EEL100: Introduction to Electrical Engineering

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IIT Jammu, II Semester 2016–17

This course is broadly divided into 3 parts: Circuits, Devices, and Power. Below is the schedule of classes.

Timetable: M Th 9–10.50 (Lecture 9–10.15, Discussion 10.20–10.50)
Office/interaction hours: M 11–1
If you are doing the course, please join the Piazza forum at `http://piazza.com/iit_jammu/spring2017/eel100eep100` *(the access code has been announced in class and e-mailed to you).*

1 Circuits (Basics of circuit theory)

The main references for this section will be Bobrow [1] and Smith & Dorf [2]. Section numbers from Bobrow given below are indicative; the lectures also draw on materials from other sources.

- **Lectures 1,2 (Thu 2nd Feb)**: Introduction to the course; What is Electrical Engineering? Recap of elements in an electrical circuit (Resistors, Inductors, Capacitors, Voltage and Current Sources). [Ref.: Bobrow Sec. 1.1, 1.2, 1.5, 1.6, 1.7]
- **Lectures 3,4 (Mon 6th Feb)**: Basic Circuit Analysis: Kirchhoff's Current and Voltage Laws (KCL/KVL). KCL-Nodal and KVL-Mesh analysis with Independent and Dependent Sources. [Ref.: Bobrow Sec. 1.3, 1.4, 1.8, 2.1, 2.2, 2.3]
- **Lectures 5,6 (Thu 9th Feb)**: One-port networks: Thévenin and Norton theorems. Concept of duality, Maximum power transfer theorem. [Ref.: Bobrow Sec. 2.4, 2.5, 2.6, 3.1]
- **Lectures 7,8 (Mon 13th Feb)**: Step response in Resistor-Capacitor (RC) and Resistor-Inductor (RL) circuits. [Ref.: Bobrow Sec. 3.2, 3.3]
- **Lectures 9,10 (Tue 14th Feb)**: Resistor-Inductor-Capacitor (RLC) circuits; step response in RLC circuits; AC analysis. [Ref.: Bobrow Sec. 3.4, 3.5, 4.1]
- **Lectures 11,12 (Mon 20th Feb)**: Phasor response in RLC circuits. [Ref.: Bobrow Sec. 4.2, 4.3]
- **Minor Test I (Wed 22nd Feb)**: `http://web.iitd.ac.in/~sumeet/eel100_m1.pdf`
- **Lectures 13,14 (Sat 25th Feb)**: Power in phasor analysis. [Ref.: Bobrow Sec. 4.4, 4.5]
- **Lecture 15 (Mon 27th Feb)**: Polyphase circuits. [Ref.: Bobrow Sec. 4.6]

2 Devices and Electronics (Basics of electronic devices and digital electronics)

- **Lecture 16 (Mon 27th Feb)**: Semiconductors. [Ref.: Bobrow Sec. 6.1, 6.2]
- **Lectures 17,18 (Wed 1st Mar)**: Semiconductor doping and grading; The *pn* junction diode. [Ref.: Bobrow Sec. 6.2, 6.3]

- **Lectures 19,20 (Mon 20th Mar)**: Ideal diode; Diode applications (rectifiers, clippers, clampers); Operational amplifiers (as inverting and non-inverting amplifiers and voltage followers). [Ref.: Bobrow Sec. 6.4, 10.1]
- **Lectures 21,22 (Tue 21st Mar)**: Op amps as adders and differential amplifiers; Bipolar Junction (***pnp***) Transistors. [Ref.: Bobrow Sec. 10.1, 7.1]
- **Lectures 23,24 (Thu 23rd Mar)**: ***npn*** transistors; Cutoff and saturation. [Ref.: Bobrow Sec. 7.2, 7.3]
- **Minor Test II (Thu 30th Mar)**: `http://web.iitd.ac.in/~sumeet/eel100_m2.pdf`
- **Lecture 25 (Thu 30th Mar)**: BJT amplifiers and biasing. [Ref.: Bobrow Sec. 9.1]
- **Lectures 26,27 (Sat 1st Apr)**: Small-signal AC models; Digital logic circuits. [Ref.: Bobrow Sec. 9.1, 12.3]
- **Lecture 28 (Mon 3rd Apr)**: Boolean algebra; Standard forms of Boolean functions. [Ref.: Bobrow Sec. 12.4, 12.5]
- **Lecture 29 (Thu 6th Apr)**: Simplification of Boolean functions (Karnaugh maps). [Ref.: Bobrow Sec. 12.6]

3 Electromechanical Energy Conversion

The main references for this section will be Bobrow [1] and Del Toro [3].

