

Semifinal exam questions (ED-2014)

1. Radiation
 - a) Properties and types of radiation
 - b) Physical parameters of radiation
2. Law of attenuation of radiation
 - a) Experimental interpretation of the law
 - b) Forms and validity of the law
 - c) Application of the law in medical and laboratory practice
3. Basic principles of optics (1)
 - a) refraction of light; Fermat's principle; Snellius-Descartes law
 - b) applications: prism, optical fiber
4. Basic principles of optics (2)
 - a) Reflection, spectral reflectance
 - b) Scattering : Rayleigh-, Mie-, Raman-scattering
5. Optics of the human eye
 - a) Image formation and power of the eye
 - b) Visual acuity, resolution of the eye; accommodation power, eyeglasses
6. Image formation by optical devices and their medical application
 - a) Optical lenses, lens systems, microscope
 - b) Resolution; Abbe's principle
7. Light as electromagnetic wave
 - a) Parameters of electromagnetic waves
 - b) Family of electromagnetic radiation; electromagnetic spectrum
8. Wave nature of light
 - a) Superposition, interference
 - b) diffraction, optical grating, dispersion of white light
9. Corpuscular nature of light
 - a) photoelectric effect (experiment and its interpretation); the photon concept
 - b) particles and wave nature of particles
10. Concept of electron microscopy
 - a) resolution of electron microscope
 - b) TEM, SEM
11. Absorption of light
 - a) Mechanism of light absorption; the absorption spectrum
 - b) Lambert-Beer's law and its medical application
 - c) Measuring techniques: light sources, monochromators, detectors
12. Blackbody radiation
 - a) absorption coefficient; radiant emittance; Kirchhoff's law
 - b) origin of blackbody radiation
 - c) Spectrum of blackbody radiation; Wien's displacement law
13. Basic principles of telethermography
 - a) Stefan-Boltzmann law
 - b) Thermal radiation of human body
 - c) Other application fields of thermal radiation
14. Luminescence
 - a) Mechanisms of luminescence; Kasha's rule
 - b) Emission spectrum, Stokes rule
 - c) Life time of fluorescence and phosphorescence

15. Application fields of luminescence
 - a) Light sources based on luminescence
 - b) Medical and laboratory use of luminescence
16. Concept of light amplification
 - a) Optical pumping and population inversion
 - b) Induced emission
17. Production of LASER light
 - a) Preconditions for LASER operation
 - b) Emission and properties of LASER light
18. Medical application of LASERs
 - a) Characteristics of LASER light
 - b) Biological effects and medical application of LASER light
19. Generation of X-ray I.
 - a) Structure and operation of X-ray tube
 - b) Generation and spectrum of Bremsstrahlung
20. Generation of X-ray II.
 - a) Power and efficiency of the X-ray tube
 - b) Generation and spectrum of characteristic radiation
21. Absorption of X-ray
 - a) Attenuation and mass attenuation coefficient
 - b) Mechanisms of the absorption
22. Medical application of X-ray absorption
 - a) Factors influencing X-ray absorption
 - b) Basic principles of X-ray diagnostics and radiation protection
 - c) Application of contrast materials
23. X-ray diagnostics I
 - a) Summation image; fluoroscopy
 - b) X-ray image amplifier; DSA
24. X-ray diagnostics II
 - a) Concept of CT; Hounsfield units, spiral CT, spatial and temporal resolution
 - b) Generations of CT
25. Nuclear radiation
 - a) Composition and stability of the nucleus
 - b) Nuclear forces; mass defect
26. Radioactive decay law
 - a) Activity; definition and factors influencing its value
 - b) Change of activity in time; decay constant, half life
27. α - and β -radiation
 - a) α -particle; spectrum of α -radiation; interaction with matter
 - b) Types, characteristics and spectrum of beta-radiation; interaction with matter; annihilation
28. Gamma-radiation and its interaction with matter
 - a) Nature, characteristics and spectrum of gamma-radiation; isomeric transition
 - b) Interaction of Gamma-radiation with matter
29. Basic principles of diagnostic application of radioisotopes
 - a) Basic principles and information provided by isotope diagnostics
 - b) Selection rules for in vivo application of radioisotopes
30. Methods in isotope diagnostics I.
 - a) Isotope accumulation curve; effective and biological half life
 - b) Gamma camera (structure and operation); static and dynamic pictures

31. Radiotherapy
 - a) Types of radiation in radiotherapy and their absorption characteristics
 - b) Relative depth-dose
32. Accelerators and therapeutic devices
 - a) Linear accelerator and cyclotron
 - b) Collimators
 - c) Gamma knives, brachytherapy
33. Isotope diagnostics II
 - a) SPECT
 - b) PET
34. Biostatistics I
 - a) Variable and probability distribution
 - b) Normal distribution and its parameters
35. Biostatistics II
 - a) Sample and statistical characteristics
 - b) Estimation of the expected value
36. Biostatistics III
 - a) linear regression
 - b) correlation
37. Hypothesis testing (1)
 - a) t-distribution; null-hypothesis;
 - b) correlation t-test
38. Hypothesis testing (2)
 - a) t-test for one sample. T-test for two samples
 - b) χ^2 -test