

ED - PRACTICAL EXAM TOPIC LIST - 2020/2021 SEMIFINAL

1. Refractometry

- 1/1. Definition of refractive indices. Law of light refraction. Critical angle. Total internal reflection. Dispersion.
- 1/2. Formation of Snell's window. Abbe refractometer. Concentration determination by refractometry.

2. Optics of the eye

- 2/1. Focal accommodation of the eye. Refractive media and image formation of the eye. Refractive disorders of the eye and their corrections.
- 2/2. The reduced eye. Limiting angle of vision. Visual acuity and its measurement. Factors influencing visual acuity. Estimation of receptor density.

3. Light emission

- 3/1. Thermal emission and luminescence. Characterization of light emission spectra. Light sources.
- 3/2. Parts of a spectrometer, monochromator types. Flame photometer and its diagnostic applications.

4. Light absorption

- 4/1. Definition of absorbance and transmission. Beer-Lambert law. Concentration determination by light absorption.
- 4/2. Absorption spectra, types, characteristics. Parts and function of absorption spectrometer.

5. Resonance

- 5/1. Oscillation, harmonic oscillation, damped and undamped free oscillation. Definition of driven oscillation. Critical damping, resonance.
- 5/2. Elastic deformation. Hooke's law. The concept of resonance and the interpretation of the resonance curve.

6. Polarimetry

- 6/1. Definition of polarized light. Relations between linearly and circularly polarized light. Optical activity. Parts and function of polarimeter.
- 6/2. Definition of specific rotation. Factors influencing specific rotation. Biot law. Parts and function of polarimeter.

7. Nuclear medicine

- 7/1. Parts and function of scintillation counter. Processes in the scintillation crystal.
- 7/2. Parts and function of scintillation counter. Processes in the PM tube. Signal selection. Sources of noise. Signal-to-noise ratio.

8. Gamma absorption

- 8/1. Attenuation of gamma radiation. Attenuation coefficient and half-value thickness. Mass attenuation coefficient, surface density, half-value mass.
- 8/2. Atomic-level interactions determining the mass attenuation coefficient, their dependence on photon energy. Parts of scintillation counter.

9. Dosimetry

- 9/1. Ionizing radiations, direct and indirect chemical effects, stochastic and deterministic effects. Scintillation counter, thermoluminescence dosimeter.
- 9/2. Definition of dose concepts (absorbed dose, exposure, equivalent and effective dose) and dose rate. Parts and function of ionization chambers.

10. Amplifier

- 10/1. Electric gain, linear transfer function, distortion. Power gain, voltage gain, calculating gain level, transfer band.
- 10/2. Frequency response curve of the amplifier. Negative feedback. Advantage and disadvantage of negative feedback.

ED - THEORETICAL EXAM TOPIC LIST - 2020/2021 SEMIFINAL

1. Radiation: Properties and types of radiation; Physical parameters of radiation
2. Law of attenuation of radiation: Experimental interpretation, forms and validity of the law; Application of the law in medical and laboratory practice
3. Basic principles of optics I: Fermat's principle; refraction of light; Snell's law ; applications: prism, optical fiber
4. Basic principles of optics II : Reflection, spectral reflectance; Scattering: Rayleigh, Mie, Raman scattering
5. Optics of the human eye: Image formation, reduced eye model, visual acuity, resolution of the eye
6. Image formation by optical devices and their medical application: Optical lenses, microscope; Resolution; Abbe's principle
7. Light as electromagnetic wave: parameters of electromagnetic waves; electromagnetic spectrum
8. Wave nature of light: Huygens' principle, diffraction, superposition, interference, optical grating, dispersion of white light
9. Particle nature of light: photoelectric effect, the photon concept; application of photoelectric phenomenon
10. Mechanism of light absorption, absorption spectrum ; Beer-Lambert law and its applications; Measuring techniques: light sources, monochromators, detectors
11. Thermal radiation: its origin, absorption coefficient and radiant emittance, Kirchhoff's law, spectrum of blackbody radiation, Wien's displacement law
12. Principles of telethermography: Stefan-Boltzmann law, Wien's displacement law; Thermal radiation of human body, application fields of thermal radiation
13. Luminescence: Mechanisms of luminescence, Kasha's rule, Emission spectrum, Stokes shift, Lifetime of fluorescence and phosphorescence, quantum yield
14. Application fields of luminescence: Light sources based on luminescence, medical and laboratory use of luminescence
15. Concept of light amplification: Optical pumping and population inversion, induced emission
16. Production of LASER light: conditions for LASER operation, properties of LASER light
17. Medical application of LASER: characteristics of LASER light; Biological effects and medical application of LASER light

18. Generation of X-ray: Structure and operation of X-ray tube; Duane-Hunt law, spectrum of Bremsstrahlung and characteristic radiation, efficiency of X-ray tube
19. Absorption of X-ray: Linear and mass attenuation coefficients, absorption mechanisms
20. Medical application of X-ray: principles of X-ray diagnostics, image quality, application of contrast materials, DSA
21. X-ray diagnostics: Summation image, concept of CT, CT generations, Hounsfield units, X-ray image amplifier
22. Nuclear radiation: Composition and stability of nuclei, nuclear force, mass defect, radioactive decay and its characterization, activity
23. α , β , and γ radiations: mechanisms of decay, energy spectra, penetration depth
24. Methods in isotope diagnostics I.: Selection of radioisotopes, radiopharmaceuticals, metabolic labeling, isotope accumulation curve, effective and biological half-life, static and dynamic investigations
25. Methods in isotope diagnostics II.: gamma camera, SPECT, PET
26. Modern microscopy techniques: fluorescent microscopy, confocal laser scanning microscopy; two-photon excitation
27. Concept of electron microscopy: resolution of the electron microscope; TEM, SEM
28. Biostatistics I: stochastic variable and probability distribution; Normal distribution and its parameters
29. Biostatistics II: Sample and its characteristics; Estimations of expected value and standard deviation
30. Biostatistics III: linear regression; correlation
31. Hypothesis testing I: t-distribution, confidence interval, null-hypothesis, type-I and type-II errors
32. Hypothesis testing II: t-test for a single sample, t-test for two samples, t-test for correlation