The **minimum requirements** for lab reports in case of each biophysics lab.

Measurements to be executed in the lab are highlighted in red. All measured data should be written down on the lab report form during class and signed by the lab teacher. Evaluation is to be prepared at home then submitted for evaluation in the next class. All lab reports (incl. 1st semester) must be corrected if necessary and brought to the oral part of the final exam to be presented upon request.

II/1. Dosimetry (number of graphs: 1; number of functions: 1)
The aim of the lab: familiarizing with the radiation protection aspects of ionizing radiations applied in medical practice, with the basic dose concepts, as well as with the working principle of some dosimeter appliances; application of a gaseous ionization chamber as dose rate meter.
Assignments:

1. Measure the signal of the ionization chamber (i.e. current) as a function of the voltage applied to the chamber.
2. Plot the current as a function of voltage
3. Identify the observable chamber characteristics ranges in the graph.
4. Calculate the exposure rate.
5. Calculate the absorbed dose rate respective to air.

II/2. Coulter-counter (number of graphs: 1; number of functions: 2)
The aim of the lab: familiarizing with principle of operation of the appliance constructed for the electronic counting of the corpuscular elements of blood as well as with the steps of the determination of their concentrations.
Assignments:

1. Measure the known blood model sample in RBC mode.
2. Calculate the calibration factor.
3. Measure the unknown model blood sample in RBC mode.
4. Calculate the concentration of the unknown sample.
5. Record the pulse count as a function of the integral discriminator level for the known sample.
6. Calculate the differential discrimination function using the data in section (5).
7. Plot the functions in sections (5) and (6) in the same graph.
8. Use the plot of data in section (5) to find the ID level corresponding to the pre-defined RBC setting of the appliance. Indicate the reading in the graph.

II/3. Amplifier (number of graphs: 1; number of functions: 2)
The aim of the lab: familiarize with the most important characteristics of the amplifier, an electric device found in almost all medical appliances where the amplification of the power of signals coming from the human body is necessary as well as with the means of reducing signal distortions.
Assignments:

1. Determining the output and input voltage of the amplifier as a function of frequency in case pure sinusoidal signals without and with negative feedback.
2. Calculate and plot the frequency response characteristics for both cases in the same graph.
3. Determine the lower and upper cut-off frequencies as well as the maximum gain levels for both cases.
4. Summarize the effects of negative feedback.

II/4. X-ray (number of graphs: 3)
The aim of the lab: determining the characteristic data of the spectrum of X-rays used in medical diagnostics; experimental proof of theoretical knowlegde on X-rays; quantitative characterisation of the attenuation of the radiation when passing through different media.
Assignments:

1. Record the spectrum (or use previously recorded spectra) of X-rays at different anode voltages using an X-ray spectrometer.
2. Plot adequately the cut-off wavelength–anode voltage function and determine its parameters in order to prove the Duane–Hunt law.
3. Record the spectrum of X-rays at different anode currents.
4. Prove the dependence of the emitted X-ray power (or a relative value proportional to it, e.g. the maximum of Bremsstrahlung) on the anode current.
5. Measure the (relative) X-ray intensity without absorber then with a series of different absorbers.
6. Determine the value of the partial mass attenuation coefficient of photoeffect (= τ_m) for each absorber.
7. Prove the depenedence of τ_m on the atomic number of the absorber by plotting and fitting the data.

II/5. Gamma energy (number of graphs: 1; number of functions: 2)
The aim of the lab: demonstration of the energy selectivity of the scintillation counter, identification of different gamma emitting isotopes based on the determination of their gamma energy, learning of the advantages of dual isotope labeling.
Assignments:

1. Determine the pulse number as a function of discrimination level using a given channel width: first with the known (^{127}Cs) isotope then with the "unknown" (^{51}Cr) isotope only, finally with both isotopes at one time.
2. Plot the relative pulse height spectra so that they can be well compared.
3. Use the readings from the spectra to find the gamma energy of the "unknown" isotope.

II/6. ECG (number of graphs: 4; number of functions: 4)
The aim of the lab: understanding the physical principles of electrocardiography and general properties of each of the ECG leads, determination of the simplest parameters using the recording of own ECG.
Assignments:

1. Record the ECG curve at rest using the three Einthoven leads.
2. Calculate the heart rate from the time difference between R-waves and compare it with the value displayed by the appliance. Determine the PQ-interval, the QRS complex and the QT interval.
3. Construct the integral vector belonging to the R-wave, determine the electrical axis (angle) of the heart, compare it with your anatomical axis.

