

<b>1. Module identification code.</b>	
Name of the institution:	Universidad Autónoma de Nuevo León
Name of the school:	School of Medicine
Name of the degree program:	Clinical Chemistry
Name of the course (learning unit):	Advanced mathematics
Total number of class hours-theory and practice:	100
Class hours per week:	5 hours
Independent study:	50
Course modality:	Face-to-face instruction
Module level:	First semester
Core/elective module:	Core
Curriculum area:	ACFB
UANL credit points:	3
Create date:	April 17 <sup>th</sup> , 2017
Date of last amendment made:	July 5 <sup>th</sup> , 2023
Person(s) responsible for the design and amendment of the module:	Dr. C Judith Rocha Gámez M.C. Samantha Armijo Martínez Amendment: Dra. C. Magdalena Escobar Saucedo

## 2. Presentation:

The module (learning unit) of Advanced Mathematics is part of the first semester of the Clinical Chemistry **degree** and is divided into three stages. The chosen order for the stages allows for starting the learning process with the fundamental aspects of mathematics and progressing toward more advanced mathematical algorithms and reasoning.

In stage one, arithmetic operations and commonly used algebraic algorithms are covered, which develop basic mathematical skills by systematically solving problems. Then, in stage two, transcendental functions and general concepts of analytical geometry are addressed, which are useful for interpreting graphs and scales frequently used in physics, chemistry, and biology. Finally, stage three focuses on basic differential and integral calculus, which requires the competencies acquired in the previous stages and allows for a better understanding of the mathematical expression of various laws used in the natural sciences.

Throughout the development of these three stages, students are guided to recall and apply the knowledge they have acquired through the learning activities outlined in this analytical program. Additionally, problems are presented that illustrate the relationship between the studied content and the fields of chemistry and biology. Regarding the evaluation system, the learning unit requires the completion of evidence, measurable activities, and concludes with the integrative learning product (ILP), which consists of solving mathematical application problems in the areas of physical chemistry or biology.

## 3. Purpose:

Develop the student's capacity for abstraction and logical thinking to apply commonly used mathematical tools in the fields of chemistry and biology. The mathematical skills acquired in this unit of learning (UL) will be utilized to solve problems related to biochemical analysis during their academic and professional performance.

Regarding the contribution to the development of the university's general competencies, the student will be able to use the learning strategies suggested by the professor for problem-solving and timely decision-making. When working in teams, they demonstrate commitment and respect toward their peers, maintaining a conciliatory attitude toward differing opinions. Furthermore, by participating in class, they assume leadership by being attuned to the needs of their colleagues, contributing coherent ideas for solving presented problems.

As for the contribution to the development of specific competencies, the student acquires the mathematical tools that they will later use to solve problems related to the chemical composition of matter and its physicochemical properties. This unit of learning serves as a foundation for most of the learning units in the educational program. For example, the properties of arithmetic operations, the use of logarithms, scientific notation, and calculations involving derivatives and integrals are employed in the learning units of Physics, Physicochemistry, and Fundamentals of Analytical Chemistry. Likewise, the UL of Fundamentals of Analytical Chemistry, Biochemistry, and Instrumental Analysis utilizes systems of equations and graphical representations to construct calibration curves and create acid-base equilibrium graphs and/or kinetics graphs. In these same learning units and in Microbiology, they apply the concepts of dilutions in the preparation of their reagents and/or samples.

#### 4. Competences of the graduate profile

**General competences to which this module (learning unit) contributes:**

*Instrumental skills:*

1. To apply autonomous learning strategies at different levels and fields of knowledge that allow them to make timely and relevant decisions in the personal, academic and professional spheres.

*Personal and social interaction skills:*

9. To maintain an attitude of commitment and respect towards the diversity of social and cultural practices that reaffirm the principle of integration in the local, national and international context in order to promote environments of peaceful coexistence.

