



MATHEMATICS PROGRAM

Rubrics for Assessing Student Outcomes

2018

(1) Problem Solving

Definition	Identify, formulate and solve scientific and technical problems properly applying the knowledge of mathematics and science, and technical topics relevant to basic and applied mathematics.
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Capacities	Very Good	Good	Regular	Bad
Identify and diagnose problems and prioritize them according to their impact and relevance.	Identify all problems in a given situation, characterize each of them, assess their impact, and prioritize their solving according to their relevance on the outcomes of the overall system.	Identify, characterize and prioritize problems, assessing their impact and relevance to solve them.	Not all relevant problems are identified and well characterized and assessed. The solutions are incomplete and present some conceptual and calculation errors.	Relevant problems are not identified and are vaguely characterized and assessed. Calculations are incorrect yielding incoherent solutions.
Propose and compare practical and realizable solutions.	Propose proper and realizable solutions with optimal criteria, satisfying restrictions, and applying appropriate norms and standards.	Propose realizable solutions satisfying restrictions and constraints.	Proposed solutions present some inconsistencies, and not all requirements and constraints are satisfied.	Proposed solutions are inconsistent. Requirements and constraints are not taken into account or are vaguely considered.

Capacities	Very Good	Good	Regular	Bad
Evaluates and select the proper solution with sustainability and economic rationality criteria.	Define all relevant criteria for selecting the proper solution considering all technical aspects, as well as sustainability issues, and economic rationality.	Define criteria for selecting the proper solution considering relevant technical aspects, as well as sustainability and economic issues.	Criteria for selecting the proper solution are not well-defined, do not consider relevant technical aspects, and sustainability and economic issues are vaguely considered.	Formulates non-consistent criteria conducting to selection of non-proper solutions.
Correctly apply the concepts and methods of mathematics and sciences for the formulation, description and solution of problems.	Correctly apply methods and techniques of mathematics to describe and analyze with detail and deepness a problem to formulate coherent solutions	Apply proper methods and techniques to describe, analyze and solve scientific problems.	Methods and techniques are not properly applied presenting inconsistencies and application errors.	Methods and techniques are incorrectly applied. The problem is vaguely described and the solution is incoherent and incomplete.
Operate and use equipment, instruments and software required for mathematics practice.	Correctly set and operate instruments, and use or develop software applications pointing to the solution of mathematics problems.	Operate instruments and use software applications to solve mathematics problems.	Present errors when setting and operating instruments. Software applications are efficiently used.	Do not correctly set and operate instruments. Do not properly use software applications.
Take into account safety measures in the practice of Mathematics.	Identify and assess all potential risky situations and apply safety measures to prevent or opportunely solve them, applying scientific criteria.	Identify main potential risky situations and apply safety measures for solving problems.	Not all potential risky situations are identified. Safety issues are partially considered.	Risky situations are not identified and safety measures are not taken into account or are vaguely considered.

(2) Design

Definition	Formulate and design a system, process, procedure, program or component satisfying requirements and needs, as well as given technical, economic, social and legal constraints.
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Capacities	Very Good	Good	Regular	Bad
Interpret requirements and needs and translate them into the formulation of a mathematics design project.	All requirements and needs are identified and clearly described to properly formulate the scope and goals of the mathematics project.	Main requirements and needs are identified and described to formulate the mathematics project.	Not all requirements and needs are identified or well interpreted, and the mathematics problem is vaguely defined.	Requirement and needs are incomplete, inconsistently interpreted, and the scope and goals of the project are unclear.
Formulate and analyze the specifications of a design project considering technical variables, as well as realistic economic, social, and environmental restrictions.	Clearly define all specifications of the final product/service in terms of appropriate variables and design parameters. Economic, social, legal and environmental constraints are identified and clearly described.	Main specifications of the final product/service are defined in terms of main variables and design parameters. Main economic, social, legal and environmental constraints are identified and described.	The final product/service is not completely specified and not all variables and design parameters are identified. Not all economic, social, legal and environmental constraints are identified and well described.	The final product/service is not clearly specified. Design parameters are vaguely defined and incomplete. Few and irrelevant economic, social, legal and environmental constraints are identified.
Propose and evaluate solution alternatives to select the most adequate satisfying requirements and constraints.	Propose at least two realizable solutions satisfying design specifications and given restrictions, and define clear criteria for selecting the most appropriate solution.	Propose one realizable solution satisfying design specifications and constraints.	Propose one solution partially satisfying design requirements and constraints.	Propose incoherent solutions which do not satisfy design requirements and constraints.

