Tfy-99.269 Current methods and issues in monitoring physiological systems

<u>Problems for examination on May 6, 2005</u>

1. Assume an EEG signal with amplitude $U(t) = \sum_{k=1}^{10} k^{-1} \cdot \cos(2\pi kt)$. Draw its power spectrum and calculate the spectral entropy.

2. Assume a person being mechanically ventilated 6 liters/min at tidal volume of 500 ml. Let the exhalation time be twice the inhalation time and assume serial dead space of 150 ml. Draw a figure illustrating qualitatively how the partial pressure of CO_2 is varying as a function of time over a full breath cycle: a) in the lungs, b) in the exhaled gas measured at the airway. What will happen after 30 s end-inspiratory breath hold when using side-stream CO_2 measurement with sampling flow rate of 200 ml/min?

3. Derive the basic pulse oximeter equation for SpO2 as a function of R. Calculate the value of R at SpO2 = 80% and SpO2 = 97%, when the wavelengths used are 660 and 940 nm.

4. Assume a person's S_aO_2 having dropped down to 60% as caused by carbon monoxide poisoning. Calculate how high pressure would be required in the pressure chamber for hyperbaric oxygen therapy to restore the normal oxygenation level of blood. Let the hemoglobin contents of his/her blood be 150 ml in 1 liter of blood. What if a person happens to suffer from severe anemia with Hb of 85?

5. Based on the Stewart-Hamilton equation elaborate and discuss the inherent methodological and practical sources of inaccuracy in measuring cardiac output by the cold liquid bolus injection method.

The attached selected lecture material is at your disposal

You may answer either in English or Finnish