Chapter 5: Magnetostatics

For this chapter you should:

• know the basic direction of a magnetic field due to a current in a wire (by using a right hand rule),
• know the magnitude and direction of the magnetic force on a charge moving with a known velocity in a magnetic field,
• know the Lorentz force law and be able to use it solve problems involving the motion of a charge in an electric and magnetic field,
• know and understand why that magnetic forces do no work,
• know the definition of an Ampere,
• know how to calculate the force on a current carrying wire that is placed in a magnetic field,
• know the definition of surface current and its relationship to a moving surface charge and its velocity,
• know the definition of volume current and its relationship to a moving volume charge and its velocity,
• know and be able to derive the continuity equation that describes the conservation of charge,
• know and be able to use the Biot-Savart Law to calculate the magnetic field due to a given current distribution,
• know that the magnetic field has zero divergence,
• know the differential and integral forms of Ampere’s Law, be able to convert from one to the other, and be able to use the integral form to solve problems involving symmetric current distributions (infinite straight lines, infinite planes, infinite solenoids, toroids),
• know how the magnetic field is calculated from the magnetic vector potential,
• know that the line integral around a closed loop of the magnetic vector potential equals the flux of the magnetic field through the loop (eqn. 5.69), be able to derive this relationship, and be able to use it to solve for the magnetic vector potential in highly symmetric fields and currents,
• know that the magnetic vector potential generally is in the same direction as the current,
• know the conditions on the parallel and perpendicular components of the magnetic field at a surface current and be able to use these relationships to check your results when calculating the field on both sides of a surface current,
• be able to calculate the magnetic field of a dipole if given the magnetic vector potential.