Capacities	Very Good	Good	Regular	Bad
<p>Make use of applicable methods, techniques, norms and standards.</p>	<p>Complete all required calculations for determining the construction parameters of each component of the product/service, and integrate them, making use of applicable norms and standards.</p>	<p>Calculate and determine with minor errors the construction parameters of the components of the product/service, and integrate them, using relevant norms and standards.</p>	<p>Calculate with errors the construction parameters of the components of the product/service and integrate them without a clear and ordered structure. Some applicable norms and standards are identified.</p>	<p>Formulas used for calculating the construction parameters are not correct and the components are inconsistently integrated. Applicable norms and standards are not identified.</p>
<p>Present and describe the solution through specifications, maps, graphs, drawings, diagrams and virtual simulations.</p>	<p>Completely describe the technical characteristics and functioning of the final product/service, and represent it through planes, diagrams and drawings using proper symbology and norms.</p>	<p>Describe the main characteristics of the final product/service, and represent them in graphical formats using proper symbology and norms.</p>	<p>Incompletely describe the characteristics of the final product/service. Graphical representations are not clear and without a proper use of symbology and norms.</p>	<p>The final product/service is vaguely and inconsistently described, and the drawings are incomplete and unclear without respecting symbology and norms.</p>

(3) Experimentation and Testing

Definition	Conceive and conduct experiments, validate hypothesis, analyze data and interpret results, and apply scientific judgment to draw conclusions.
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Capacities	Very Good	Good	Regular	Bad
Determine objectives and restrictions of the experiment or test to be performed.	Clearly formulate the objectives and expected outcomes of the experiment/test, and identify the physical restrictions and limitations that can affect the results.	Formulate the main objectives and outcomes of the experiment/test, and identify main restrictions and limitations.	Not all objectives are identified, and expected outcomes are incompletely described. Not all restrictions are identified and described.	Main objectives of the experiment are not precisely described. Expected outcomes are unclear and restrictions are not identified.
Determine the required equipment and software applications according to the experiment or test to be done.	Identify and select the equipment, instruments and software applications required for data acquisition, processing and displaying, and for the successful completion of the experiment/test.	Determine required equipment and software for completing the experiment/test.	Not all required equipment and software are determined. Equipment operating range is not optimal for experiment/test conditions.	Do not determine required equipment and software for measuring or processing the relevant variables of the experiment/test.
Discriminate the relevant variables of an experiment/test, measure and quantify them, determining errors and tolerances.	Identify all variables of an experiment/test with correct metrics and ranges, and measure them indicating error sources and tolerances. Validate measured variables.	Identify and measure the relevant variables of an experiment/test, indicating instrument errors and tolerances.	Not all relevant variables are identified, measurement errors are frequent, and not all variable units are dimensionally correct.	Relevant variables are not identified, measurement errors are high, and variable units are incorrect.

Capacities	Very Good	Good	Regular	Bad
Analyze and process data and results using proper concepts, statistical methods and criteria.	Process and analyze data using proper experimental and statistical methods applying scientific criteria for obtained expected results.	Analyze and process data using proper methods for obtaining expected results.	Not all relevant data is analyzed, processing and analysis methods do not always conduce to expected results.	Data analysis and processing are incorrect conducting to incoherent and incorrect results.
Draw coherent and logical conclusions with scientific criteria.	Draw consistent and well-rounded conclusions from applied procedures, methodologies and obtained results. All expected conclusions are clearly formulated and supported by convinced arguments.	Draw consistent conclusions from main procedures, methodologies and obtained results. Most of expected conclusions are formulated and argued.	Not all relevant conclusions are formulated and arguments are partially convincing or are vaguely stated.	Draw inconsistent and non-coherent conclusions.
Use the scientific method for developing experiments, design and research projects.	Understand, apply and appraise the scientific method including problem identification, formulation of hypotheses, experiment/tests, analysis of results for verifying the hypotheses or solution to the problem, formulate conclusions and communicate findings and results. Validate the pertinence of obtained results.	Apply the main steps of the scientific method assuring the validity of obtained results.	The scientific method is partially applied and with inconsistencies in the application.	Do not understand the steps of the scientific method and do not apply it for developing experiment or research projects.