- **Lecture 30 (Thu 6th Apr)**: Magnetic fields and flux; Magnetic circuits. [Ref.: Bobrow Sec. 13.1, 13.2, 13.3]
- **Lectures 31,32 (Mon 10th Apr)**: Magnetisation curves; Hysteresis; Electromagnetic induction and magnetic coupling; Transformers. [Ref.: Bobrow Sec. 13.4, 13.5, 13.6, 13.7, 13.8]
- **Lectures 33,34 (Thu 13th Apr)**: Coupling coefficient; Ideal transformer. [Ref.: Bobrow Sec. 13.8, 13.9]
- **Lectures 35,36 (Thu 20th Apr)**: Non-ideal transformer models; OC and SC tests. [Ref.: Bobrow Sec. 13.10]
- **Lectures 37,38 (Mon 24th Apr)**: Rotating machines; DC generators. [Ref.: Bobrow Sec. 15.1]
- **Lectures 39,40 (Thu 27th Apr)**: DC motors; Alternators. [Ref.: Bobrow Sec. 15.1, 15.2]
- **Lectures 41,42 (Mon 1st May)**: Rotating stator field; Induction motors. [Ref.: Bobrow Sec. 15.2]
- **Major Test (Wed 3rd May)**: `http://web.iitd.ac.in/~sumeet/eel100_maj1.pdf`; `http://web.iitd.ac.in/~sumeet/eel100_maj2.pdf`

4 Evaluation

- Minor I: 20%
- Minor II: 20%
- Major: 44%
- Class participation + online quizzes: 16%

5 Practice Assignments

- Assignment 1: `http://web.iitd.ac.in/~sumeet/eel100_a1.pdf` (Answers: `http://web.iitd.ac.in/~sumeet/eel100_a1_ans.pdf`)
- Assignment 2: `http://web.iitd.ac.in/~sumeet/eel100_a2.pdf` (Answers: `http://web.iitd.ac.in/~sumeet/eel100_a2_ans.pdf`)
- Assignment 3: `http://web.iitd.ac.in/~sumeet/eel100_a3.pdf` (Answers: `http://web.iitd.ac.in/~sumeet/eel100_a3_ans.pdf`)
- Assignment 4: `http://web.iitd.ac.in/~sumeet/eel100_a4.pdf` (Answers: `http://web.iitd.ac.in/~sumeet/eel100_a4_ans.pdf`)
- Assignment 5: `http://web.iitd.ac.in/~sumeet/eel100_a5.pdf` (Answers: `http://web.iitd.ac.in/~sumeet/eel100_a5_ans.pdf`)
- Assignment 6: `http://web.iitd.ac.in/~sumeet/eel100_a6.pdf` (Answers: `http://web.iitd.ac.in/~sumeet/eel100_a6_ans.pdf`)
- Assignment 7: `http://web.iitd.ac.in/~sumeet/eel100_a7.pdf` (Answers: `http://web.iitd.ac.in/~sumeet/eel100_a7_ans.pdf`)
- Assignment 8: `http://web.iitd.ac.in/~sumeet/eel100_a8.pdf` (Answers: `http://web.iitd.ac.in/~sumeet/eel100_a8_ans.pdf`)

References

[1] Bobrow, Leonard S. (Adapted by Navneet Gupta). *Foundations of Electrical Engineering*. Oxford University Press, Asian Edition, 2013.

[2] Smith, Ralph J. and Dorf, Richard C. *Circuits, Devices and Systems*. Wiley, 5$^{\text{th}}$ Edition, 2007.

[3] Del Toro, Vincent. *Electrical Engineering Fundamentals*. Pearson, 2$^{\text{nd}}$ Edition, 2015.