Practice questions on the semifinal exam 2019/20 I. semester (ED)

1. Refractometry
   Theoretical background:
   - law of light refraction, definition of index of refraction
   - critical angle, total reflection
   - formation of Snell circle
   - factors influencing the value of index of refraction
   - parts and function of Abbe-refractometer
   Quantities to be determined based on the given data after proper graphical representation:
   the unknown concentrations.

2. Light absorption
   Theoretical background:
   - derivation of Lambert-Beer law from the absorption law
   - absorbance, transmittance and the relation of them
   - absorption spectrum and the information available from it
   - parts of absorption spectrometer
   - application of absorbance measurement in laboratory diagnostics
   Quantities to be determined based on the given data after proper graphical representation:
   photon energy belonging to electron transition (in eV units)

3. Polarimetry
   Theoretical background:
   - linearly polarized, circularly polarized light and the connection between them
   - definition and interpretation of optical activity
   - Biot-law, specific rotation
   - parts and function of polarimeter
   Quantities to be determined based on the given data:
   the type of given sugar and the unknown concentration.

4. Optics of the eye
   Theoretical background:
   - refractive media and image formation of the eye
   - accommodation
   - refractive disorders of eye and the way for correction of them
   - limiting angle of vision, visual acuity (visus), factors influencing the visual acuity
   - distribution of photoreceptors on the retina
   Quantities to be determined based on the given data:
   accommodation power and visual acuity.

5. Nuclear medicine
   Theoretical background:
   - parts of scintillation counter
   - possible processes happening in the scintillation crystal
   - processes happening in the photomultiplier
   - signal selection, function of the discriminator, sources of noise pulses
   - optimal setting of scintillation counter
   Quantities to be determined based on the given data after proper graphical representation:
   the optimal discrimination level.

6. Gamma-absorption
   Theoretical background:
   - attenuation law of radiation, attenuation coefficient, mass attenuation coefficient
   - processes of attenuation on the atomic scale (photoeffect, Compton-scattering, pair production, elastic scattering)
   - the dependence of mass attenuation coefficients due to different processes on the photon energy
   - viewpoints of radiation protection
   Quantities to be determined based on the given data after proper graphical representation:
   D, μ, $\mu_{m,}$ for all the absorbents and ε, τ_{mPb}, σ_{mPb}.

7. Resonance
   Theoretical background:
   - elastic deformation, Hooke's law
   - harmonic oscillation
   - undamped and damped free oscillation
   - driven oscillation, resonance
   - effect of external force (depending on the distance) on the driven oscillation (working principle of AFM)
   Quantities to be determined based on the given data after proper graphical representation:
   the spring constant.

8. Skin impedance
   Theoretical background:
   - definition and components of impedance
   - electric model of the skin and the possible simplifications on the model
   - frequency dependence of capacitive reactance, approximation of skin impedance in case of low and high frequencies
   - practical applications of impedance measurement
   Quantities to be determined based on the given data:
   specific resistance and specific capacity of the skin.

9. 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.

10. 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?