(4) Effective Communication

Definition	Communicate clearly and effectively in oral, written and graphical formats, interacting with different types of audiences.
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Capacities	Very Good	Good	Regular	Bad
Express their ideas clearly and concisely using the adequate technological support.	Elaborate and clearly express coherent and well supported ideas, making correct use of the proper technological support to get the desired impact in the audience.	Express their ideas clearly and concisely using the adequate technological support.	Ideas are not expressed in an ordered fashion to make them clear. Speech is not concise with redundancy and including unnecessary topics. Partial use of technological support.	Do not elaborate clear and concise ideas supported with convincing arguments. Do not correctly use technological support.
Elaborate clear and precise technical documentation using norms, symbology and terminology proper of the application field.	Elaborate clear and precise technical documentation using norms, symbology and terminology proper of mathematics, and carefully respecting grammar rules.	Elaborate clear technical documentation using norms, symbology and terminology proper of mathematics.	Documents are not completely clear. Not all norms, symbology and terminology of mathematics are properly used.	Do not elaborate well redacted and clear documents. Incorrect use of norms, symbology and terminology proper of mathematics.
Adjust their speech according to the type of audience for getting a proper understanding and interpretation.	Speaks clearly and loudly with proper nuance and vocabulary according to the type of audience for getting a proper understanding and interpretation.	Speaks clearly using a vocabulary appropriate for the audience.	Speech is not completely clear, including some redundant and unnecessary content.	Speech is unclear and confuse. Incorrect use of vocabulary and grammar rules. Do not differentiate speech according to the type of audience.
Read technical documentation in English.	Read, understand and correctly interpret technical documents in English, explaining the main points of the document.	Read, understand and interpret technical documents in English.	Not all documents are clearly understood and interpreted.	Cannot understand documents written in English.

(5.a) Ethics and Professional Responsibility

Definition	Evaluate their decisions and actions from a moral perspective and assume responsibility for the executed projects.
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Capacities	Very Good	Good	Regular	Bad
Anticipate the implications of their decisions as well as the results of their actions and projects.	Anticipate the implications of their decisions, as well as the outcomes of their actions and projects. Identify all parties affected by their decisions and avoid conflicts of interest. Fulfills applicable norms and regulations.	Anticipate the implications of their decisions and fulfill norms and regulations, avoiding conflicts of interest with affected parties.	Do not clearly anticipate the implications of their decisions and actions. Partially identify all affected parties.	Do not care about anticipating the implications of their decision and actions on people and third parties.
Appraise the punctual and responsible fulfillment of their personal and professional duties.	Punctually fulfill schedules and agreements in all their personal and professional duties and responsibilities. Complete assigned tasks in advance.	Punctually fulfill schedules and agreements in all their personal and professional duties.	Not always punctually fulfill schedules assigned tasks and agreements.	Do not care about punctually fulfilling assigned task and agreements.
Take into consideration community interests and the social benefit.	Recognize the importance of community wellbeing and take into consideration the social benefit in all his/her actions and endeavors. Community interests and society benefits are clearly identified.	Take into consideration community interests and social benefits in all his/her actions and endeavors.	Do not always take into account common interests and society benefits in all his/her actions.	Do not care about community interests and social benefits.

Capacities	Very Good	Good	Regular	Bad
Respect intellectual property and recognizes the authorship of other people works and projects.	Respect intellectual property rights using licensed products, and recognize the authorship of other people works and projects making proper reference of their contributions.	Respect intellectual property rights using licensed products, and making reference to the contributions of other people or authors.	Do not always respect intellectual property rights, and do not always make reference to contributions of other people or authors.	Do not care on respecting intellectual property rights or contributions of other people and authors.
Know and act according to the professional code of ethics.	Know, understand and appraise the code of ethics of a scientific association or other relevant professional group, acting bounded by its norms, and agreeing to be held accountable for their actions and opinions.	Know, appraise and act according to the code of ethics of a scientific professional association or other professional group.	Partially knows the code of ethics of a scientific association or professional group. Their actions are not completely bounded by the recommendations of the code.	Do not care about fulfilling the norms and recommendations of the code of ethics of a scientific or professional association.