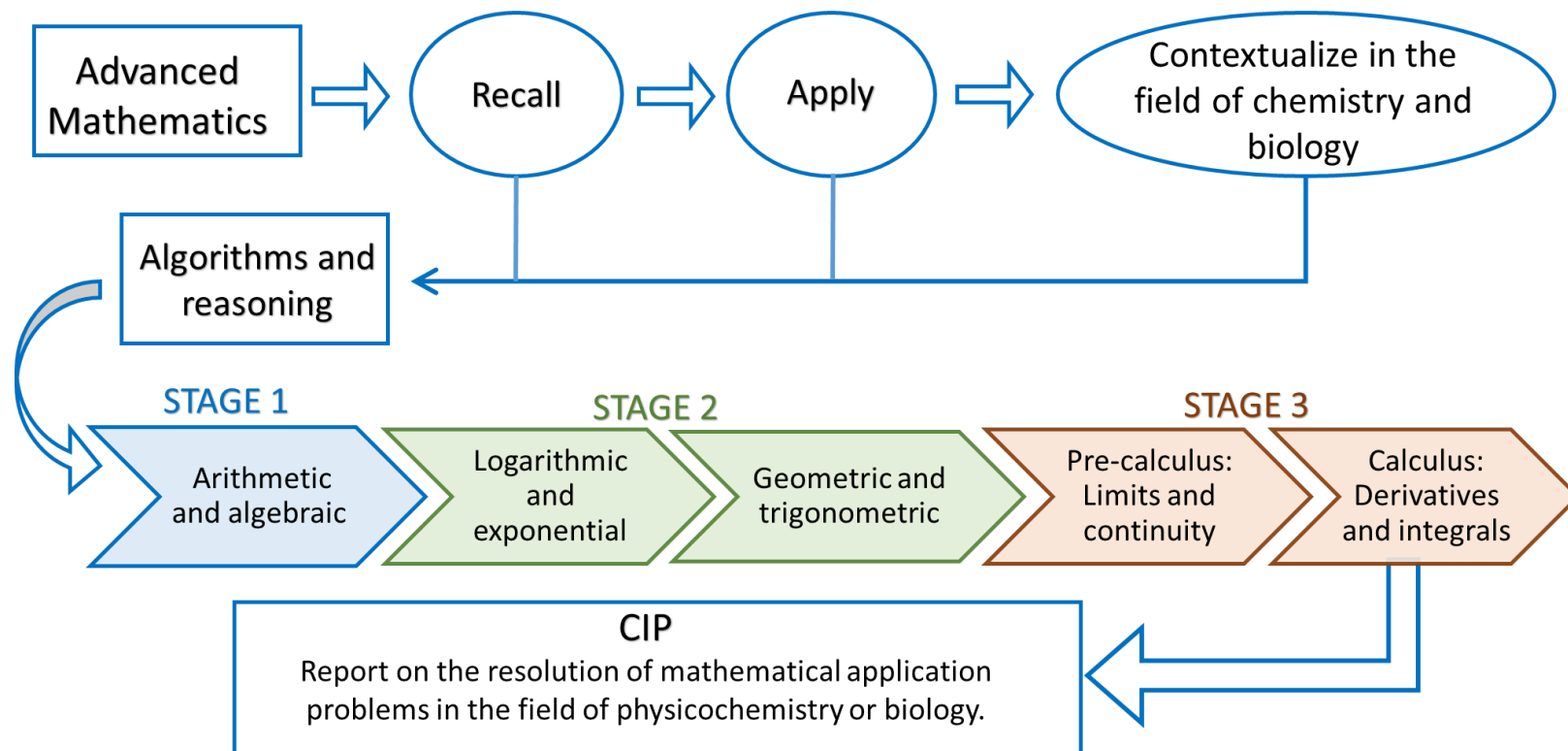
*Integrative skills:*

13. To assume leadership roles committed to social and professional needs in order to promote relevant social change.

**Specific competences of the graduate profile to which this module (learning unit) contributes:**

1. To solve problems by applying knowledge of the chemical composition of matter as well as its physicochemical properties to determine analytes in biological, environmental and food matrices.

## 5. Course roadmap:



## 6. Structuring into stages or phases:

**Stage 1: Arithmetic operations and algebraic algorithms.**

**Stage 2: Transcendental functions, trigonometry, and analytical geometry.**

**Stage 3: Precalculus and basic differential and integral calculus.**

### Stage 1: Arithmetic operations and algebraic algorithms.

**Component(s) of the competence:** To solve problems using arithmetic operations and algebraic algorithms according to an increasing level of complexity, through systematic planning to achieve an organized solution.

