Biophysics (Pharmacy)

LESSON № 20

The topic of section: " Optics ".
The topic of seminar: " Electromagnetic waves and their properties. The polarization of light. The use of polarization methods for the study of biological objects. Laboratory work "DEFINITION OF CONCENTRATION OF OPTICALLY ACTIVE SUBSTANCES BY POLARIMETER ".
The purpose of the lesson: Learn the concept of electromagnetic waves and properties of polarized light; to study the principle of operation of the polarimeter, to study the determination of the concentration and the specific rotation of sugar solution using polarimeter..

Theoretical questions:

1. An electromagnetic wave. Maxwell's theory. Types of polarization of electromagnetic waves. The degree of polarization.
2. Birefringence of light in the crystal. Nicolas Prism.
3. Polarization of waves reflected from the dielectric. Brewster's law.
4. The phenomenon of optical dichroism, polaroid's action principle.
5. Passage of natural and linearly polarized light through a polarizer. Malus law.
6. The optical activity, the device is a polarimeter.
7. Determination of the concentration of optically active substances polarimeter.

Practical tasks:

1. Perform laboratory work " DEFINITION OF CONCENTRATION OF OPTICALLY ACTIVE SUBSTANCES BY POLARIMETER "
2. Solve the problem:
   1. Between two crossed Polaroids third polaroid is placed so that its plane makes an angle of $\varphi = 45^0$ with the main plane of the first Polaroid. How to change the intensity of the natural light passing through such a device? Absorption of light in Polaroids is neglected.
   2. Between two crossed Polaroids placed a plate of quartz with thickness l = 3 mm, with the result that the field of view is maximally bright. Determine the constant rotation used in quartz.
   3. Determine the concentration of sugar in the solution, if the angle of rotation of the polarization plane of light $2,2^o$ when the length of the cuvette is 4 cm. The specific rotation of sugar used for this light is equal to 6.6 grad·sm2 / g.
   4. What is the angle between the principal planes of the polarizer and the analyzer, if the intensity of the natural light transmitted through the prism decreased by 4 times? The absorption of light is neglected

Literature

1. Medical and biological physics for medical students: Textbook / L.V.Kucharenko et all. – Minsk: BSMU. 2015. – 260p. Chapter 18.

2. Medical and Biological Physics. Workshop: Textbook / V.G.Leschenko [et al.]; ed. V.G.Leschenko. - Minsk: The new knowledge; Moscow: INFRA-M, 2013. - 334 p. pp 213-220

LESSON № 20

Lab work "Definition of concentration of optically active substances by polarimeter".

Aim: to determine the concentration of the optically active substance and the specific rotational constant.

Theory: the chapter 18 "Electromagnetic waves. Light polarization" (pages 146-158).

1. What polarization types are known?
2. Explain the Nicol prism construction and a light propagation through it.
3. Explain phenomenon of dichroism. What are the polarizers?
4. Write Malus's Law.
5. What is the optical activity? How to determine a concentration of optically active substance by polarimeter?

Practical part:

Number of measurements, n	Cuvette length L, cm	Concentration C, %	Initial angle	Angle of rotation $\alpha_n=\varphi_n - \varphi_0$	Calculations	
					Rotation constant α_0	Unknown concentration C_x
Initial count	–	–	$\varphi_0=$	–	–	–
1	10	20	$\varphi_1=$	$\alpha_1=$	$\alpha_0 =$	–
2	10	X_1	$\varphi_2=$	$\alpha_2 =$	–	$C_1 =$
3	10	X_2	$\varphi_3=$	$\alpha_3 =$	–	$C_2 =$

Conclusion:

Solve the problems:

1. Plate of quartz (thickness is 3 mm) was placed between two crossed polarizers and field of vision has been maximum light as result. Determine the specific rotational constant.
2. What part of the natural light will pass through a polarizer and analyzer, if the angle between their polarization planes is equal to 60^0?

Literature

1. Medical and biological physics for medical students: Textbook / L.V.Kucharenko et all. – Minsk: BSMU. 2015. – 260p. Chapter 18.