(5.b) Science Impact

Definition	Understand the impact of technical and/or scientific solutions on people, society and environment in local and global contexts.
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Capacities	Very Good	Good	Regular	Bad
Recognize the role of mathematics on the progress of society and the wellbeing of people.	Recognize, appraise and argue on the role of mathematics on people life and wellbeing, government performance, and society progress and development. Provide clear examples of application in local and global contexts.	Recognize the role of mathematics on the progress of society and wellbeing of people, arguing and presenting actual examples in local and global contexts.	Recognize some roles of mathematics but supporting arguments and examples are not completely clear.	Do not present convincing arguments on the role of mathematics on the progress of society.
Identify and appraise the economic and social benefits of mathematics works and methods.	Identify, appraise and argue the applications of mathematics on business and government for improving their performance, generating wealth and improving the overall progress of the country. Provide clear examples of application in local and global contexts.	Identify and argue on the applications of mathematics generating economic benefits in government, business and the country.	Identify some economic benefits of mathematics but supporting arguments and examples are not completely clear.	Do not present convincing arguments on the economic benefits of mathematics works.

Capacities	Very Good	Good	Regular	Bad
Recognize the importance of mathematics for the creation and innovation of products and processes.	Recognize, appraise and argue on the importance of applying mathematics for the creation, innovation and improvement of products and services. Provide clear examples of application.	Recognize and argue on the importance of mathematics for the creation and innovation of products and services.	Recognize the importance of mathematics in innovation but supporting arguments and examples are not completely clear.	Do not present convincing arguments and examples on the importance of mathematics for the creation and innovation of products.
Understand the role of mathematics in risk prevention and disaster mitigation.	Understand, appraise and argue on the role of mathematics for identifying risks and hazards, preventing the occurrence of disasters and opportunely mitigating their effects.	Understand and argue on the role of mathematics in risk prevention and disaster mitigation.	Show a partial understanding on the role of mathematics in risk prevention and disaster mitigation, Supporting arguments are not clear.	Unclear and vaguely explanation on how mathematics can be applied in risk prevention and disaster mitigation.

(5.a) Teamworking

Definition	Appraise the importance of teamworking, and participate actively and effectively in multidisciplinary teams.
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Capacities	Very Good	Good	Regular	Bad
Can perform as leader or active member of a working team effectively participating to achieve the proposed goals and results.	Promote the creation of work teams, actively leading and effectively contributing to achieve goals and expected outcomes.	Actively participate in work teams, effectively contributing to achieve goals.	Occasionally participate in work teams. Complete assigned task but do not show interest in supporting the work of other team members.	Do not show interest in participating in work teams. Preference to work alone. scientific
Propose and accepts ideas conducting to the achievement of objectives and results.	Propose coherent ideas, as well as listen, analyze and accept propositions conducting to the attainment of objectives and goals. Promote the formation of discussion groups.	Propose coherent ideas, as well as listen, analyze and accept propositions conducting to the attainment of objectives and goals	Not always propose ideas in group discussions. Occasionally, unjustifiably reject ideas proposed by other members of the team.	Do not show interest in proposing ideas. Frequently, unjustifiably reject ideas proposed by other members of the team.
Appraise the differences of opinion, is tolerant and respect agreements	Understand and are tolerant to opinion differences, analyzing their relevance and contribution to team integration and achievements. Promote the formulation of agreements, consensus and conclusions from team discussions.	Appraise and are tolerant to opinion difference, promoting and respecting agreements and consensus.	Not always show tolerance to different opinions and points of view. Sometimes do not reach consensus and agreements.	Do not show tolerance to opinion differences. Difficult to reach consensus and agreements.