II/7. Pulse Generators (number of graphs: 1)
The aim of the lab: familiarizing with the devices producing the electric pulses used in medical practice and with the electric circuits used as part of them; setting or determining the electric parameters of a pacemaker model.
Assignments:

1. Construct an astable multivibrator and set all the possible timing combinations using the two capacitors and the minimum/maximum values of the variable resistors.
2. Determine the time and amplitude parameters of the square pulses.
3. Plot some mebers of the pulse train of the setting which most most closely resembles a pacemaker.
4. Calculate the energy of one pulse and the charge that would get throught the tissue in case of setting (3).

II/8. Audiometry (number of graphs: 4; number of functions: 6)
The aim of the lab: familiarizing with the analysis of the general properties of sound; determination of own threshold of hearing and audiogram.
Assignments:

1. Record your own auditory threshold curve for the left ear and the right.
2. Plot the auditory threshold of each ear together with the normal auditory threshold curve.
3. Prepare the audiogram using the curves of (2) for both ears.

II/9. Isotope diagnostics (number of graphs: 1; number of functions: 2)
The aim of the lab: familiarizing with the principles of isotope diagnostics and with function of some diagnostic appliances; demonstration of the role of the collimator in isotope imaging.
Assignments:

1. Do (or check) the optimal setting of the scintillation counter.
2. Measure the background pulse count.
3. Measure the pulse count as a function of position along the longitudinal axis of the body model first with the narrower then with the wider collimator.
4. Prepare and compare the pulse count–position plots for both cases.

II/10. Diffusion (number of graphs: 1)
The aim of the lab: familiarizing with the laws related to diffusion; determination of the diffusion coefficient and Stokes radius of K^+ and Cl^- ions (together with ther hydration shell) using a piece of gel.
Assignments:

1. Soak the KCl-containing gel rod in distilled water for the given time intervals using a series of water aliquots.
2. Measure the conductance of each aliquot.
3. Calculate the amount of KCl diffused out into each beaker of water by using the measured conductance.
4. Plot the KCl remaining in the gel rod as a function of time.
5. Determine the diffusion coefficient using the slope of the linear section of the adequately transformed curve.
6. Calculate the Stokes radius (hydrodynamical radius) of the K^+ and Cl^- ions using the diffusion coefficient.

II/11. Sensory function (number of graphs: 3; number of functions: 9)
The aim of the lab: examining the relationship between the magnitude of stimulus and sensation using first a light sensor system functioning as a simplified eye model then our own ears.
Assignments:

1. Measure the receptor potential and the time period of action potential trains simulated by the eye model in case of different illuminations.
2. Plot the receptor potential as a function of illuminance.
3. Calculate and plot the action potential frequency as a function of illuminance.
4. Estimate your subjective sensation intensity on a relative scale for a series of pre-defined pure sinusoidal sounds.
5. Plot the sensation intensity as a function of the physical intensity of the sound.
6. Fit the data of (2), (3), and (5) hypothesizing both the Weber–Fechner and the Stevens law and compare the validity based on the coefficients of determination.

II/12. Flow (number of graphs: 0)
The aim of the lab: examination of different flow characteristics of liquids; determination of various flow parameters using an electric model of the blood vessel system consisting of resistors.
Assignments:

1. Determine the flow time of water in a capillary viscosimeter.
2. Calculate the viscosity of water.
3. Using the electric model of the blood vessel system, measure the electric current and the potential drop for each section.
4. Calculate the characteristic flow parameters using the measured data.

II/13. CAT scan (number of graphs: 1)
The aim of the lab: familiarizing with the physical background of X-ray imaging and with the principles of computer assisted X-ray tomography.
Assignments:

1. Do (or check) the optimal setting of the scintillation counter.
2. Measure the background pulse count.
3. Measure the pulse count along the rows and columns of the cube model.
4. After subtracting the background, calculate the X-ray densities for each row and column.
5. Using the relative values of X-ray densities, prepare the densitogram and find the position of the iron rods.

II/14. Revision (number of graphs: 0)