NOVATEUR PUBLICATIONS
INTERNATIONAL JOURNAL OF INNOVATIONS IN ENGINEERING RESEARCH AND TECHNOLOGY
[IJIERT] ISSN: 2394-3696 Website: ijiert.org
VOLUME 8, ISSUE 3, Mar.-2021

ONLINE ACCESS TO THE TOPIC OF FLUID FLOW AND BIOPHYSICAL PROPERTIES FOR STUDENTS OF MEDICAL INSTITUTES

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ABSTRACT
This article is devoted to the transition of students of medical institutes in the modular system of lectures, practical classes and independent work on "Flow of fluids and biophysical properties." The importance of the viscosity coefficient in medicine, its application in diagnosis and forensic medical examination, the Stokes method of finding the viscosity coefficient, the availability of viscometric methods, and the use of the Gess (VK-4) viscometer in medicine to find the viscosity coefficient. It is also shown that the coefficient of surface tension is obtained by the method of drop break and the role of the surface tension coefficient in medicine.

Basic words and phrases: Submerged and convex surface, gas embolism, fluid, velocity, viscosity, modulus, internal friction coefficient, viscometer, hydraulic resistance, turbulent flow, laminar flow, Renolds number, Poiseuille formula, capillary viscometer, Newtonian fluid, Newtonian non-viscous fluid, capillary , platform system, ZOOM software, test, video conferencing, temperature dependence, diagnostics, independent mastering, surface tension, wetting, wetting, hydrostatic pressure.

INTRODUCTION
The fluid environment makes up a large part of the human body (≈70%) (blood, lymph, urine, breast milk, etc.). The movement of fluids throughout the body provides metabolism, as well as nutrients and oxygen to the cells. Releases nutrient residues and carbon dioxide from cells. Therefore, fluids should flow throughout the body and the biophysical properties of fluids should be known to medical institute students and medical staff. This topic is devoted to the hemodynamics department of physics, which studies the laws of interaction between the motion of an incompressible fluid and its surrounding solid environment, and the rheology department of physics, which studies the fluidity and deformation of fluids.
Training at the Samarkand State Medical Institute (SamDTI) has been conducted in a modular system since 2013. More than six and a half terabytes of data were collected on the basis of the modular system of the Institute's platform. According to the state educational standards and the decision of the Pedagogical Council of the Institute of August 14, 2020, 18 hours of lectures, 54 hours of practical classes and 36 hours of independent work are allocated for the subject "Medical and Biological Physics" [1.2.].
Given the current prevalence of the Coronavirus pandemic around the world, and the high prevalence of various infectious diseases in some countries, we will explain the advantages of modular training on the basis of the SamDTI platform during the lessons.

MAIN PART

I. LECTURE ON "FLUID FLOW AND BIOPHYSICAL PROPERTIES" ONLINE

The main part of continuing education of the department "Medical and Biological Physics" is the teaching of bachelors in a modular system of the institute's platform. The subject of medical and biological physics is taught in the first year.

I. 1. Time distribution of lectures.

1. Organizational part of the lesson (5 min).
2. Formation of the coefficient of internal friction of liquids. Newton's formula. Poiseuille formula. Hydrodynamic resistance (15 min).
3. The role of viscosity coefficient in cognition in medicine (10 min).
4. Stokes method for determining viscosity. Viscosometric methods (15 min).
5. Laminar and turbulent flows. Reynolds number (8 min).
6. Processes on the surface of liquids (7 min).
7. Capillary. Wetting and non-wetting events in liquids (10 min).
8. Gas embolism (5 min).
9. Concluding part of the lesson (5 min).

