

# NS 543 Concepts in Physics IV: Electrostatics, Magnetostatics, and DC Circuits Schedule

**N.B.:** The schedule below has not yet been adapted to the blended schedule of online and in-class meetings. Course readings may vary between course offerings.

## **Session 1: Charge, Conductors and Insulators, Induced Charge, Coulomb's Law**

*Pre-test*

**Sections from Cutnell & Johnson:** 18.1 – 18.5

**Reading assignment for Session 3:**

- Excerpt from I.B. Cohen's *Benjamin Franklin's Experiments* (1941). Chapter Two: Electricity Before Franklin. Read Sections 1 and 2, pp. 21 – 47.

## **Session 2: Electric Field, Charge on Conductors**

**Sections from Cutnell & Johnson:** 18.6 – 18.11

*Web assignment 1*

## **Session 3: Electric Potential Energy and Electric Potential.**

**Sections from Cutnell & Johnson:** 19.1 – 19.4

*Laboratory Experiment:* Electric Fields and Potentials

*Philosophy/History/Education Research:* Overview of the history of electricity.

**Reading assignment for Session 5:**

*Benjamin Franklin: Papers on Electricity* collected by Robert A. Morse. Read Part III. Experiments and theory of the Leyden jar. Read Franklin's theory and try some experiments.

## **ONLINE Session 4: Connecting Potential and Field; Capacitors and Dielectrics**

**Sections from Cutnell & Johnson:** 19.5

*Home Laboratory Experiment:* Construct a Leyden Jar following *Ben Franklin as my Lab Partner: Section I. Bring your Leyden Jar for Session 7.*

*Web assignment 2*

## **Session 5: Current, Batteries, Resistance, and Ohm's Law**

**Sections from Cutnell & Johnson:** 20.1 – 20.7

*Laboratory Experiment:* Ohm's Law

**Reading assignment for Session 7:**

*Benjamin Franklin: Papers on Electricity* collected by Robert A. Morse. Observations and Conjectures, Sections 1 through 18 (pp. 36 – 43) and Sections 33 – 36 (pp. 51 – 53). Morse's annotated version is *Ben Franklin as my Lab Partner*, Part VI.

## **ONLINE Session 6: Series and parallel circuits, ammeters and voltmeters**

**Sections from Cutnell & Johnson:** 20.8 – 20.9. 20.13 – 20.14

Chapter 2 from *Structure of Scientific Revolutions* by Thomas Kuhn.

*Web assignment 3*

**Session 7: Franklin's theory**

*Philosophy/History/Education Research:* Franklin's electricity theory and experiments.

**ONLINE Session 8: Kirchhoff's Rules, RC Circuits.**

**Sections from Cutnell & Johnson:** 20.10 – 20.11

**Web assignment 4**

**Session 9: Midterm Exam**

*Laboratory Experiment:* RC Circuits

**ONLINE. Session 10: Magnetic Fields**

**Sections from Cutnell & Johnson:** 21.1, 21.7

**Web assignment 5**

**Reading assignments for online discussion and summative Session 13:**

- McDermott, L. and Shaffer, P. (1992). Research as a guide for curriculum development: An example from introductory electricity. Part I: Investigation of student understanding. *American Journal of Physics*, 60, 994-1003.
- Shaffer, P. and Shaffer, P. and McDermott, L. (1992). Research as a guide for curriculum development: An example from introductory electricity. Part II: Design of instructional strategies. *American Journal of Physics*, 60, 1003-1013.
- Cohen, R., Eylon, B., Ganiel, U. (1983). Potential difference and current in simple electric circuits: A study of students' concepts. *American Journal of Physics*, 51, 407-412.
- Heller, P.M. and Finley, F.N. (1992). Variable Uses of Alternative Conceptions: A Case Study in Current Electricity. *Journal of Research in Science Teaching*, 29, 259-275.

**Session 11: The magnetic force on charged particles and wires**

**Sections from Cutnell & Johnson:** 21.2, 21.4

*Laboratory Experiment:* Charge-to-mass ratio of the electron

**ONLINE Session 12: Magnetic fields produced by current**

**Sections from Cutnell & Johnson:** 21.5 – 21.6

**Web assignment 6**

**Session 13: Forces on wires, torques on wire loops; Magnetic materials**

**Sections from Cutnell & Johnson:** 21.8 – 21.10

*Laboratory Experiment:* Ampere's Law

*Philosophy/History/Education Research:* Misconceptions on electricity.

**Take home exam handed out**

**Electrostatic generators due.**

**Session 14: Wrap-up**

**Student presentations.**

**Take home exam due**

## **Bibliography**

### **Selections from primary sources**

Morse, R. A. (2004). *A Comprehensive Collection of Franklin's Electrical Works: The Electrical Writings of Benjamin Franklin*.

[http://www.tufts.edu/as/wright\\_center/fellows/bob\\_morse\\_04/index.html](http://www.tufts.edu/as/wright_center/fellows/bob_morse_04/index.html)

Specifically, refer to Letter III to Peter Collinson (1747) and to Additional Papers for Peter Collinson, Opinions and Conjectures (1750).

### **Selections from secondary sources**

Cohen, I.B. (1941). *Benjamin Franklin's Experiments*. Cambridge: Harvard University Press.

### **Selections from Physics Education Research Literature**

McDermott, L. and Shaffer, P. (1992). Research as a guide for curriculum development: An example from introductory electricity. Part I: Investigation of student understanding. *American Journal of Physics*, 60, 994-1003.

Shaffer, P. and McDermott, L. (1992). Research as a guide for curriculum development: An example from introductory electricity. Part II: Design of instructional strategies. *American Journal of Physics*, 60, 1003-1013.

Cohen, R., Eylon, B., Ganiel, U. (1983). Potential difference and current in simple electric circuits: A study of students' concepts. *American Journal of Physics*, 51, 407-412.

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