MECHATRONICS ENGINEERING PROGRAM

Rubrics for Assessing Student Outcomes

2018

(1) Problem Solving

Definition	Identify, formulate and solve complex mechatronics engineering problems properly applying the principles, methods, techniques and tools of engineering, science and mathematics.

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 adequate and realizable solutions pointing to the effective solving of the problem	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
Use techniques and methodologies of mechatronics engineering to describe, analyze and solve engineering problems.	Correctly apply methods and techniques of mechatronics engineering to describe and analyze with detail and deepness a problem to formulate coherent solutions	Apply proper methods and techniques to describe, analyze and solve engineering 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 instruments and software required for mechatronics engineering practice.	Correctly set and operate instruments, and use or develop software applications pointing to the solution of mechatronics engineering problems.	Operate instruments and use software applications to solve mechatronics |engineering 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 engineering.	Identify and assess all potential risky situations and apply safety measures to prevent or opportunely solve them, applying engineering 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) Engineering Design

Definition	Design and integrate mechatronics engineering systems and components that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

Capacities	Very Good	Good	Regular	Bad
Interpret requirements and needs and translate them into the formulation of a mechatronics engineering project.	All requirements and needs are identified and clearly described to properly formulate the scope and goals of the mechatronics engineering project.	Main requirements and needs are identified and described to formulate the mechatronics engineering project.	Not all requirements and needs are identified or well interpreted, and the mechatronics engineering 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, legal 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
Calculate the construction parameters of all components and properly integrate them into the final product or service.	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.	Calculate and determine with minor errors the construction parameters of the components of the product/service, and integrate them, using relevant norms and standards.	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.	Formulas used for calculating the construction parameters are not correct and the components are inconsistently integrated. Applicable norms and standards are not identified.
Describe the final product/service through their technical specifications, and graphically represent it through engineering drawings.	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.	Describe the main characteristics of the final product/service, and represent them in graphical formats using proper symbology and norms.	Incompletely describe the characteristics of the final product/service. Graphical representations are not clear and without a proper use of symbology and norms.	The final product/service is vaguely and inconsistently described, and the drawings are incomplete and unclear without respecting symbology and norms.
Propose the process to implement the solution.	Sequentially and orderly describe all the processes required to implement/construct the final product/service using proper norms and recommendations.	Describe the processes required to implement/construct the final product/service using relevant norms.	Not all the processes required for implementing the product/service are identified or are vaguely described. Norms and recommendations are partially applied.	Propose incorrect or incoherent processes to implement/construct the final product/service.

(3) Effective Communication

Definition	Communicate clearly and effectively in oral, written and graphical formats, interacting with different types of audiences.

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 technical documentation using proper norms and terminology.	Elaborate clear and precise technical documentation using norms, symbology and terminology proper of mechatronics engineering, and carefully respecting grammar rules.	Elaborate clear technical documentation using norms, symbology and terminology proper of mechatronics engineering.	Documents are not completely clear. Not all norms, symbology and terminology of mechatronics engineering are properly used.	Do not elaborate well redacted and clear documents. Incorrect use of norms, symbology and terminology proper of mechatronics engineering.
Speaks clearly using a vocabulary appropriate for the audience	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.

(4.a) Ethics and Professional Responsibility

Definition	Recognize and assume ethical and professional responsibilities in engineering situations and make informed judgments.

Capacities	Very Good	Good	Regular	Bad
Anticipate the implications of their decisions and actions.	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
Know and act according to the professional code of ethics.	Know, understand and appraise the code of ethics of the Peruvian Engineers 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 the Peruvian Engineers Association.	Partially knows the code of ethics of the Peruvian Engineers Association. 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 the Peruvian Engineers Association.

(4.b) Engineering Impact

Definition	Understand and consider the impact of engineering solutions on people and society in local, global, economic, environmental, and societal contexts.

Capacities	Very Good	Good	Regular	Bad
Recognize the role of mechatronics engineering on the progress of society and wellbeing of people.	Recognize, appraise and argue on the role of mechatronics engineering 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 mechatronics engineering on the progress of society and wellbeing of people, arguing and presenting actual examples in local and global contexts.	Recognize some roles of mechatronics engineering but supporting arguments and examples are not completely clear.	Do not present convincing arguments on the role of mechatronics engineering on the progress of society.
Identify the economic benefits of mechatronics engineering works.	Identify, appraise and argue the applications of mechatronics engineering 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 mechatronics engineering generating economic benefits in government, business and the country.	Identify some economic benefits of mechatronics engineering but supporting arguments and examples are not completely clear.	Do not present convincing arguments on the economic benefits of mechatronics engineering works.

Capacities	Very Good	Good	Regular	Bad
Recognize the importance of mechatronics engineering for the creation and innovation of products and services.	Recognize, appraise and argue on the importance of applying mechatronics engineering for the creation, innovation and improvement of products and services. Provide clear examples of application.	Recognize and argue on the importance of mechatronics engineering for the creation and innovation of products and services.	Recognize the importance of mechatronics engineering in innovation but supporting arguments and examples are not completely clear.	Do not present convincing arguments and examples on the importance of mechatronics engineering for the creation and innovation of products.
Understand the role of mechatronics engineering in risk prevention and disaster mitigation.	Understand, appraise and argue on the role of mechatronics engineering for identifying risks and hazards, preventing the occurrence of disasters and opportunely mitigating their effects.	Understand and argue on the role of mechatronics engineering in risk prevention and disaster mitigation.	Show a partial understanding on the role of mechatronics engineering in risk prevention and disaster mitigation, Supporting arguments are not clear.	Unclear and vaguely explanation on how mechatronics engineering 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 whose members together provide leadership, creating a collaborative and inclusive environment.

