P435 Course Summary

Selected Griffiths problems in parentheses.

1. **Electric field:**
   Divergence → charge density. Gauss' law.
   Curl = 0 (static) → Electric potential.
   Electrostatic energy

   You should know how to:
   calculate the charge density. (2.9)
   apply Gauss' law. (2.16)
   calculate potential differences (*e.g.*, do line integrals). (2.44)
   calculate fluxes (surface integrals). (2.10)
   calculate the field energy. (2.34)

2. **Conductors:**
   Equipotential surfaces.
   Induced charge.
   Capacitors
   Method of images

   You should know how to:
   calculate capacitance. (2.39, 2.40)
   use images to solve (simple) problems. (3.34)

3. **Laplace's equation:**
   Separation of variables
   Boundary conditions: V or E at a surface.
   Multipole expansion
   Cartesian, cylindrical, spherical coordinates

   You should know how to:
   solve in various coordinate systems (3.39)
   apply boundary conditions (3.37)
   solve problems with electric (and magnetic) dipoles (3.31)

4. **Electric fields in matter:**
   Polarization
   E, D, and P
   Linear dielectrics
   Boundary conditions
   Field energy

   You should know how to:
   calculate bound charges (4.10)
   calculate the force and torque on a dipole (4.6, 4.9)
   apply the boundary conditions (4.16, 4.18 4.22)
   calculate the field energy and forces (4.26, section 4.4.4)

5. **Magnetic fields:**
   Lorentz force
   Biot-Savart and Ampere's laws
   Vector potential

   You should know how to:
   calculate forces on moving charges and current carrying wires (5.40-5.42)
   calculate the field produced by a current (5.45)
   calculate the vector potential, given the current (5.22, 5.23)

6. **Magnetic fields in matter:**
   Magnetization
   B, H, and M
   Bound currents
   Boundary conditions

   You should know how to:
   calculate forces on magnetic dipoles (and current loops) (6.1, 6.3)
   calculate the bound currents and field of a magnetized object (6.7-6.9)
   apply boundary conditions (6.17, 6.18)

4. **Time dependence:**
   Ohm's law
   Electromotive force, motional emf, Faraday's law
   Inductance and magnetic energy
   Maxwell's equations in vacuum and in matter

   You should know how to:
   solve RC, LC, and RLC circuits (7.2, 7.3, 7.29)
   calculate inductance and field energy (7.26, 7.30)
   calculate induced currents (7.12)