I.2. Students should know about the topic [3,4,]:

1. Reasons for the formation of the coefficient of viscosity.
2. Internal friction coefficient or dynamic viscosity.
3. Newton's formula.
4. Units of measurement of viscosity coefficient.
5. Newtonian fluids.
6. Non-Newtonian fluids.
7. Blood viscosity and its use in diagnosis.
8. Sedimentation rate of erythrocytes
9. Use of internal friction coefficient in forensic examination.
10. Determination of the coefficient of viscosity by the Stokes method.
11. Stokes formula.
12. Capillary or Ostvold viscometer.
13. Medical or Gess viscometer.
14. Rotational viscometers.
15. Laminar flow of liquids.
16. Turbulent flow of liquids.
17. Reynolds number.
18. Poiseuille formula.
19. Hydraulic resistance.
20. Surface tension forces.
21. The phenomenon of wetting and non-wetting.
22. Laplace formula.
23. Determination of the coefficient of surface tension by the method of drop break.

I. 3. Additional questions to reinforce the report [3,4,5]:

1. What is the "coefficient of internal friction of liquids"?
2. Newton's equation for viscous liquids.
3. Explain that the coefficient of viscosity depends on the velocity gradient.
4. Newton and non-Newtonian fluids.
5. The coefficient of viscosity of air, water, glycerin, blood and blood plasma at a temperature of 200 C.
6. The importance of the coefficient of internal friction in medicine.
7. Laminar and turbulent flow of liquids.
8. Reynolds number.

9. Find the viscosity by the Stokes method.
10. Viscometers.
11. The effect of viscosity coefficient in medical processes.
12. Poiseuille formula.
13. Hydraulic resistance.
14. Hydraulic resistance when pipes are connected in series.
15. Hydraulic resistance when pipes are connected in parallel.
16. The phenomenon of surface tension.
17. Viscosity of blood.
18. Reynolds number.
19. Determination of the coefficient of surface tension by the drop method.
20. What substance surface is called an active substance.
21. Temperature dependence of the surface tension coefficient.

I. 4. The text of lectures on "Fluid Biophysics" was presented in the modular system of the platform SamDTI. [2]

The following texts are additionally presented. [2]

1. Finding the perturbation by the Stokes method.
2. Capillary viscometers. Ostvold and Gess viscometers
3. Capillary phenomena.
4. Gas embolism.

II. Practical lesson on "Methods for finding the coefficient of internal friction of liquids."

160 min were allocated for the practical lesson "Fluid flow and biophysical properties". His first report was entitled "Methods for Finding the Internal Friction Coefficient of Fluids." In this course, we will explain the criteria for assessing students in the modular system, as well as the transition and coverage of this course online on the platform SamDTI, modular system, programs "ZOOM" and "telegram".

II.1. Time distribution of the practical lesson on "Methods for finding the coefficient of internal friction of liquids."

1. Organizational part of the lesson (5 min.).
2. Principles of operation of tools and equipment required for laboratory work. (10 min.).
3. Information on the "coefficient of internal friction of liquids" (15 min.).
4. Theoretical data on the determination of the "coefficient of viscosity of liquids" by the Stokes method (10 min.).
5. Theoretical data on the determination of the "coefficient of internal friction of liquids" by the method of Ostvold (15 min.).
6. Using a medical viscometer (Gess), determine the coefficient of internal friction of liquids (10 min.).
7. The importance of the "coefficient of internal friction of liquids" in medicine (10 min.).
8. Concluding part of the lesson (5min.).

II.2. Students should know: [3.4.5.6]

1 Description of the equipment required for the experiment.
2 Internal friction coefficient or dynamic viscosity.
3 Causes of viscosity.
4 Newton's formula.
5 Units of viscosity.
6 Information on Newtonian fluids.
7 Information about non-Newtonian fluids.
8 Viscosity of blood and its use in diagnosis.
9 Erythrocyte sedimentation rate (SOE).
10 Use of the coefficient of internal friction in forensic medical examination.

11 Determination of viscosity coefficient by Stokes method.
12 To derive the formula for finding the coefficient of internal friction by the Stokes method.
13 Ostvold vskozametrini.
14 Medical or Gess viscometer.
15 Rotational viscometers.
16 Poiseuille formula.
17 Hydraulic resistance.
18 Laminar flow of liquids.
19 Turblent flow of liquids.
20 Reynolds number.

