ABET Interim Report July 1, 2018

Department of Food Engineering
School of Agronomy
Autonomous University of Nuevo Leon

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Food Industry Engineer (FIE)
B.S. Program

INTRODUCTION

The Food Industry Engineer Educational (FIE) Program in the School of Agronomy is a five-year (nine semesters) program with 488 registered students for the spring term, 2018. The first evaluation of the FIE educational program by the Accreditation Board for Engineer and Technology (ABET) was on the autumn 2010. On the fall of 2016, the FIE program received ABET evaluators for re-accreditation process. Because of the ABET Draft Statement received by the Autonomous University of Nuevo Leon on February 2017, different actions have been conducted to overcome the observed weakness on three Criteria of the FIE educational program.

Autonomous University of Nuevo Leon response after 30 days was submitted to ABET due to shortcomings identified in each program's section of the EAC Draft Statement of 2016. The EAC accreditation statement of October of 2017 for Criterion 3 (Student Outcomes) was that the Food Industry Engineer curriculum is already mapped to the student outcomes in considerable detail and a linkage of the (a) through (k) outcomes to the newly established program education objectives has been established. EAC concluded that the weakness is resolved. However, EAC accreditation statement found for Criterion 2 (Program Educational Objectives) that revised program educational objectives better meet the EAC of ABET definition, but two of the five objectives still emphasize entry level skills and abilities rather than skills and abilities developed with professional experience. The summary of the first advisory board meeting includes a list of board recommendations that are best characterized as suggestions for program operation and curriculum delivery but do not seem to be suggestions subsequently captured in the revised program educational objectives. Finally, the program educational objectives on the program's website have not been updated. The establishment of an advisory board with well-qualified members is a first step, but evidence of an actual process, involving all constituencies, to periodically review the program educational objectives and ensure compatibility with the constituents' needs is still lacking, therefore, the weakness remains unresolved and EAC anticipates documentation of program educational objectives that are consistent with the EAC of ABET definition, publication of these objectives in appropriate places, an effective process for periodic review of the objectives, and evidence that the process is systematically implemented and periodic reviews are performed. The conducted progress actions were: a) the PEO's were published on the Department of Food Engineering Website; b) a revision of the PEO's were conducted to consider internal and external constituents; in addition, the External Advisory Board was incorporated to the FIE program on February 24th, 2017; and c) Five PEO's were proposed and accepted for the constituents of the program. EAC accreditation statement found for Criterion 4 that the process described supports establishing an effective process, but details are missing. First, a schedule of assessment and evaluation is not defined (i.e. each outcome is evaluated each semester, each year, every two years etc.) Second, the processes used to evaluate assessment results and establish actions for continuous improvement are also not described. Finally, the process appears to jump directly from data analysis to continuous improvement with no intermediate step to judge what actions are justified or appropriate. Documentation provided included one cycle of assessment results for each of the eleven outcomes. In some instances, data were gathered from multiple courses but there was no explanation of how the multiple results were evaluated to reach the final achievement score (75%). There is no discussion of

how results that disagree are evaluated. For example, outcome (a) was assessed using two courses: 1) Balance of Matter and Energy and 2) Science and Technology of Meat. Sixty-six percent of the students were rated deficient in the first course while none were deficient in the second. Such information should be of considerable value when considering the need for improvement but there was no discussion of how these results, or results from multiple courses in general, are used, therefore the weakness remains unresolved and EAC expects documentation of the assessment and evaluation process and evidence that the process is systematically used to support continuous improvement of the program. For Criterion 4, to ensure that the students achieve their ABET outcomes upon graduation, an assessment process has been established for the FIE Program by using an analysis of rubrics. Diverse class activities through the FIE curriculum was evaluated to analyze the level of attainment. The results of this analysis were used as input to determine strategic actions for the continuous improvement of the program.