Evidence of student learning	Performance criteria	Learning activities	Content	Resources
Evidence 1: Portfolio with tasks and exercises solved on arithmetic and algebra.	<ul style="list-style-type: none"> <li>Uses concepts, laws, and algorithms related to solving arithmetic, algebraic, and systems of equations problems.</li> <li>Submits individually or as a team, as specified, by the assigned date and time.</li> <li>Meets the content and format requirements.</li> <li>Includes the identification information of the student or students.</li> </ul>	<p>The professor presents the course and the learning unit program.</p> <p>The professor explains the methodology for the activities required for each stage and mentions the corresponding platform where they will be scheduled.</p> <p>Additionally, he explains the evaluation system, the requirements for written assessments, and announces the dates for these assessments.</p> <p>The professor reviews the content of each session; the following instructional sequence will be used:</p> <p>The student conducts a daily pre-reading of the topics indicated in advance</p>	<p>Classification of the different sets of numbers.</p> <p>Properties and arithmetic operations with real numbers, both in fractional form and in decimal notation.</p> <p>Notation and uses of intervals in relation to inequalities.</p> <p>Laws of exponents when operating on numbers.</p> <p>Ways to represent a real number (scientific notation, units of concentration, use of prefixes, etc.).</p> <p>Significant figures and error calculation.</p>	<p>Computer and audiovisual equipment.</p> <p>Whiteboard.</p> <p>Website of the School of Medicine (educational program of CC).</p> <p>Moodle platform and MS Teams platform.</p> <p>Web tools for creating concept maps and audiovisual resources.</p> <p>Scientific calculator, with usage instructions.</p> <p>Support presentations on the topics of the stage.</p> <p>Student guide and lesson script</p>

<p>Evidence 2: Written assessment. Resolution of problems involving fundamental arithmetic operations, algebraic algorithms, and equations. Section A and Section B.</p>	<ul style="list-style-type: none"> <li>Identifies the type of problem to be solved.</li> <li>Decides on the appropriate operation or algorithm to use.</li> <li>Conducts a systematic planning of the solution.</li> <li>Develops the selected operation or algorithm for the orderly resolution of the problem.</li> <li>Presents in the assigned classroom on the specified date and time.</li> <li>Includes identification information.</li> <li>Solves the problems individually.</li> <li>Writes legibly the procedures followed to obtain the result.</li> <li>Clearly indicates the result.</li> </ul>	<p>by the professor.</p> <p>The professor presents the theoretical concepts of the algorithms in the classroom and solves sample exercises.</p> <p>The student engages in collaborative learning and team teaching with groups of six to solve problems in the classroom.</p> <p>The student participates by answering questions guided by the professor.</p> <p>The student solves exercises on arithmetic and algebra in the classroom with the professor's guidance, where the student must identify and copy the relevant information and methodology into their notebook.</p> <p>The student solves exercises in the classroom, either individually or in teams.</p>	<p>Laws of exponents using variables.</p> <p>Fundamental operations in algebra (addition, subtraction, multiplication, and division).</p> <p>Grouping symbols.</p> <p>Notable products and factoring.</p> <p>Linear and quadratic equations and inequalities in one variable.</p> <p>Absolute inequalities in one variable.</p> <p>Linear equations and inequalities in two variables and quadratic functions.</p> <p>Solution of systems of two and three linear equations.</p>	<p>Educational videos available online related to the content:</p> <ul style="list-style-type: none"> <li>Julio profe Internet Academy</li> <li>Khan Academy Español</li> <li>Math2me</li> <li>Vitual</li> </ul> <p>Formats with exercises to be submitted as Problem Sets for each exam.</p> <p>Books:</p> <ul style="list-style-type: none"> <li>(Swokowski, 2011)</li> <li>(Rees, 2011) Chapters: 1 to 4, 6 to 8, and 13.</li> <li>(Brown, 2014) Chapter: 13.4.</li> <li>(Giancoli, 2009) Chapters: 1-4, 1-5, 1-7, A-3.</li> <li>(Christian, 2009) Chapters: 3.1 to 3.6, 3.16 to 3.19, 6.11, 10.3, and 16.7.</li> </ul>
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## 6.2 Stage 2. Transcendental Functions, Analytic Geometry, and Trigonometry.

### Component(s) of the competence:

Solve problems involving transcendental functions, analytic geometry, and trigonometry from algebraic, graphical, numerical, or verbal perspectives to develop systematic reasoning and identify their applications in the fields of chemistry and/or biology.