II.3. Additional questions to reinforce the practical lesson: [2.7.8]

1. What is the "coefficient of internal friction of liquids"?
2. For viscous liquids, Newton's equation.
3. Explain the temperature dependence of the viscosity coefficient.
4. Newtonian and Newtonian fluids.
5. Coefficient of viscosity of air, water, glycerin, blood and blood plasma at a temperature of 200 C.
6. The importance of the coefficient of internal friction in medicine?
7. Turbulent and laminar flow of fluids.
8. Reynolds number.
9. Viscometers.
10. Coefficient of viscosity in medical procedures (in the administration of anesthesia through the tube and the introduction of drugs in syringes).
11. Find the viscosity by the Stokes method.
12. Poiseuille's equation.
13. Hydraulic resistance.
14. Hydraulic resistance when pipes are connected in series.
15. Hydraulic resistance when pipes are connected in parallel.

II.4. The module system presents the text of a practical training on "Determination of the coefficient of internal friction of liquids" (We also abbreviate the text). [2.7.9]

When molecules of real liquids and gases move, internal friction forces are created because there are mutual gravitational forces between them. These forces occur between the fluid layers, causing anger even if the fluid layers are moving at different speeds. These forces are created when the velocities of the stratum fluids with high velocities are pulled back by the fluids of the strata with low velocities.

If there is no source that supports the velocities of the fluid layers, the fluid will flow in layers due to the effect of frictional forces and internal friction between the fluid layers.

The first layer is attached to the vessel wall, the velocity is zero, the second layer is at a low velocity, the third layer is greater, and so on. In the center of the nay, the speed will have a maximum value. Newton found that the frictional force *($F_{ишқ}$)* generated between these two layers is proportional to the nature of the fluid, the contact surface (S) of these layers, and the velocity gradient (*dϑ/dz*). 〖F〗 $_F_{\text{ишқ}} = \eta \cdot S \cdot \frac{d\vartheta}{dz}$ (1) where S - is the surface, η − is the coefficient of friction, $\frac{d\vartheta}{dz}$ −is the velocity gradient. In the SI system:

In *F~* Newtons, the ϑ -velocity is measured in $\frac{\text{м}}{\text{с}}$ and the S-surface is measured in m2. η −unit of friction coefficient

$\frac{\text{Н}}{\text{м}^2 \cdot \frac{\text{м}}{\text{с}}} = \frac{\text{Н}}{\text{м}^2 \cdot \frac{1}{\text{с}}} = \frac{\text{Н}\cdot\text{с}}{\text{м}^2} = \text{Па} \cdot \text{с}$ will be. Represented in Poises in the SGS system

equal to*1* Пуаз *=0,1*$\cdot\frac{\text{Н}\cdot\text{с}}{\text{м}^2}$ *=0,1* Па·с.

As the temperature increases, the viscosity coefficient decreases.

1) Liquids whose coefficient of internal friction obeys Newton's law does not depend on the velocity gradient are called Newtonian fluids. Examples are blood plasma water and various solutions.

2) Liquids that do not obey Newton's formula are called non-Newtonian fluids.
Non-Newtonian fluids are liquids composed of large molecules with a complex structure, e.g., a solution of polymers. Since the composition of blood is composed of shaped elements, the change in velocity gradient does not correspond to the change in the coefficient of internal friction, so blood is a non-Newtonian fluid. The viscosity coefficient of human blood is normal (4 ÷ 5) mPa · s, and in pathology it can vary from 1.7 mPa · s to 22.9 mPa · s. Determining the coefficient of viscosity of blood is important in the diagnosis (diagnostic). Decreased viscosity in infectious diseases increases in colds: for example, in respiratory diseases. In diabetes it reaches 22.9 mPa · s.

II. 5. The following additional texts on the topic "Fluid flow and biophysical properties" are presented in the module system. [2]
1) Stokes' method for finding the "internal friction coefficient of liquids".
2) Find the "viscosity of liquids" with a viscometer.
3) VK-4 (Gess) viscometer.
4) Rotational viscometers.