(6.b) Project Fulfillment

Definition	Within the context of teamwork, plan and complete technical and/or scientific projects, fulfilling objectives, restrictions and deadlines, considering risks and uncertain conditions.
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Capacities	Very Good	Good	Regular	Bad
Formulate the objectives and restrictions of a project, and plan and propose strategies for implementation.	Clearly formulate the scope, all objectives and expected outcomes of scientific projects. Identify restrictions and limitations and their impact on the project outcomes.	Formulate the main objectives and expected outcomes of an scientific project. Identify restrictions and limitations.	Not all objectives and expected outcomes are formulated. Not all restrictions and limitations are identified.	Objectives are incomplete, unclear and inconsistent. Expected outcomes, restrictions and limitations are not identified or are inconsistent.
	Propose coherent and realizable strategies for the implementation of scientific projects with criteria of efficiency and optimality.	Propose coherent strategies for the implementation of scientific projects with some optimality criteria.	Implementation strategies are vaguely described with limited efficiency considerations.	Proposed strategies are incoherent and do not take into account efficiency and optimality criteria.
Identify the required resources to complete a project and ensure their availability.	Identify all required materials, equipment and resources. Justifiably determine and compare unitary costs, and elaborate in detail the total budget of the scientific project using specialized software.	Identify required materials, equipment and resources, and estimate their unitary cost to estimate the budget of the project.	Not all required resources and equipment are identified. The budget is based on approximate unitary cost.	Resources are not identified or badly specified. Unitary costs are imprecise conducting to erroneous budgets.

Capacities	Very Good	Good	Regular	Bad
Determine the scope of a project, its activities and priorities, and propose execution plans to meet deadlines.	Determine all required activities to complete the project, justifiably estimate execution times and priority sequences to formulate detailed and complete schedules and Gantt diagrams.	Determine the activities to complete the project, prioritize them, and estimate execution times to formulate complete schedules.	Not all required activities are determined and prioritized. Execution times are calculated with minor errors. Schedules are not complete.	Main activities are not determined. Activities prioritization and sequencing are not correct. Execution times are calculated with errors and schedules are incorrect.
Identify the risks and uncertainties affecting a project, and propose actions to avoid or mitigate their effects on the project development.	Identify all potential risks and uncertainties that can affect a scientific project and propose consistent and realizable solutions to mitigate their impact, ensuring the attainment of project goals.	Identify main potential risks and uncertainties that can affect a scientific project and propose realizable solutions to mitigate their impact.	Do not identify the relevant risks that can affect a scientific project, and proposed solutions do not clearly point to mitigate risks impact.	Risks are incorrectly identified and propose inconsistent and non-realizable solutions

(7) Environmental Awareness

Definition	Take into account the importance of preserving and improving the environment in the development of their personal and professional activities.
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Capacities	Very Good	Good	Regular	Bad
Promote the use of materials, technologies and processes that are environmentally adequate.	Identify and use clean and environment-friendly materials, processes and technologies, and promote their use in the development of their activities and projects.	Identify and use environment-friendly materials, processes and technologies.	Not all used materials, technologies and processes are environmentally adequate.	Do not care about the use of environment-friendly materials, processes and technologies.
Make a rational use of natural resources understanding their importance in the life of people and society.	Rationally use materials and resources avoiding their waste and unnecessary use, and arguing on their importance for a clean and sustainable environment.	Make a rational use of materials and technologies avoiding their waste and unnecessary use.	Not all materials and resources are used with a rationality and sustainable criterion.	Do not care about the rational use of materials and resources.
Participates in activities and campaigns for the conservation and improvement of environment and ecosystems.	Promote and actively participate in activities for waste classification and recycling, and environment/ecosystem conservation and improvement.	Participate, when is required, in activities for conserving and improving the environment and the ecosystem.	Not always participate in activities for conserving and improving the environment and the ecosystem.	Do not have interest in participating in activities for conserving and improving the environment.

Capacities	Very Good	Good	Regular	Bad
<p>Promote the sustainable development in their professional activities, and apply norms of environmental management.</p>	<p>Identify and properly apply norms, standards, regulations and criteria for environment management, and promote a sustainable development in their personal and professional activities.</p>	<p>Identify and apply norms of environmental management, and promote a sustainable development in their professional activities.</p>	<p>Not all relevant norms of environmental management are identified and applied. Partially engaged in activities for promoting a sustainable development.</p>	<p>Do not have interest in applying norms of environmental management, and do not appraise the importance of a sustainable development.</p>