CRITERION 2. PROGRAM EDUCATIONAL OBJECTIVES

A. Review process for Program Educational Objectives

The FIE educational objectives of the curriculum included in the manuscript of response after 30 days of draft statement were the following:

a) To apply their knowledge and skills to solve contemporary problems in the analysis, design and evaluation of processes and transformation of food engineering systems.
b) To enter the professional market of the food industry with creativity and competitiveness, practicing firm ethical principles.
c) To demonstrate their competence to continue with sustained learning by adapting to changes in their professional environment through self-study, professional development, postgraduate programs, and continuous education.
d) To demonstrate efficiency and effective leadership and communication, pursuing the goals of the companies in which they perform, knowing how to listen to different opinions, recognizing the achievements of others, and obtaining satisfactory results.
e) To engage with commitment, creativity and tolerance in multidisciplinary teamwork, multicultural, respecting ethnic and religious origins.

The five objectives of the program were revised after the ABET academic visit on November 2017. This review process was based on the external and internal constituencies that are related to the FIE Educational Program. A description of their participation in the revision process is given on the following sections of the actual manuscript:

I) INTERNAL ELEMENTS

Academies. The course syllabus is integrated by the academies of Biosystems Engineering (BE), Food Science and Technology (FST), and Bioproducts and Food Safety (FS). They are on charge of planning the courses which are offered to students during the academic term and revision of syllabus. After the ABET academic visit on January 2017, the FIE academies proposed modifications of PEO's as suggested by ABET reviewers (Appendix 1).

Quality Committee of the Food Industry Engineer Program (QC-FIE). The QC-FIE is involved full-time professors of the FIE Program, to analyzes continuous improvement strategies, curriculum modifications, and the preparation of self-study report for accreditation processes (Appendix 2).

The Academic Commission of School of Agronomy (AC-SA). The AC-SA is represented by the coordinators of educational programs and assistant deans for academic affairs office, postgraduate studies, and planning and continuous improvement area. They analyze the operation of the educational programs and decide to improve academic indicators.

Academic Model UANL. This document establishes roles and functions of students in the educational programs which are taught at the Autonomous University of Nuevo León.

Program Educational Objectives

During the revision and adjustment of the objectives of the FIE Program, Academies and the QC-IIA proposed the objectives for the academic program, considering the Academic Model UANL. These PEO's were endorsed by External Advisory Board in the meeting held in November 25th of 2017 and by the Academic Commission of the Agronomy School (AC-AS) on June 28th of 2018 (Appendix 3).

Within 3 to 5 years of graduating from the educational program Food Industry Engineer, graduates are expected to achieve one or more of the following milestones:

a. Advance professionally in positions that integrate food engineering and other perspectives such as research and development, education, etc.
b. Earn a postgraduate degree or an advanced certification.
c. Assume leadership roles in technical, community, public organizations or other endeavors.
d. Become a successful manager, consultant or entrepreneur who is developing global expertise.
e. Written scientific articles and received patents.

II) EXTERNAL CONSTITUENTS

The National Assessment Center for Higher Education (CENEVAL for the acronym in Spanish). The CENEVAL is a non-profit civil association, whose main activity is the design and application of knowledge, skills, and competences assessment tools, as well as the analysis and diffusion of results of the obtained data. CENEVAL is constituted by a General Assembly, formed by educational institutions, associations and professional schools, social and business organizations, as well as governmental educational authorities. It´s Board of Directors guarantees the Center's proper day-to-day running, and its Director-General is the executive authority of the mandate issued by the General Assembly (http://www.ceneval.edu.mx/web/guest). This body establishes for the graduates of FIE educational programs, the Mexican Public Universities Exam (EGEL-IALI exam, for the acronym in Spanish) that identifies the level of mastery or performance achieved by the sustaining students regarding the knowledge and skills that the Technical Examination Council has Defined as necessary to start effectively in the professional practice. This exam has been presented by the FIE graduates during the last three years (Appendix 4).

Mexican Committee for the Accreditation of Agronomic Education (COMEAA for the acronym in Spanish). The COMEAA establishes the criteria in its Mexican Accreditation System for Academic Programs for Higher Agricultural Education to accredit undergraduate agro-industry educational programs (http://www.comeaa.org/). The most recent evaluation of the curriculum was conducted in October 2016. The result of this evaluation is a report on the weaknesses and strengths that were addressed during the internal visit (Summary of the report). The COMEAA has issued an Accreditation Certificate for the FIE program with a validity of 5 years, from January 30, 2017 to January 29, 2022 [Appendix 5 (summary of evaluation report)].

