Electromagnetic Induction

1. Electromagnetic induction

◦ When there is magnetic flux cutting by a conductor or change in magnetic flux (linkage) through a conductor, an electromotive force (emf) is induced in the conductor.
◦ Magnetic flux is defined as the product of the area and the component of the magnetic flux density perpendicular to the area. $\Phi = BAcos\theta$, where θ is the angle between B and the normal to the area.
◦ Unit of magnetic flux is weber (Wb). One weber is the magnetic flux if a field of flux density one tesla passes perpendicularly through an area of one square metre.
◦ Magnetic flux linkage in a coil is the product of the magnetic flux (Φ) passing through the coil and the number of turns (N) of the coil. Its unit is Wb turns.

2. Faraday's Law and Lenz's Law

◦ Faraday's Law states that the magnitude of the induced emf (ε) in a conductor is directly proportional to the rate of change of magnetic flux linkage or to the rate of cutting of magnetic flux. $\varepsilon = -\dfrac{d(N\Phi)}{dt} = -N\dfrac{d\Phi}{dt}$.
◦ Lenz's Law states that the direction of the induced current is such that it produces a magnetic field that opposes the change in magnetic flux that causes it. When the induced emf is caused by flux cutting, we use Fleming's Right Hand Rule to determine the direction of the induced current.