Syllabus for ECE Qualifying Examination
Subject Area: Electromagnetics and Optics

There are 5 general areas in E&M that you are expected to understand with sufficient depth to be able to describe the physics and limitations of a simple device or process.

1. **Electrostatics**
   a. Coulomb’s law
   b. Poisson, Laplace equations
   c. Gauss’s law of electrostatics
   d. Potential energy
   e. Image charges
   f. Boundary value problems
   a. Energy stored in the electric field

2. **Magnetostatics**
   a. Biot-Savart law
   b. Ampere’s law of magnetostatics
   c. Vector potential
   d. Lorentz force and torque
   e. Energy stored in the magnetic field

3. **Maxwell’s equations**
   a. Faraday’s law, induction
   b. Displacement current
   c. Constitutive relations
   d. Wave equation
      1. Solutions with rectilinear, cylindrical, and spherical boundary conditions
      2. Plane electromagnetic waves, wave propagation, and evanescent waves
      3. Polarization
      4. Reflection, refraction, interference
   e. Energy conservation and Poynting’s vector

4. **Waveguides, Resonant cavities, and Modes**
   a. Electromagnetic boundary conditions
   b. TE, TM, TEM waveguide modes
   c. Fabry-Perot resonators

5. **Radiation**
   a. Electric dipole fields and radiation
   b. Magnetic dipole fields and radiation
   c. Simple dipole arrays, and image dipoles