RECORDING PROBLEMS – MEASUREMENTS WITH TWO ELECTRODES

Various physiological processes produce electrical currents in the form of ions flows, which cause potential difference in the volume conductor of the body. The potential differences on the skin are some sources of information about the bioelectric process that occur inside the human body.

The output voltage of an amplifier used to measure bioelectric events is not always an accurate representation of event under examination. It is composed of the desired voltage, and a number of unwanted voltages. The desired voltage is called the signal. All unwanted voltages are referred as noise. When the term noise is used, it does not mean that the origin of the fluctuating voltage is unknown.

Thermal noise:

Every resistor will produce a certain amount of noise above 0^oK. This is due to the fact that heat is random movement of elementary particles. In theory the movements are in all directions, and should cancel each other, however some imbalance remains. The random movement of charged particles causes thermal noise, and it has a root mean square value of

$$V_{th}=\sqrt{4kTBR}$$

Where

K is Boltzmann's constant (1.380×10^{-23} J/K)

T is the temperature in kelvin

B is the bandwidth of the voltage measuring device in Hertz

R is the resistance in ohms

Amplifier noise:

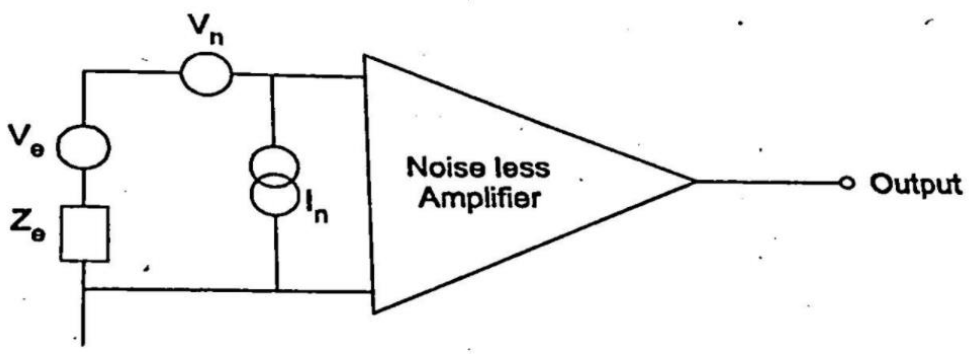

Fig: Amplifier noise source model

The noise introduced by the amplifier can be modelled as two uncorrelated noise sources, V_n and I_n in figure 1.35 Z_e is the electrode-electrolyte impedance and V_e is a voltage noise source related to electrode processes. As the noise sources are independent, the total amount of noise from the amplifier is given by

$$V_a^2 = V_n^2 + (Z_e I_n)^2$$