker students, or those who could not finish in time. There are now enough lab stations to allow this.

Students are expected to bring a pair of side-cutters, and not to use their teeth on hook-up wire!!!

Students are required to attend all labs; failure to do so will result in a Due Performance refusal.

Project

There will be a project which will commence just before the mid-term break and be handed in just before the end of term. The device being built will be assessed in the Basic Lab on the last lab day of term. Exact dates can be found on the course Homepage when they become available.

The Mezzanine in the Genmin Power Workshop will be made available to students to work on their projects. Basic function generators, oscilloscopes, and soldering stations will be available. This facility *WILL NOT* be available during lecture times.

The School's policy on timely submission of projects will be enforced and must be read by the student. A late hand-in will attract a FAIL-ABSENT mark (0%).

7 Information to Support the Course

7.1 Prescribed Text/Reading

The prescribed text is Rashid, M. "Microelectronic Circuits—analysis and design" PWS Publishing Company, 1999.

This text will also be used in Electronics II.

There are no notes handed out for this course. The text books consitute the notes, and will be followed closely. The one exception is the digital logic section. There are plenty of digital books in the library!

7.2 Other References

A *Highly* recommended book for the more practical side of electronics is the excellent:

- Horowitz and Hill, *The Art of Electronics*, Cambridge University Press.

In addition, there are some excellent Hobby magazines that are available:

- Elektor
- Electronics Today International (ETI)
- The Maplin Electronics Magazine.
- Electronics World + Wireless World.

7.3 Course Home Page

For other information related to the course, please refer to the Course Home page at *ytdp.ee.wits.ac.za/elen224Home.html*

For users of the Linux operating system, free and unrestricted schematic and printed circuit board layout programs exist, visit my site for details—generally speaking, these are *not* available for users of MsLoss, and its derivatives.

8 Other Information

Although the University Senate has ruled that attendance at lectures is not compulsory, lectures will be used to *supplement* course texts, and this supplementary information *will* be examinable. Announcements relating to the course will also be made in lectures from time to time.

I have what I call a "Modified Open Door" policy. You can come and see me at any time, but only in groups! I have a great regard for the peer-support system; you only really understand something if you can explain it to your peers. I have long ago forgotten the particular difficulties I had with some of the concepts taught in this course, they now appear to me as "obvious"; peers do not have this myopia.

The preferred method of contact, however, is email.

The Second Year notice board may be used for any course announcements.

The online version is `http://ytdp.ee.wits.ac.za/elen224outline.html`