Inter-institutional Committees for the Evaluation of Higher Education (CIEES for the acronym in Spanish). The CIEES is an organization dedicated to the quality assurance of higher education. It is composed of nine committees (seven of academic programs and two of institutional functions) whose main function is to dictate on the quality of the programs and functions evaluated. The CIEES are a Civil Association (non-profit), which General Assembly of Associates (highest governing body) is made up of public and private institutions (http://www.ciees.edu.mx). The last evaluation was carried out from September 23 to 25, 2015. Like COMEAA, the strengths and weaknesses of the FIE academic program, detected during the evaluation by CIEES, allowed the updating of the curriculum objectives based on the ABET recommendations report. The CIEES has issued the highest level of certification (Level 1) to the FIE program with validity until January 2021 [Appendix 6 (summary of evaluation report)].

FIE's External Advisory Board (EAB-FIE). The EAB-FIE was integrated on February 24, 2017, by business owners, consultants, and managers of food industries (Appendix 7). During the meeting of its initial integration, the previous five PEO's and the contributions of other external constituents such as CENEVAL, COMEAA and CIEES were analyzed and approved by the EAB-FIE and FIE's Quality Committee (QC-FIE), considering the recommendations of ABET.

In addition, in last meeting (November 25th of 2017) discussed the characteristics of the PEO´s and received the following recommendations to:

a) Strengthen the student English language and encourage the students to start a third language.
b) Systematize the design and innovation projects in which students participate during their studies to present a better curriculum to employers;
c) Request companies and institutions where students perform social service and professional practices a feedback of the skills and abilities to implement a quality improvement program.
d) Give a major diffusion of services offered for research and evaluation of new products related to the food industry (training agreements).
e) Permanently expand and update student knowledge and skills to be at the forefront of changes and market speed.

Table 2.1. Members of the External Advisory Council of the FIE Program.

Name	Position
Dalila Maldonado Caraza	M. Sc. in Chemical Engineering with over 13 years of experience in Food Industry, including 10 years in PepsiCo R&D (as specialist in healthy

	snacks, portfolio transformation and ingredients functionality) and 3 years in Quality and Process Control (Kraft, Nestlé and Sugar Cane Industry). Manager of Research and Development in science of ingredients for Global Snacks at PEPSICO.
María Guadalupe Ovalle Alvarez	Production Superviser at Hersheys, Monterrey, México.
Gerardo Ignacio Saldivar Carranza	PICSA Director of Mexico International S.A. of C.V.
Jesús Sotero Navarro Vidales	He obtained his B.S. on Food Engineering degree in April of 1999. His professional development has been in the Nuevo Leon food industry directing divers food production processes and innovation and development of new products
Rigoberto Gómez Esquivel	Manager of engineer and projects of Molinera de Mexico S.A. de C.V. He obtained his B.S. on Food Engineering degree in 2002 and was an awarded as professional excellence in 2012
José Roberto Ancira Esquivel	With more than 25 years of experience as Director of Operations of National Cheese Plants of Sigma Alimentos, General Manager of several Chen Group Plants; Experience in Plant Management, Dairy Distribution Center Management, Transportation Logistics, Operations, Sales, Administration, Finance, Training, Production and Leadership
Jaime H. Yesaki Cavazos	President of the National Agriculture and Livestock Council (CAN for the acronym in Spanish), member of the Business Coordinating Council and Legal Representative of Yesaki Chicken and Meat Marketing

FIE Students. The students were consulted to give their opinion (Appendix 8) about the objectives proposed by the academic groups of the FIF program. In general, all the graduates and students considered that these PEO´s agreed with the professional area of the Food Industry that they face within the first four years after graduation. The resigned five program educational objectives will be considered for the class of the spring term 2018 and beyond.

