

The FINAL EXAM will be held Monday May 21 9 am to 12 pm. Location: Johnson Track (upstairs).

Material Covered & Exam Format:

1. All material covered in the course through the end of the course (through interference) will be fair game for the final exam.
2. The exam will be slightly less than twice the length of your first three exams, with analytic and conceptual questions.
3. This will be a closed book exam. There will be a formula sheet given on the exam. You should have plenty of time to finish the exam in the three hours allotted.

What We Expect From You In Particular On The Final

- (1) An understanding of Maxwell's equations, including Maxwell's addition to Ampere's Law (displacement current). You should be able to produce and identify each of Maxwell's equations, as well as give brief explanations of the meaning and use of each of them (don't be surprised by a question like "State each of Maxwell's equations and briefly explain their meaning and typical use.") In particular:
 - (a) The ability to use Gauss's Law to obtain electric fields from highly symmetric distributions of charge.
 - (b) An ability to use Ampere's Law to obtain magnetic fields in magnetostatics for highly symmetric distributions of current.
 - (c) An ability to do analytic problems related to the displacement current. That is, you should be able to calculate the magnetic field anywhere inside a charging capacitor, and so on.
 - (d) An understanding of how to use Faraday's Law in problems involving the generation of induced EMFs. You should be able to formulate quantitative answers to questions about energy considerations in Faraday's Law problems, e.g. the power going into ohmic dissipation comes from the decreasing kinetic energy of a rolling rod, etc.
- (2) An understanding of the concept of electric field and electric potential difference, an ability to calculate those in specific circumstances (e.g. given $V(x,y,z)$ find $\mathbf{E}(x,y,z)$, or given $\mathbf{E}(x,y,z)$ find $V(x,y,z)$, and so on). This includes the ability to calculate capacitance for highly symmetric situations.
- (3) An understanding of the concept of an electric dipole and the forces and torques on such a dipole in an external electric field.
- (4) An ability to use the Biot-Savart Law to obtain magnetic fields in magnetostatics for any distribution of current.
- (5) An understanding of how to calculate the forces and torques on a current element in an external magnetic field or on a charge moving in an external magnetic field, including the characteristics of cyclotron motion.
- (6) An understanding of the concept of a magnetic dipole and the forces and torques on such a dipole in an external magnetic field.
- (7) An understanding of inductance and the ability to calculate it for simple geometries.
- (8) An understanding of the behavior of DC and AC circuits involving resistors, capacitors, inductors and any combination thereof.

- (9) An understanding of the concepts of energy in electric and magnetic fields, and of energy flow in the Poynting vector.
- (10) An ability to do analytic and conceptual problems related to plane electromagnetic waves—e.g. obtain \mathbf{E} given \mathbf{B} and vice versa, determine the direction of propagation, and so on.
- (11) An understanding of the concepts of interference and diffraction, and the ability to do simple (conceptual) problems related to these concepts.
- (12) An ability to calculate the Poynting flux vector and integrals of that vector over surfaces to show energy conservation in situations involving, for example, a charging or discharging capacitor, a resistor, a charging or discharging battery, and an inductor where the current is increasing or decreasing. This means that you should both be able to do the analytic calculations and explain their physical significance.