II. 6. Assessment of students in the modular system [2]
1. The student's test scores.
2. Scores from situational tests.
3. Scores from control tests.
4. Written online answers to control questions.
5. Activities in the platform system are taken into account and the student is summarized and evaluated.

III. Practical lesson on "Determination of the surface tension coefficient of liquids by the method of droplet rupture"
In the study of fluid flow and biophysical properties of liquids, 80 minutes were allotted for “Determination of the surface tension coefficient of liquids by the drop-break method”. We will show the advantages of the system of detailed coverage of the lesson online on the platform SamDTI, modular system, programs "ZOOM" and "Telegram". [2].

III.1. Time distribution of the practical lesson on "Determination of the coefficient of surface tension of liquids by the method of drop break". [9.10]
1. Organizational part of the lesson (5 min)
2. Question and answer assessment with students. (10 min)
3. Information on the operation of instruments and equipment required for laboratory training. (5 min).
4. Information on “Formation of surface tension coefficient from liquids” (15 min).
5. Theoretical data on the determination of the surface tension coefficient of liquids by the method of droplet rupture (10 min).
6. Information about the Laplace formula (5 min).
7. What is the medical significance of "Determination of the coefficient of surface tension of liquids"? (5 min).
8. Students solve theoretical tests (20 min)
9. Concluding part of the lesson (5min).

III.2. Students should know: [2.4.5.]
1. Descriptions of the equipment required for the experiment.
2. What is the “surface tension coefficient of liquids”?
3. Units of measurement of "surface tension coefficient of liquids".
4. Liquidity of liquids. The equation of continuity of flow.
5. What is the surface tension force and its formula?
6. Causes of the formation of the phenomenon of surface tension.
7. The phenomenon of application and non-application.
8. Capillary events.

9. Gas embolism.
10. The reasons for the formation of convex and concave meniscus in capillary tubes.

III.3. Additional questions to reinforce the practical lesson: [2.5.10]

1. What is the surface tension of liquids?
2. What do you mean by molecular or internal pressure?
3. What do you mean by the free energy of a liquid surface?
4. What is the force and coefficient of surface tension?
5. Explain the additional pressure that occurs under the curved surface of the fluid?
6. Explain the Laplace formula?
7. Explain that the coefficient of surface tension depends on the temperature?
8. The process that takes place on the surface of mercury glass?
9. The process that takes place on the surface of mercury iron?
10. What process is observed in the capillary tube if the hydrostatic pressure is greater than the Laplace pressure, which is formed additionally?
11. What is the importance of studying the coefficient of surface tension in medicine?

III.4. The modular system of the SamDTI platform presents the text of a practical training on "Determination of the coefficient of surface tension of liquids by the method of droplet rupture" (We also abbreviate the text). [2]

A liquid, with some of its properties, resembles gases and solids in terms of its dependence on pressure and temperature. But the peculiarity of liquids is that they have a free surface. The molecules on this surface are in a completely different condition than the molecules in the other liquid.

The thickness of the surface layer is very small in the order of 10–7 cm, approximately equal to the radius of the molecular sphere of action. Molecules in the surface layer are affected not only by molecules in the inner layer of the liquid, but also by other environmental molecules (in the air) that surround the surface, and by the molecules of this liquid vapor. The surface environment of a liquid differs from that of a liquid both in nature and in the density of the particles. Therefore, the molecules of the outer layer interact with them differently. The forces of interaction are forces of a van der Waals force nature and of an electrical nature, and their equal action is different from zero. In a liquid, the forces acting on each molecule within the range of molecular action are evenly distributed, and the total force of impact is zero. The value of these forces per square meter of the surface layer is called the internal or molecular pressure. Its value is enormous. For example, the internal pressure for water is about 11 · 108 Pa. The forces in the horizontal plane, on the other hand, are the forces acting on the surface of the liquid in an attempt to shrink the surface of the liquid, and this force on the surface of the liquid is called the surface tension. Under the influence of the surface tension force, the surface of the liquid is reduced to as small a size as possible, which means that the surface layer of the liquid is tense, as if it were an elastic stretched curtain. The tension of the surface layer of a liquid is called the surface tension. The surface tension force of the fluid will be directed perpendicular to the contour bordering the surface of the fluid and controlling the surface. Hence, the surface tension force is proportional to the number of molecules attached to the contour, and the number of molecules in turn is proportional to the length of the contour.