CRITERION 4. CONTINOUS IMPROVEMENT

A. Student Outcomes

Regarding FIE continuous improvement a complete discussion of the assessment for SO's is documented in this section. Using tables and figures, we describe the evaluation process and how it was documented and will be maintained. Each section for this criterion is based on the recommended format from the template of the Self- Study Report Cycle 2016-2017. We would like to point out, that this is a recent practice in the process of evaluating and assessing SO's, because of the academic visit process completed in November 2016. Figure 4.1 illustrates a five-step procedure used to assess the degree to which outcomes have been achieved.

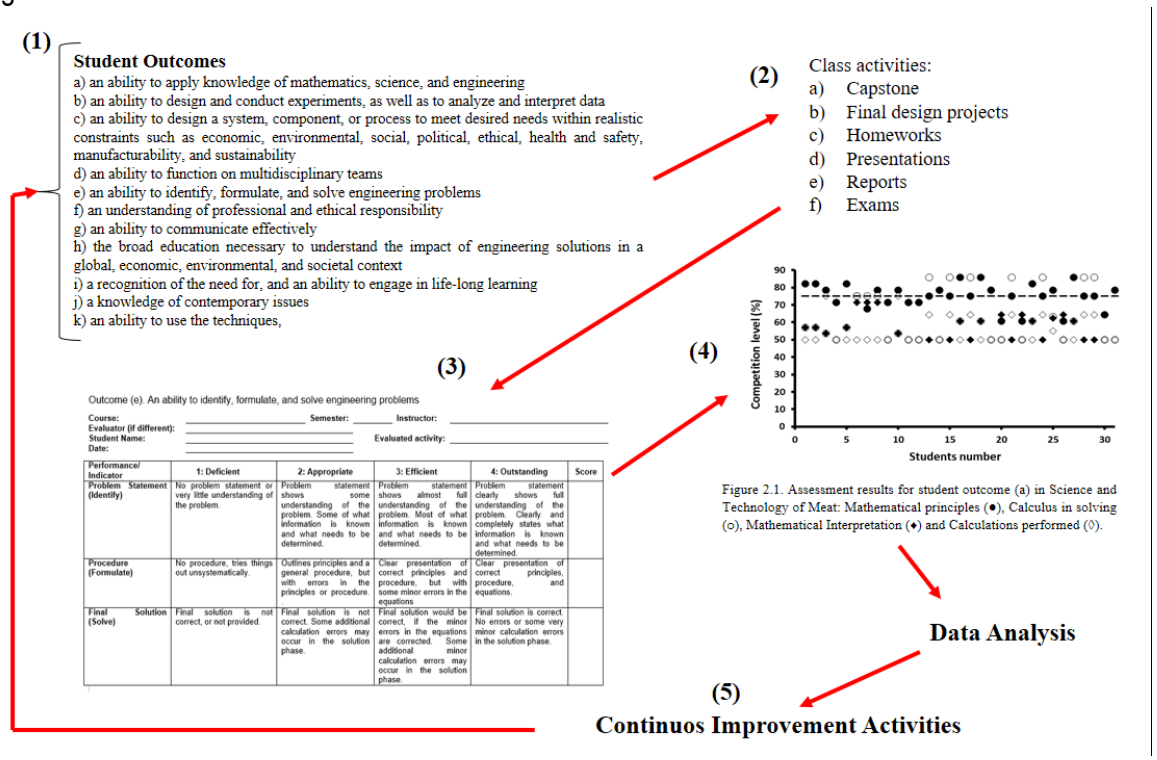


Figure 4.1. Assessment procedure for SO's.

In Figure 4.1, we can see the steps for assessment for SO's as follows:

1. Student outcomes were delineated by outcomes a-k.
2. Faculty identify class activities. and other assessments indicators i.e. results and class presentations, to determine the level of achievement of a-k outcomes. Rubrics (Appendix 9) were developed.
3. Rubrics were applied to interpret performance indicators data. These rubrics included tables for the course instructors to identify the percentage of students who are below, meet or exceed expectation **(75%)** for the outcome. The use of the rubrics has the advantages of i) dividing the outcomes into separated components to detect areas that require to be reinforced, and ii)

providing in such way changes in achieving the outcomes can be more easily tracked with time, as well as changes in the academic program.

