Course Brief and Outline – 2016

Academic Staff:

Prof. Ling Cheng (Coordinator)
Room CM 380 Tel:011 717 7228 E-mail: ling.cheng@wits.ac.za

1 Course Background and Purpose

The Electric Circuits course (Circuits) is an introductory course in electrical engineering for students studying in the degrees of Bachelor of Science in Applied Computing, and has a number of objectives:

1. To introduce you to the fundamental principles and to assist you in reaching the stage where you can apply them with confidence.
2. To allow you to acquire a good physical feeling for the behaviour of circuit components and networks consisting of these components.
3. To develop your insight into selecting an appropriate technique for solving any specific circuit problem.
4. To develop your laboratory skills in the area of electric circuit fundamentals.

2 Course Outcomes

You will be required to demonstrate your capabilities to:

1. Describe, with the aid of physical, mathematical and systems modelling, the behaviour of the basic circuit elements: resistance, inductance, capacitance, independent voltage and current sources, dependent voltage and current sources;
2. Describe and apply the principles encapsulated in laws and theorems: Ohm's law, Kirchhoff's laws, superposition theorem, Thévenin's and Norton's theorems, delta/star transformation;
3. Analyse circuits by using formal methods such as node analysis, mesh analysis and loop analysis;
4. Simplify and transform circuits: components in series and parallel, Thévenin and Norton equivalents, two port networks, circuit transformation;
5. Use specialised techniques: solution of differential equations, circuits with sinusoidal excitation;
6. Design and analyse circuits including an operational amplifier (op-amp).

3 Course Content

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

The electric circuits course is divided into the following knowledge areas:

Knowledge area 1: Concepts

Basic electrical concepts: Voltage, current, energy, power, resistance, independent and dependent voltage and current sources, charge, *average* values.
Waveforms: dc, step, ramp, rectangular pulse, sinusoidal, exponential.
Inductors and capacitors: Physical basis of their voltage-current (v-i) laws, v-i laws in integral and differential forms, energy and power relations, behaviour under excitation, capacitive voltage divider.
Energy and power: Instantaneous power, average power, general power equation, energy-power relations, conservation of energy, ideal voltage and current sources, root mean square values.

Knowledge area 2: Analysis Techniques

Network theorems and laws: Ohm's law, Kirchhoff's voltage and current laws, series and parallel resistors, voltage and current divider laws, star-delta transformations, interconnected sources.
Systematic circuit analysis: Node voltage and mesh current analysis, superposition theorem, phasors.
Two terminal networks: Real sources, source transformations, Thévenin and Norton theorems, maximum power transfer in resistive circuit.

Knowledge area 3: Laboratory Concepts and Techniques

Laboratory techniques and measurement skills; including the building of circuits, understanding of oscilloscopes, multimeters, power supplies and signal generators, and the analysis of results.

Knowledge area 4: Complex Real Circuits

Operational amplifiers: Abstraction to circuit model, open loop gain, input resistance and output resistance.
Analyses of inverting, non-inverting, buffer, summing, integrator and differentiator types.
Calculation of gain and input and output impedance.

4 Prior knowledge Assumed

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

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.

Three class tests and the examination will measure your ability to meet the course outcomes (see Section 2). The examination and tests will be set with sections examining the knowledge areas described in Section 3. Failure to pass one or more of the knowledge areas will result in failure of the course (FCOM). **Students will**

have to demonstrate that they have knowledge of all the knowledge areas to pass the course.

5.2 Assessment Criteria

All work presented for examination will be assessed, not on what you know, but rather on what you can **do** with what you know (understanding).

Notes on tests and the exam

There will be two class tests for marks. The examination duration is 3 hours and is ``restricted'' Open Book, limited to one text book, one A4 plastic sleeve and any calculator.

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.

The successful completion of all tasks and laboratories, completed before the published due dates, are SP requirements. This rule will be strictly applied. It is each student's own responsibility to ensure that (s)he knows when the due date for each task is.

No students (including repeats) will be exempted from the laboratories.

Each student **MUST** complete all the laboratory submissions and testing.

5.4 Calculators in the 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

Most of the electric circuits content of the course is defined in the course text (see Section 7.1). The text, together with any additional information, made available during lectures, tutorials and laboratories, may be examined.

6.2 Arrangements

Lectures:

There will be two lectures per week. Students are expected to attend all lectures and to make their own notes when necessary. The lectures will be a combination of *workshop* and *traditional* lecturing approaches.

The basic material of the course will be covered in lectures. In general, the lectures complement the relevant sections and chapters in the course prescribed textbook and develop the skills (see Section 1) that the students will require to meet the outcomes for the course and their degree programme.

Please Note: The rule of *Better never than late* will be strictly applied.

Tutorials:

Tutors will be available for consultation during laboratory/tutorial periods.

Laboratory:

The laboratory tasks form an integral component of the course and are designed to develop critical thinking, laboratory and measurement skills as well as insight of electric circuits (see timetable).

Consultation:

All questions arising from the Laboratory exercises must be directed to the tutors. Questions relating to lectures and course material must be directed to the course lecturers **during the lectures** or to tutors during the laboratory/tutorial periods. Students must, however, try to resolve any problems among themselves first. Groups of two or more students may schedule an appointment with a lecturer if they are unable to resolve their problem after consultation with the tutors.

7 Information to Support the Course

7.1 Prescribed Text

Hanrahan, H.E., *Electric Circuit Fundamentals*, 2002. (Charged on fees account for ELEN 1000 students.)

7.2 Other References

Alexander, C.K. and Sadiku, M.N.O., *Fundamentals of Electric Circuits*, 2nd ed., McGraw-Hill, 2003, ISBN: 007249350X.

Dorf, R.C. and Svoboda, J.A., *Introduction to Electric Circuits*, 6th ed., Wiley, 2003, ISBN: 0-471-44795-1

7.3 Course Home Page

Further information and announcements regarding the course is posted on the course home page *http://dept.ee.wits.ac.za/~cheng/*. All students are expected to consult the course home page at regular intervals.

8 Other Information

8.1 Administrative details

Further information regarding times for tests, laboratories and tutorials will be posted on the notice board and the course home page.

Further information and announcements regarding the course will be communicated either via the 1st year notice board, verbal announcements or printed material distributed during lectures or posted on the course home page (see Section 7.3).

All students are expected to consult the notice board and the course home page at regular intervals.