$$F = \sigma \ell \qquad (1)$$

Here, F is the surface tension force acting on the contour of length ℓ, which limits the surface of the liquid, and is the coefficient of proportionality, which is called the surface tension coefficient.

For the surface area of a liquid to increase, a certain number of molecules must pass from the volume of the liquid to the surface layer. To do this, work must be done to overcome the molecular forces directed at the interior of the liquid. This external work will be negative. Conversely, as the surface shrinks, the molecular forces work by pulling excess molecules from the surface into the liquid. And the work done will be positive. As the surface increases, the potential energy of the molecules rising to the surface decreases accordingly. Therefore, as the surface area of the liquid increases, the temperature decreases slightly and cools slightly. A change in the surface temperature causes a change in the surface tension coefficient. In order to maintain a constant coefficient of surface tension, it is necessary to change the surface of the liquid isothermally.

Accordingly, the surface layer of the liquid will have an excess potential energy relative to the remaining mass. It is called the free energy of the liquid surface. When the surface of a liquid shrinks isothermically, the molecular forces do a positive job at the expense of this free energy. Therefore, the part of the liquid surface potential energy that can be converted into isothermal contraction work of the liquid surface can be said to be the free energy of the liquid surface. The free energy is proportional to the surface area of the liquid:

$$A = \sigma S \qquad (2)$$

Whether or not the liquid soaks into the vessel wall depends on the value of its surface tension coefficient. If the force of the interaction of the liquid molecules is less than the force generated between the liquid molecules and the vessel wall, the wetting event occurs, and vice versa. Such a liquid is called hydrophilic if the liquid forms a botted surface by wetting the vessel wall, and such a liquid is called hydrophobic if the liquid forms a convex surface without wetting the vessel wall.

When applied, under the influence of surface tension force, the surface of the liquid becomes bottled, creating additional pressure on the surface pressure. This additional aggregate pressure is directed upwards from the surface of the liquid when applied, and inwards from the surface of the liquid when not applied, and

$$\Delta P = \frac{2\sigma}{r} \qquad (3)$$

is equal to Where r is the radius of curvature

As mentioned above, the compressive forces are directed outwards from the surface of the liquid, that is, upwards, and under the influence of this force, the liquid rises upwards along the capillary tube. Capillary events determine the condensation of vapors, the boiling of liquids, the conditions of crystallization, and so on.

Air bubbles that enter the bloodstream can block small mining vessels and block the supply of minerals to some organs. This is called a gas embolism. As a result of gas embolism, the human body can be seriously injured or even killed.

The phenomenon of gas embolism also occurs when divers release gas from their blood as bubbles rapidly emerge from deep underwater, bubbles appear, and pilots and astronauts break the tightness of their cabins and spacesuits at very high altitudes. This leads to the transition of liquefied gases in the mine to a gaseous state as a result of a sharp decrease in atmospheric pressure. Nitrogen also plays a leading role in the formation of gas bubbles in the blood due to the fact that the main part of the pressure of gases in the blood is nitrogen, because it does not participate in gas exchange with the body and the air it receives. This is called Kesson's disease.

III.5. The following additional texts on the topic "Determination of the surface tension coefficient of liquids by the method of droplet rupture" are presented in the module system. [2]

1.Laplas pressure formation.

The criteria for assessing students on this topic are given above.

