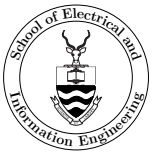

School of Electrical and Information Engineering
University of the Witwatersrand, Johannesburg
ELEN3000—Electromagnetics

Course Brief and Outline—2016

Academic Staff:

Professor Alan Robert Clark (course co-ordinator)
Room CM4.236
(011) 717-7223
AlanRobertClark@gmail.com

1 Course Background and Purpose

The aim of the course is to provide an overview of electromagnetic concepts and to lay a sound theoretical foundation. It therefore includes the debunking of the standard "black magic" image of electromagnetics, where problems are solved by "thumb suck" and side-cutters!

Electromagnetics pervades almost every aspect of our everyday lives, Radio, TV, Ordinary Telephones, Cell's Doll, Microwave Ovens, Radar, Remote Sensing, Medical Electronics, Roving Mars Robots, Iridium/GlobalStar Satellite "phones", GPS positioning, Wireless LANs at Ethernet speeds, "toy" LANs like Bluetooth, broadband microwave LANs(WiMax, iBurst)...

In many ways, Electromagnetics can be viewed as a superset of circuit theory, with the power flow through the mysterious "ether" as opposed to a physical circuit. Thus the student is exposed to a broader and more general context than before.

There is a growing awareness of compatibility issues in Electromagnetics—what with planes crashing by Notebook; cancer by 50Hz; headaches by power-lines; Brain tumors by Cellular phone—so it is essential that *knowledge* of this field is gained by *all* engineers, so that the effect on the environment is minimized (and to improve the SNR :-).

It is to be remembered that the Electromagnetic Spectrum is simply another part of our environment, but that its pollution and desecration is just not so easily seen!

2 Course Outcomes

On successful completion of this course, the student is capable of:

1. understanding electromagnetics terminology;
2. using simple finite element software;
3. using sophisticated Method-of-Moments software;
4. designing simple transmission line systems, including matching circuits;
5. antenna and radiation fundamentals; and
6. understanding electromagnetic compatibility issues.

3 Course Content

The content of this course is as per *Rules & Syllabuses: Faculty of Engineering and the Built Environment.*

4 Prior Knowledge Assumed

The prerequisites and corequisites for this course are as per *Rules & Syllabuses: Faculty of Engineering and the Built Environment.*

Thorough knowledge of basic physics, especially the field components, and a thorough grasp of mathematics, especially vector calculus.

5 Assessment

All submissions must be in strict accordance with the guidelines contained in the *School's Blue Book* and the rules contained in the *School's Red Book.* No exceptions will be considered.

5.1 Components of the Assessment

This is described in the School's document entitled *Application of Rule G.13 and Calculator Requirements* on the School notice board.

The examination will cover *all* material covered in the course, and especially discussion topics in lectures.

5.2 Assessment Criteria

The student's understanding of the fundamental aspects of the course will be probed. Exam questions etc will need to be answered in order to answer the question: "WHY?" as opposed to the simplistic "HOW". I am not attempting to assess a simple methodology, I will assess fundamental understanding of concepts.

Note that the onus is upon the student to convey this understanding in an examination. A terse, correct "answer" may not necessarily attract marks! Please refer to my exam writing skills notes at `ytdp.ee.wits.ac.za/ExamWritingSkills.html`.

5.3 Satisfactory Performance (SP) Requirements

Rule G.13 and the School's documents entitled *Application of Rule G.13 and Calculator Requirements* and the *School's Red Book* (see the School notice board) apply.

In addition, the successful completion of the laboratory is an SP requirement.

5.4 Calculators in Examinations

See the School's document entitled *Application of Rule G.13 and Calculator Requirements* on the School notice board.

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.

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, which typically cover more comprehensive, integrated material. Doing these tutorial exercises only just before the exams will not help. They are to be done concurrently with the material being explored. The past exam papers are to be used as a benchmark for examination questions.

6.2 Arrangements

Lectures:

There will be three lectures per week. Students are expected to attend all lectures and to make their own notes.

I keep strictly to South African Standard Time (SAST). I respect your time, and will not drag on my lectures, and I expect you to respect my time, and that of your colleagues, by arriving on time, so that latecomer disruption is avoided.

Tutorials:

There will also be one tutorial per week.

Project:

There is no project associated with this course.

Laboratory:

There will be a laboratory associated with this course held 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.

School Policy states that there are no lab exemptions.

Consultation:

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.

It is generally convenient to grab me between and after lectures.

7 Information to Support the Course

7.1 Prescribed Text/Reading

No text perfectly covers the course material: all books have flaws.

- Cheng, D.K (1989) "Field and Wave Electromagnetics" Second Edition, Addison Welsey Publishers.

There are no notes handed out for this course.

In addition, there is a 122 page "Study Guide", by some obscure bloke:

- Clark A. R. (2004) "SuperNEC Study Guide for Electromagnetics and Antennas", Poynting Innovations, Wynberg, Sandton.

available from the Course Home Page. (See below).

7.2 Other References

If it can be obtained the *Third Edition* of "Electromagnetics" by J.D. Kraus (McGraw-Hill) is definitive. The *Fourth Edition* is OK, the *Fifth Edition*, co-authored by Fleisch, is completely useless.

7.3 Course Home Page

For other information related to the course, please refer to the Course Home page at
`http://ytdp.ee.wits.ac.za/elen3000Home.html`

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.

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

The online version is `http://ytdp.ee.wits.ac.za/elen3000outline.html`