

# 1 Key

- F2014p1 is Final exam 2014 problem 1
- C1 is comps problems 1
- HW10p1 is homework 10 problem 1

# 2 Radiation and Scattering in Non-relativistic systems.

1. Use Larmor, electric dipole, magnetic dipole, electric quadrupole radiation to compute radiation patterns and scattering.
  - (a) Larmor F2014p2, C3, HW9p3, HW11p4
  - (b) Electric Dipole C3, C4, C2, F2015p1, HW9p3, F2016p1
  - (c) Magnetic Dipole F2014p1 and scattering HW13p2, C7
  - (d) Thompson scattering HW13p3, dipole scattering C2, scattering from a metal sphere HW13p2.
2. Interference between multiple sources of radiation F2015p1, HW9p3, C2
3. Formal. Derive the electric dipole radiation and Larmor formula from maxwell equations, qualitatively understand where the higher multipoles come from (see C3, F2104p2, also C1 (a) and (b) and lecture, HW9p1, HW9p2).
4. Understand near field and far field HW9p1, HW9p2, C2
5. Antennas (HW9p4, HW9p2, F2014p1)

# 3 Formal aspects of Maxwell Equations and Relativity

1. Gauge invariance, current conservation, covariance waves, covariant stress tensor, Bianchi identity
  - (a) See HW9p6, HW9p7, HW10p5, HW10p4, C5
2. Write down the action of Maxwell equations and varying the action to determine the equations of motion. See lecture
3. Write down the action of a relativistic point particle and varying the action to determine the equations of motion. See lecture, F2016p3
  - (a) F2014p2, F2016p3
4. Transformation of fields and currents. Electrodynamics and relativity
  - (a) Fields of a point particle F2013p3, HW11p1, currents in cylinder HW10p3, F2016p2, moving sphere F2015p2, stress in sheets HW10p5, stress in plates C5. torque in relativity C6

## 4 Radiation from relativistic particles

1. Formal. Derive the Lienard-Wiechert potential and check Lorentz gauge condition C1,C3. Derive formulas such as Eq. 13.16 and 13.17 of class notes (see lectures) (though this last item will probably not be on the test directly it is important to understand everything else).
2. Compute the energy radiated during various motion HW11p2, HW11p3,HW11p4,F2013p3,F2014p3,Line acceleration (lectures), HW11p7, F2016p3
3. Compute the frequency spectrum for some problems F2014p3 (great problem for homework, but was too hard for a final), HW11p4, HW11p6, F2015p3, F2016p1
4. Compute the bremsstrahlung spectrum during a collision and analyze the result HW13p1, HW11p4, lecture
5. Elements of synchrotron radiation lecture. Carefully explain the frequency width.