Electricity and Magnetism in Biological Systems (生物電磁學)

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This course aims to help students to master the theory of electricity and magnetism in a manner that is readily accessible to them and to point to some areas of biology within which these physical techniques may be applied directly. The content has two distinct parts. First part aims to present the theory of electricity and magnetism in a manner that is accessible to students. Second part applies the principles dealt with in the first part to selected topics where electricity or magnetism is known to play a direct role in the explanation of biological function.

Course contents:

Part I: The basic theory of electricity and magnetism

1. Electrostatic fields and voltage
2. How conductors shape an electric field
3. Ionic conductors
4. Properties of electric dipole and application of gauss's law when dielectrics are present
5. The calculation of electric fields and voltages in the presence of dielectrics
6. Static magnetic fields
7. The generation of magnetic fields
8. Magnetic polarization of material
9. Induced electric and magnetic fields
10. The motion of charged particle in electric and magnetic fields and relativity

Part II: Applications in Biological Systems

1. Ions in aqueous solution and the ionization of acids and bases
2. The Debye layer
3. The behavior of ions in narrow pores
4. Possible mechanisms for a magnetic animal compass
5. An electrostatic model of a proton/ion or ion/ion coport or counterport
6. An introduction to the semi-classical theory of pulsed nuclear magnetic resonance

References:

1. "Electricity and Magnetism in Biological Systems," published by Oxford University Press Inc., New York. D.T. Edmonds , The Clarendon Laboratory University of Oxford. 2001.
2. "生物電磁學". 馬志欽,國立台灣大學嚴慶齡工業研究中心嚴慶齡思庫, 2000.