

Synopsis for 1st-year Circuits

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Michaelmas 2019

The purpose of the course is to provide an elementary introduction to linear circuit theory. The lectures will fully cover the syllabus and will assume very little previous knowledge of the subject. We shall cover the following topics:

- **Introduction and Basics:** Voltage, current, power. Resistance and Ohm's Law. DC, AC and RMS values.
- **Simple Circuits and Kirchhoff Laws:** Series and parallel circuits. The potential divider. Networks and Kirchhoff laws. Mesh currents, node voltages, superposition.
- **Sources, Thevenin and Norton's Theorem:** Ideal voltage and current sources, output impedance. Power matching. Thevenin and Norton theorems.
- **Capacitors :** Capacitors in series and parallel; stored energy. The RC transient circuit.
- **Inductors:** Mutual and self-inductance. Inductors in series and parallel. Stored energy. The LR transient circuit.
- **AC Theory:** First pass with trig relations and phasor diagrams. Response of resistors, capacitors and inductors to steady AC. RL and RC circuit response to AC. Bode plots. Complex notation: RL circuit revisited. Power dissipation. Bridge circuits.
- **LCR Circuits:** Series LCR circuit. Response to steady AC. Resonance. Series LCR circuit transient response. Parallel LCR circuit.
- **Operational Amplifiers:** The ideal op-amp. Non-inverting and inverting amplifier circuits. Summation and difference circuits. Integration and Differentiation. Filter circuits.

Recommended Books

You will find all the material you need for the Prelims Circuit Theory syllabus in self-contained chapters of books on general electronics or electromagnetism.

- *Electronics: Circuits, Amplifiers and Gates*, D.V. Bugg, CRC Press.
Chapters 1 to 7 and 14 cover the material required for course. An excellent book.
- *Basic Electronics for Scientists and Engineers*, D. L. Eggleston, CUP.
Chapters 1, 2, and 6 cover the material required for the course.
- *Electromagnetism - Principles and Applications*, Lorrain and Corson, Freeman.
Chapters 5, 16, 17 and 18 in Edition 1 and Chapters 5, 15, 16 and 18 in Edition 2.

Other useful resources.

- *Practical Course Electronics Manual*
http://www-teaching.physics.ox.ac.uk/practical_course/ElectronicsManual.pdf
- *Elementary Linear Circuit Analysis* L S Bobrow, HRW.
Chapters 1-6 cover all the material on this course.
- *The Art of Electronics*, Horowitz and Hill, CUP.
Standard reference on electronics, although now a little out of date. Far more information than you need for this course, but written in an accessible, lucid style.