Evidence of student learning	Performance criteria	Learning activities	Content	Resources
Evidence 3. Portfolio with tasks and solved exercises on transcendental operations, analytic geometry, and trigonometry.	<ul style="list-style-type: none"> <li>Uses concepts and formulas to solve general exercises and/or those in the field of chemistry that involve transcendental functions, analytic geometry, and trigonometry.</li> <li>Submission individually or as a team, as specified, by the assigned date and time.</li> <li>Meets content and format requirements.</li> <li>Includes identification details of the student or students.</li> </ul>	<p>The teacher reviews the content of each session; the following instructional sequence will be used:</p> <p>The student conducts a daily reading of the topics indicated in advance by the teacher.</p> <p>The teacher presents the theoretical concepts of the algorithms in the classroom and solves typical exercises.</p> <p>The student engages in collaborative learning and team teaching in groups of 6 to solve problems in the virtual classroom.</p> <p>The student participates by answering guided questions from the teacher.</p>	<p><b>Analytic Geometry:</b></p> <ul style="list-style-type: none"> <li>Concepts (graphing points, distance between points, relation, function, domain, range, etc.).</li> <li>Identification and graphing of quadratic equations in two variables (horizontal and vertical parabolas, circles, ellipses, and hyperbolas).</li> <li>Graphing of factored polynomial functions.</li> <li>Exponential and logarithmic functions.</li> <li>Definitions</li> <li>Graphs</li> <li>Transformations</li> <li>Properties</li> <li>Calculations</li> <li>Solution of equations</li> <li>Use of logarithmic scales.</li> </ul>	<p>Computing and audiovisual equipment. Whiteboard</p> <p>Website of the School of Medicine</p> <p>Moodle platform and MS Teams platform.</p> <p>Web tools for creating concept maps and audiovisual resources. Scientific calculator, with user manual.</p> <p>Supporting presentations on the topics of the stage.</p> <p>Student guide and class script.</p> <p>Educational videos available online, related to the content:</p> <p>Internet Academy Julioprofe Khan Academy Español Math2me Virtual</p>

<p>Evidence 4. Second written assessment. Problem-solving with transcendental operations, analytic geometry, and trigonometry.</p>	<ul style="list-style-type: none"> <li>Identifies the type of problem to be solved.</li> <li>Decides on the appropriate operation or algorithm to use.</li> <li>Conducts a systematic planning of the solution.</li> <li>Develops the selected operation or algorithm for the orderly resolution of the problem.</li> <li>Presents in the assigned classroom on the specified date and time.</li> <li>Includes identification information.</li> <li>Solves the problems individually.</li> <li>Writes legibly the procedures followed to obtain the result.</li> <li>Clearly indicates the result.</li> </ul>	<p>The student solves exercises on arithmetic and algebra in the classroom with the teacher's guidance. The student must identify and copy the relevant information and methodology in their notebook.</p> <p>The student solves exercises in the classroom, either individually or in teams.</p> <p>The student uses the virtual library and electronic resources for independent learning.</p>	<ul style="list-style-type: none"> <li>Trigonometry: <ul style="list-style-type: none"> <li>Definitions</li> <li>Classifications of angles</li> <li>Angle measurement systems</li> <li>Transformations</li> <li>Trigonometric functions and inverse trigonometric functions</li> <li>Signs in the quadrants of the plane</li> <li>{Obtaining values, with and without a calculator.</li> </ul> </li> </ul>	<p>Books:</p> <p>(Swokowski, 2011)</p> <p>(Rees, 2011) Chapters: 5, 8, 9, and 14.</p> <p>(Zill, 2011) Chapter 1.</p> <p>(Goodman, 1996) Chapters: 6.1, 6.2, 7.1, 7.5, 8.1, and 8.2.</p>
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### Stage 3. Precalculus, basic differential and integral calculus.

#### Component(s) of the competence:

Solve basic calculus problems according to their purpose (differentiating or integrating equations) and order (first or higher) to understand the description of the laws governing the field of physical chemistry and/or biology.