IV. Independent work of students on the topic "Fluids and properties of liquids."

A total of 36 hours are allocated for students to do independent work in medical and biological physics, and 80 minutes are devoted to this topic. At present, due to the pandemic of coronavirus (COVID-19) in our country, the system of distance learning has been introduced in all universities. Students are required to practice more independently in order to master the topic well.

On the page of medical and biological physics of the SamDTI distance learning center on the Internet portal MT.sammi.uz can use the following to perform and master independently [2.4.11]:

- Methodical instructions.
- Practical course materials.
- Texts of lectures.
- Slides (presentations).
- Abstracts.
- Video clips.
- Teaching tests.
- Picture tests.

• Control tests

Instructions for students to work independently:

- Feeling you can't be a mature professional without constant work with literature.
- Demonstrate maximum interest and activity in independent work.
- Independent acquisition of knowledge, knowledge and skills about real fluids, internal friction, Newtonian and non-Newtonian fluids.
- To study the phenomena of wetting and non-wetting of surface tension forces and to know the application of surface processes in liquids to medicine. Obtains the necessary information through the website mt.sammi.uz, from the training manuals.

The module system can use the following concepts:

1. Mechanical properties of solids and biological tissues.
2. Bioreology. Viscosity of biological fluids.
3. To study the motion of objects applied in a viscous fluid.
4. "Study of surface tension coefficients of liquids and their application in medicine.
5. Use of electronic textbooks and other databases.

Each student accesses the database of medical and biological physics from the Internet platform mt.sammi.uz through a personal login and password and uses the text of the lecture, methodological guidelines, slides, materials for practical training, abstracts, tests, case studies and other information [2]

The student writes essays on the topic on the basis of the following points, exchanges information with the students of the group, reads, masters and exchanges ideas [1.2.11]:

1. Newton's formula.
2. The coefficient of internal friction of liquids and its unit.
3. The relationship between the viscosity coefficient SI and SGS systems.
4. Speed gradient.
5. Temperature dependence on viscosity.
6. Determination of viscosity of liquids using the Stokes method.
7. Determination of the coefficient of internal friction of liquids by the Ostwald method.
8. The concept of a viscometer.
9. Determination of the coefficient of internal friction using a medical viscometer.
10. The coefficient of viscosity of human blood.
11. Poiseuille formula.
12. Hydraulic resistance.
13. Processes in which liquids occur on the surface.
14. The coefficient of surface tension of liquids.
15. Determination of the surface tension coefficient of liquids by the method of drop break.
16. Units of measurement of the surface tension coefficient of liquids.
17. The importance of the surface tension coefficient of liquids in medicine.
18. Incidents of application and non-application.
19. The phenomenon of gas embolism.

IV.1. Supervise the independent work of students. [11]

Each student sends the information prepared on the independent work in electronic or picture format to the organized group by telegram network. Submitted data will be discussed between the group. Whenever possible, students will present their independent work in a video conference organized on the basis of the ZOOM program on the Internet. Active students are identified. The student will be assessed based on the above information. The assessment of students' independent work is added to the assessment of practical training and is reflected in the assessment of the current control.

CONCLUSION

Advantages of teaching online lessons in the modular system of the platform SamDTI "ZOOM" and the telegram program:

1. Students actively participate in a video conference organized by the teacher through the program "Zoom" or a webinar on the platform.
2. In the platform module system, a webinar lecture is organized before the start of the lesson and the names of the students participating in the video conference and in which group they study are recorded.
3. In the program "Zoom" students are photographed, students listen to and record the dialogue between the professor and the teacher on the lesson.
4. In the telegram program, students have the opportunity to answer questions in writing at any time.
5. Student can enter the SamDTI platform module system at any time and learn the data independently.
6. The student has an opportunity to use the text of lectures and practical lesson materials in the platform module system.
7. Students have the opportunity to get acquainted with the videos on the topic in the platform module system.
8. Students have the opportunity to strengthen their knowledge by solving tests on the topic, situational tests.
9. Professors have the opportunity to monitor the activity of students on a given topic.
10. Students can find out the questions on the topic in the telegram program and ask the teacher for answers.

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