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APPLICATION OF THE VENN DIAGRAM METHOD IN THE LABORATORY LESSON "DETERMINATION OF YOUNG'S MODULUS OF DIFFERENT METALS BY BENDING METHOD"

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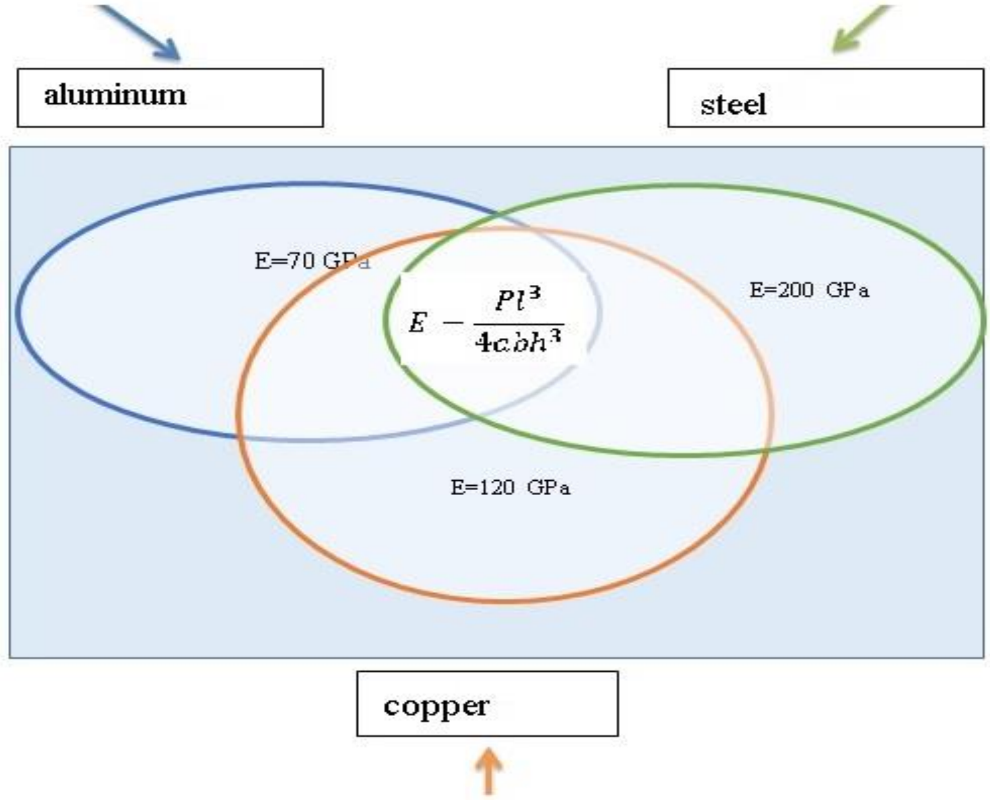
Abstract
Venn diagram is a method of organizing teaching through a graphic image, which is represented by the image of two or more intersecting circles. This method allows to consider the analysis and synthesis of various concepts, foundations, ideas, to identify their common and distinguishing aspects, and to compare them.

Keywords:Venn diagram, Young's modulus, elastic deformation, plastic deformation, relative elongation, force, bending moment, stress, elasticity coefficient

The procedure for implementing the method: the participants are put into pairs of two and they are invited to write down the specific, different aspects (or opposites) of the considered concept or basis in circles; At the next stage, the participants are divided into small groups of four, and each pair presents its analysis to the group members; After listening to the analysis of the pairs, they get together, find the common aspects (or differences) of the problem or concepts under consideration, summarize and write in the intersecting part of the circles.
If the distance between the particles of the body does not change under the influence of an external force, such a body is called an absolutely rigid body. But there is no absolute body in nature. Under the influence of force, any body more or less changes its shape, that is, it is deformed. When bodies are deformed, two limiting cases can be observed: elastic deformation or plastic deformation.

Venn diagram illustrations to explain bending modulus determination of various metals



1-picture

The force acting normal to the surface of a unit cross-section is called stress.

$$\delta = \frac{P_{og`}}{S} \qquad (1)$$

The magnitude of the relative elongation is directly proportional to the stress acting on the cross-sectional surface of the stern:

$$\frac{\Delta l}{l_0} = \delta * \alpha \qquad (2)$$

where α is the coefficient of elasticity

In order to determine the property of a given material, it is inverted except for a

$$\text{E} = \frac{1}{\alpha} \qquad (3)$$

quantity is also introduced and this quantity is called Young's modulus.

(3) If the value of a is put into expression (2) from the formula, the following formula is formed:

$$\delta = \text{E}\frac{\Delta l}{l_0} \qquad (4)$$

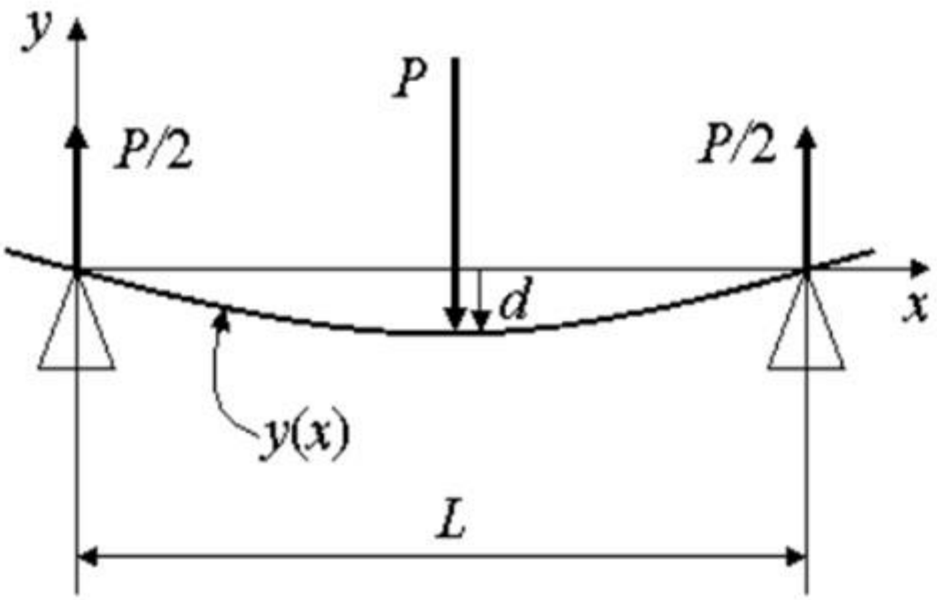
This equality is called Hooke's law for stretching deformation. In order for elastic deformation to occur, the value of the force must be within the limit of elasticity. From the formula (4), we determine the Young's modulus:

$$\mathrm{E} = \frac{Pl_0}{S\Delta l} \qquad (5)$$

The degree of deformation is determined by the amount of bending. The amount of bending in elastic deformation is determined according to the following formula.

$$\mathrm{E}\mathrm{I}y''(x) = M(x) \qquad (6)$$

$\mathrm{M}(x) = \frac{P}{2}x$ -bending moment $\boldsymbol{y}''(\boldsymbol{x}) = \frac{\boldsymbol{P}}{\mathbf{2EI}}\boldsymbol{x_0}$ (7) $\boldsymbol{y}(\boldsymbol{x}) = \frac{\boldsymbol{P}}{\mathbf{12EI}}\boldsymbol{x}^{\mathbf{3}} - \frac{\boldsymbol{PL}^{\mathbf{2}}}{\mathbf{16EI}}\boldsymbol{x_0}$ (8) here $\mathbf{I} = \frac{\boldsymbol{bh}^{\mathbf{3}}}{\mathbf{12}}$, Distance between L-prisms,E-Yung module

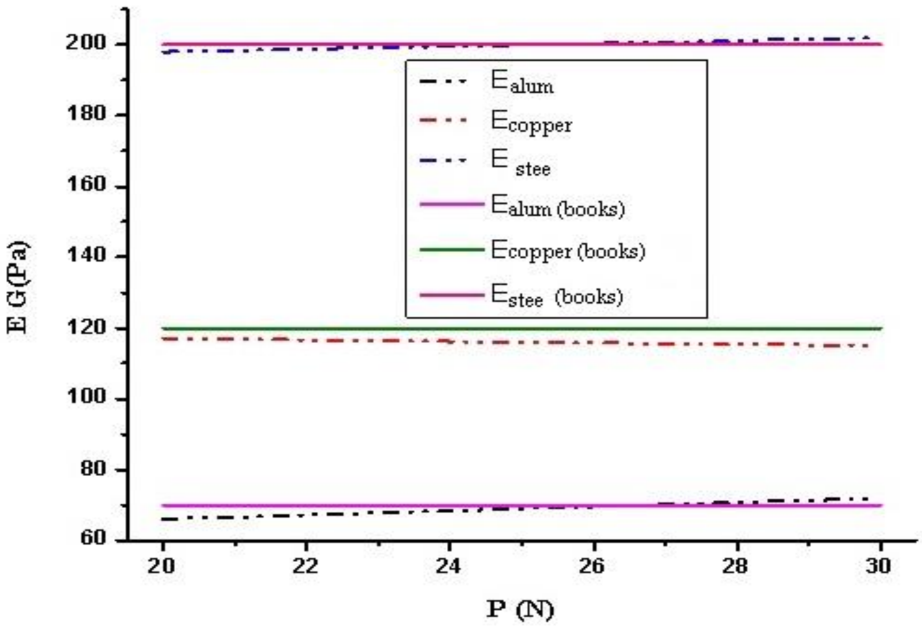


2-picture

$$d = -y\left(\frac{L}{2}\right) = \frac{PL^3}{4\mathrm{E}h^3b} \qquad (9) \qquad \mathrm{E} = \frac{PL^3}{4dbh^3} \qquad (10)$$

here P- is the weight, L- is the length of the boom, b- is the width of the boom, h- is the thickness of the boom, d- is the amount of bending.

	Aluminum	Copper	Steel
m,kg	3 kg	2 kg	3 kg
P,N	30 N	20 N	30 N
d,m	$3{,}9*10^{-2}$	$1{,}5*10^{-2}$	$1{,}3*10^{-2}$
b,m	$4*10^{-2}$	$4*10^{-2}$	$4*10^{-2}$
h,m	$2*10^{-3}$	$2*10^{-3}$	$2*10^{-3}$
L,m	$48*10^{-2}$	$48*10^{-2}$	$48*10^{-2}$
E,Pa	70 GPa	120 GPa	200 GPa
E_{taj},Pa	66 GPa	115 GPa	198 GPa



CONCLUSION

The Venn diagram method used in this laboratory work is a convenient way for students to explain the generalized cases of Yung's model measured for different materials. Students analyze the results determined in the laboratory work for each metal and gain convenience in understanding the common similarities using the above method. In conclusion, the Venn diagram method is an effective method for explaining laboratory work to students.

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