Evidence of student learning	Performance criteria	Learning activities	Content	Resources
Evidence 5. Portfolio with tasks and solved exercises on precalculus, differential calculus, and integral calculus.	<ul style="list-style-type: none"> <li>Uses concepts and formulas to solve general exercises and/or those in the field of chemistry where knowledge of precalculus, differential calculus, and integral calculus is applied.</li> <li>Submission individually or by team, as specified, on the assigned date and time.</li> <li>Meets content and format requirements.</li> <li>Includes the identification details of the student or students.</li> </ul>	<p>The teacher reviews the content of each session; the following teaching sequence will be used:</p> <ul style="list-style-type: none"> <li>The student performs a daily reading of the topics indicated in advance by the teacher.</li> <li>The teacher presents the theoretical concepts of algorithms in the classroom and solves example exercises.</li> <li>The student uses collaborative learning and team teaching of 6 to solve problems in the virtual classroom.</li> <li>The student participates by answering questions guided by the teacher.</li> <li>The student solves exercises in the classroom, with guidance from the teacher, on pre-calculus, differential</li> </ul>	<ul style="list-style-type: none"> <li>Limits: <ul style="list-style-type: none"> <li>Definition</li> <li>Theorems</li> <li>Determinate and indeterminate forms</li> </ul> </li> <li>Continuity: <ul style="list-style-type: none"> <li>Definition (at a point and in an interval)</li> <li>Theorems.</li> <li>Problem-solving to determine the continuity of given functions in graphical form, by equations, or in piecewise form.</li> <li>Calculation of limits of algebraic and transcendental functions as the independent variable approaches finite and infinite values.</li> </ul> </li> <li>Derivatives: <ul style="list-style-type: none"> <li>Finding vertical and horizontal asymptotes of algebraic and</li> </ul> </li> </ul>	<p>Computer and audiovisual equipment.</p> <p>Whiteboard</p> <p>Website of the School of Medicine</p> <p>Moodle platform and MS Teams platform.</p> <p>Web tools for creating concept maps and audiovisual resources.</p> <p>Scientific calculator, with user instructions.</p> <p>Supporting presentations on the topics of the stage. Student guide and class script.</p> <p>Educational videos available online, related to the content: Internet Academy, Julioprofe, Khan Academy Español, Math2me, Virtual.</p>

<p>Evidence 6: Third written assessment on problem-solving applying pre-calculus, differential calculus, and integral calculus.</p>	<ul style="list-style-type: none"> <li>Identifies the type of problem to be solved.</li> <li>Decides on the appropriate operation or algorithm to use.</li> <li>Conducts a systematic planning of the solution.</li> <li>Develops the selected operation or algorithm for the orderly resolution of the problem.</li> <li>Presents in the assigned classroom on the specified date and time.</li> <li>Includes identification information.</li> <li>Solves the problems individually.</li> <li>Writes legibly the procedures followed to obtain the result.</li> <li>Clearly indicates the result.</li> </ul>	<p>calculus, and integral calculus. The student must identify and copy the relevant information and methodology in their notebook.</p> <ul style="list-style-type: none"> <li>The student solves exercises in the classroom, either individually or in teams.</li> <li>The student uses the virtual library and electronic resources for autonomous learning.</li> </ul>	<p>transcendental functions.</p> <ul style="list-style-type: none"> <li>Definition (intuitive and formal).</li> <li>Formula and calculation of the derivative of a power.</li> <li>Theorems (sums, differences, multiplication by a constant).</li> <li>Derivatives of products and quotients.</li> <li>Formulas and calculation of derivatives of algebraic, trigonometric, exponential, and logarithmic functions.</li> <li>Chain rule for the derivative of composite functions.</li> <li>Higher-order derivatives.</li> <li>Implicit differentiation.</li> <li>Applications of rates of change.</li> <li>First and second derivative theorems for calculating relative maxima and minima and</li> <li>Concavity.</li> <li><b>Integrals:</b></li> <li>Definition (as an antiderivative).</li> </ul>	<p>Book:</p> <ul style="list-style-type: none"> <li>(Zill, 2011) Chapters: 2 to 5, 6.2, 7.3, and 8.1.</li> </ul>
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			<ul style="list-style-type: none"> <li>• Derivation and application of the antiderivative formula for power functions.</li> <li>• Theorems.</li> <li>• Derivation and application of formulas for integrating algebraic, trigonometric, and exponential functions.</li> <li>• Integration by parts (simple and repeated).</li> <li>• Solving integrals of algebraic functions using a change of variable.</li> <li>• Fundamental theorem of calculus for definite integrals.</li> <li>• Applications of integrals.</li> </ul> <p><b>Differential Equations:</b></p> <ul style="list-style-type: none"> <li>• Definition.</li> <li>• Order and degree of the differential equation.</li> <li>• Verification of solutions to differential equations using the method of separation of variables.</li> </ul> <p>General and particular solutions when initial or boundary conditions are given.</p>	
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## 7. Summative evaluation:

Phase	Evidence	Weighing
<b>Phase 1</b>	Evidence 1: Portfolio with tasks and exercises solved on arithmetic and algebra.	10%
	Evidence 2: Written assessment. Resolution of problems involving fundamental arithmetic operations, algebraic algorithms, and equations. Section A and Section B.	25%
<b>Phase 2</b>	Evidence 3. Portfolio with tasks and solved exercises on transcendental operations, analytic geometry, and trigonometry.	10%
	Evidence 4. Second written assessment. Problem-solving with transcendental operations, analytic geometry, and trigonometry.	12.5%
<b>Phase 3</b>	Evidence 5. Portfolio with tasks and solved exercises on precalculus, differential calculus, and integral calculus.	10 %
	Evidence 6: Third written assessment on problem-solving applying pre-calculus, differential calculus, and integral calculus.	12.5%
<b>CIP</b>	<b>Course integrative project/product</b>	<b>20%</b>
	<b>Total</b>	<b>100</b>

## 8. Course integrative project/product:

Report on Problem Solving in Mathematical Applications in the Area of Physical Chemistry or Biology.

## 9. References:

### Text books

- (Swokowski, 2011) Swokowski, (2011). *Álgebra y trigonometría con geometría analítica*, Décimo tercera edición CENGAGE learning
- (Brown, 2014) Brown, T. L., LeMay, H. E., Bursten, B. E., & Burdge, J. R. (2014). *Química. La ciencia central*. México: Pearson.
- (Christian, 2009). Christian, G. D. (2009). *Química Analítica*. México: Mc Graw Hill.
- (Giancoli, 2009) Giancoli, D. C. (2009). *Física*. México: Pearson.
- (Goodman, 1996). Goodman, A., & Hirsch, L. (1996). *Algebra y Trigonometría con Geometría Analítica*. México: Prentice Hall Inc.
- (Rees, 2011) Rees, P. K., & Sparks, F. W. (2011). *Algebra*. México: Reverté
- (Zill D. G., 2011) Zill, D. G., & Wright, W. S. (2011). *Cálculo. Trascendentes tempranas*. México: Mc Graw Hill.

### Digital tools:

- Academia Internet. (1 de agosto de 2020) Academia Internet. Tutoriales académicos. Obtenido de Academia internet canal de YouTube: <https://www.youtube.com/user/AcademiaInternet/featured>
- Facultad de Medicina. (1 de agosto de 2020). Página Facultad de Medicina de la UANL. Obtenido de Facultad de Medicina QCB: <http://www.medicina.uanl.mx/pregrado/qcb/>
- Facultad de Medicina de la UANL. (1 de agosto de 2020). Plataforma Facultad de Medicina. Obtenido de Página Plataforma Facultad de Medicina: <http://www.medicina.uanl.mx/plataforma/>
- Khan Academ yEspanol. (1 de agosto de 2020). Khan Academy Espanol. <https://www.youtube.com/user/KhanAcademyEspanol/featured>
- Math2me. (1 de agosto de 2020). Math2me matemáticas para todos. Obtenido de Math2me canal youtube: <https://www.youtube.com/user/asesoriasdematecom/featured>
- Ríos Gallego, J. A. (1 de agosto de 2020). Julio Profe Net. Obtenido de Julio Profe Net canal de youtube: <https://www.youtube.com/user/julioprofe/featured>
- Vitual. (1 de agosto de 2020). VitualTutoriales. Obtenido de Vitual canal de youtube: <https://www.youtube.com/user/AlphaMatFis/featured>.
- Nearpod: Student Engagement Platform. (1 de agosto de 2020). <https://nearpod.com/> • Edpuzzle. (1 de agosto de 2020). <https://edpuzzle.com/>
- Microsoft Teams. Office 365.