Capacities	Very Good	Good	Regular	Bad
Participate in work teams contributing to achieve goals.	Promote the creation of work teams, actively participating 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.
Propose and accepts ideas conducting to the achievement of objectives and results.	Propose coherent ideas, as well as listen, analyze and accept propositions conducing to the attainment of objectives and goals. Promote the formation of discussion groups.	Propose coherent ideas, as well as listen, analyze and accept propositions conducing 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 and consensus.	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.

Capacities	Very Good	Good	Regular	Bad
Contribute to group harmony and sustainability	Actively contribute to group harmony and sustainability, supporting the efforts and work of others, and appraising and recognizing their contributions.	Contribute to group harmony and promote group sustainability.	Partial contribution to group harmony and sustainability.	Do not committed to group harmony and sustainability.

(5.b) Project Management

Definition	Within the context of teamwork, determine the feasibility of engineering projects, establish goals, plan tasks, and formulate schedules and budgets for the attainment of objectives.

Capacities	Very Good	Good	Regular	Bad
Formulate the objectives and restrictions of an engineering project	Clearly formulate the scope, all objectives and expected outcomes of engineering projects. Identify restrictions and limitations and their impact on the project outcomes.	Formulate the main objectives and expected outcomes of an engineering 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 strategies for the implementation of an engineering project	Propose coherent and realizable strategies for the implementation of engineering projects with criteria of efficiency and optimality.	Propose coherent strategies for the implementation of engineering 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 and their costs and estimate the budget of engineering projects.	Identify all required materials, equipment and resources. Justifiably determine and compare unitary costs, and elaborate in detail the total budget of the engineering 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 conducing to erroneous budgets.

Capacities	Very Good	Good	Regular	Bad
Determine the activities and priorities, and propose execution and control schedules.	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.
Determine the technical and economic feasibility of an engineering project as well as its social and environmental viability.	Apply proper methods and criteria for determining the technical and economic feasibility of an engineering project including social and environmental feasibility. Decide on the viability and execution of the project and formulate recommendations.	Determine the technical and economic feasibility of engineering projects, as well as its social and environmental viability.	Incomplete analysis for determining the technical and economic feasibility of the project, as well as the social and environmental viability. Applied methods and criteria do not consider all relevant aspects of the project.	Incorrect application of methods and criteria for determining the technical and economic feasibility, and social and environmental viability of the project conducing to incoherent conclusions.

(6) Experimentation and Testing

Definition	Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

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 and criteria to extract proper conclusions.	Process data using proper mechatronics engineering methods to extract characteristics and properties to be analyzed using adequate concepts and criteria for formulating correct conclusions.	Analyze and process data using proper methods and formulate coherent conclusions	Not all relevant data is analyzed, processing and analysis methods do not always conduce to expected results. Conclusions are vaguely stated and incomplete.	Data analysis and processing are incorrect conducing to incoherent and incorrect 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.

(7) Autonomous Learning

Definition	Acquire and apply new knowledge for keeping themselves updated and competitive, using appropriate learning strategies.

Capacities	Very Good	Good	Regular	Bad
Identify relevant areas for the development of their professional career.	Identify relevant areas for the development of their professional career, explaining with detail their scope, applications and opportunities.	Identify relevant areas for the development of their professional career, understanding their scope and applications.	Identify areas for the development of their professional career, but vaguely explain on their scope and applications.	Do not show interest in identifying relevant areas for the development of their professional career.
Keep themselves up to date on new technologies of mechatronics engineering, as well as their diverse applications.	Identify new technologies and developments in mechatronics engineering, analyze their potential applications, and train themselves to remain up-dated and competitive.	Identify new technologies in mechatronics engineering and train themselves to remain up-dated.	Know some new developments on mechatronics engineering but do not realize their potential applications and benefits.	Do not show interest in new technologies and tendencies in mechatronics engineering.
Be autonomous in their learning process, applying appropriate learning strategies.	Pursue the successful and timely completion of their academic projects and assignments, trying different ways to overcome difficulties and shortages, working independently without requiring faculty support.	Pursue the successful and timely completion of their academic assignments, overcoming difficulties and shortages.	Require some faculty or senior student support to complete their academic assignments. Some difficulties are not completely overcome.	Not able to independently complete their academic assignments. Difficulties and shortages are not overcome.

Capacities	Very Good	Good	Regular	Bad
Identify and apply information and communication technologies that facilitate the learning process.	Identify and effectively apply different information and communication technologies and strategies proper to each learning context, boosting the assimilation of new knowledge and the development of new skills and behavior.	Identify and apply information and communication technologies proper to each learning context improving the learning process for knowledge assimilation and skills development.	Identify and apply some information and communication technologies partially attaining partial improvements in the process of knowledge assimilation and skills development.	Do not identify information and communication technologies appropriate to the learning context or improperly apply them so that there are not significant improvements in the learning process.
Recognize the importance of taking part in research groups and participate in student branches of professional societies.	Actively participate in research groups and student branches of recognized professional associations.	Is regular member and participate in at least one research group or student branch of professional association.	Occasionally participate in research groups or student branch.	Do not have interest in participating in research groups or student branches.
Attend and participate in events of professional development.	Periodically, at least four times per year, attend academic events for personal and professional development, and participate in the organization of at least one academic event.	Periodically, at least four times per year, attend academic events for personal and professional development.	Occasionally attend academic events for personal and professional development.	Do not have interest in attending or participating in events for professional development.

(8) Environmental Awareness

Definition	Takes into account the importance of preserving and improving the environment in the development of their personal and professional activities.

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