Practice questions 2016/17 II. (spring) semester
(Extended with the theoretical background)

1. Dosimetry
   Theoretical background:
   - the most important basic concepts in dosimetry
   - function of thermoluminescent dosimeter
   - application of the ionization chamber as dose rate measuring device
   Quantities to be determined based on the given data after proper graphical representation:
   Voltage – current diagram of the ionization chamber. Name the ranges of the diagram and determine the exposure rate and absorbed dose rate in air.

2. Coulter-counter
   Theoretical background:
   - parts and function of the equipment
   - function of ID, DD and multichannel analyzer
   - additional methods for counting different types of blood cells
   Quantities to be determined based on the given data after proper graphical representation:
   Calibration value, unknown blood cell concentration, RBC discrimination level

3. Diffusion
   Theoretical background:
   - phenomenon of diffusion and its mathematical description: Fick's I. and II. law.
   - solution of Fick's II. law in case of concrete experimental conditions (to be listed)
   - determination of the amount of material diffused out by the measurement of conductance
   Quantities to be determined based on the given data after proper graphical representation:
   The diffusion coefficient and the Stokes radius of hydrated K^+ and Cl^- ions

4. Amplifier
   Theoretical background:
   - gain, gain level
   - frequency response curve of the amplifier
   - negative feedback
   - advantages and disadvantages of feedback
   Quantities to be determined based on the given data after proper graphical representation:
   The maximum gain level, cut-off frequencies of the transfer band. Can it be used for the amplification of ECG signal?

5. X-ray I.
   Theoretical background:
   - parts and function of the X-ray tube
   - production, spectrum and diagnostic energy range of X-radiation
   - power of Bremsstrahlung and efficiency of X-ray tube
   Based on the given spectra make a graph, which proves Duane–Hunt-law.

6. X-ray II.
   Theoretical background:
   - attenuation of X-ray intensity
   - application of filters in X-ray diagnostics
   - atomic processes of attenuation, dependence of their mass attenuation coefficients on the photon energy
   - explain which photonenergies are the best for X-ray diagnostics
   Based on the given data make a graph that shows the relationship between the mass attenuation coefficient of photoeffect and the atomic number of the absorbent.

7. Gamma energy
   Theoretical background:
   - energy transformations in the scintillation counter, energy selectivity
   - possible applications of discriminators
   - spectrum of gamma radiation and the pulse amplitude spectrum
   - give an example for dual isotope labeling, and explain its advantage
   Quantity to be determined based on the given data after proper graphical representation:
   The unknown photon energy

8. Audiometry
   Theoretical background:
   - physical characteristics of sound
   - the human hearing range, threshold of hearing, threshold of pain
   - loudness, loudness level and the connection between them
   - interpretation of the audiogram
   Based on the given data construct the hearing threshold curve and the audiogram

9. Pulse generator
   Theoretical background:
   - characteristic parameters of square pulses
   - types of multivibrators, practical application of them
   Determine the parameters of the pulse series shown on the attached graph (amplitude, pulse duration time, period time, frequency, duty cycle, and the energy of one pulse)

10. ECG
    Theoretical background:
    - explain the formation of the ECG curve, and its components
    - types of ECG leads
    - Einthoven-triangle, integral vector
    - parts of the ECG equipment, differential amplifier
    Based on the attached ECG curves construct the integral vector and determine the heart rate

11. Flow
    Theoretical background:
    - stationary and pulsed, laminar and turbulent flow
    - Hagen–Poiseuille-law and the conditions of its validity
    - changes of pressure, cross section and flow velocity in the circulatory system
    - electrical model of the vascular system (analogies)
    Based on the given data determine the number of branches in part B and C of the model

12. Sensor
    Theoretical background:
    - model of the sensory system
    - stimulus, receptor potential, action potential, sensation
    - explain the role of voltage – frequency conversion in the sensation process
    - psychophysical laws
    Based on the given data after proper graphical representation whether the model supports the Weber–Fechner or the Stevens-law.

13. CAT-scan
    Theoretical background:
    - X-ray density and the Hounsfield scale
    - comparison of summation image and CAT-scan image
    - theoretical background of the CAT-scan image formation
    Based on the given data determine the position of absorbents in the model.