4. The observed results were tabulated during the evaluation processes. It is important to notice that class activity grades below an expectation of 75%, although it is necessary to point out that each student can approve any subject with a score which ranges from 70 to 100.
5. The obtained results are analyzed by the FIE QC-FIE looking for their improvement.

Assessments for SO's are done by using data from several sources as follows:

- for Outcomes a and e data from exams are compiled and analyzed.
- for Outcome b, c, e and f data on integrative learning product (prototype, design, model or new food product) are collected, analyzed and interpreted.
- for Outcomes d and g data, teamwork (assistance and intra-evaluation) and laboratory practice reports are scored.
- for Outcomes h, i, and j are undertaken evaluation of a Seminar and each student should prepare a Review.
- for Outcomes k outcome assessments are undertaken evaluation and validation of a computer program design; as well as, and drawings using computer technology.

Strategy for self-improvement

For student assessment analysis, a 0-100 grading range was used to evaluate students activities (n_i) and tracking the learning process. The four evaluation categories (X_i) for each outcome are the following:

1. Deficient: 0-69
2. Appropriate: 70-79
3. Efficient: 80-90
4. Outstanding: 91-100

Subsequently, the activities (n_i) were rated according to the category scores (X_i; 1, 2, 3, and 4). The average (μ) is calculated according to the scores assigned to each activity $[\mu = (\sum X_i/n_i)]$. Finally, a grade is calculated according to the highest score (4) $[\text{Performance scale } (\%) = (\mu/4) \times 100]$. These calculations were conducted for each student activity in class and for the final integration products, and final projects per learning units presented at the end of the class term during the Academic Week Exhibition Event. Using calculated data, several dispersion and percentage bar graphs were obtained. The level of achievement in every learning unit was compared with the Lower Average Limit ($LAL = (3/4) \times 100 = 75\ \%$) per outcome, which represents an adequate expected level of performance, by using the rubrics developed for senior design, portfolios, and course-based assessment. In the following pages, examples at each level are presented. All the evaluated assessment rubrics are available online (http://www.agronomia.uanl.mx/wp-content/uploads/2017/03/Appendix-10..pdf).

Example of Assessment Outcome (e): a rubric example for the Unit Operations course is shown in Table 4.1. In this course (*n* = 24 students) the indicators evaluated were: problem statement (identify), procedure (formulate), and final solution (solve). Each rubric indicator has (X_i) score categories, which were evaluated for the course.

Table 4.1. Rubric for outcome (e).

Outcome (e). An ability to identify, formulate, and solve engineering problems

Course: _____ **Semester:** _____ **Instructor:** _____
Evaluator (if different): _____
Student Name: _____ **Evaluated activity:** _____
Date: _____

Performance/ Indicator	1: Deficient	2: Appropriate	3: Efficient	4: Outstanding	Score
Problem Statement (Identify)	No problem statement or very little understanding of the problem.	Problem statement shows some understanding of the problem. Some of what information is known and what needs to be determined.	Problem statement shows almost full understanding of the problem. Most of what information is known and what needs to be determined.	Problem statement clearly shows full understanding of the problem. Clearly and completely states what information is known and what needs to be determined.	
Procedure (Formulate)	No procedure, tries things out unsystematically.	Outlines principles and a general procedure, but with errors in the principles or procedure. .	Clear presentation of correct principles and procedure, but with some minor errors in the equations	Clear presentation of correct principles, procedure, and equations.	
Final Solution (Solve)	Final solution is not correct, or not provided.	Final solution is not correct. Some additional calculation errors may occur in the solution phase.	Final solution would be correct, if the minor errors in the equations are corrected. Some additional minor calculation errors may occur in the solution phase.	Final solution is correct. No errors or some very minor calculation errors in the solution phase.	

Figures 4.2 and 4.3 show the results determined for the (e) student outcome. Figure 4.2 shows that the indicator problem statement (Identify) almost had a 100% achieved; whereas, the final solution (Solve) had the lowest efficiency level among the students.

Figure 4.3 shows the overall student performances for the 4 score categories established for each indicator on the overall evaluation. The indicator final solution (solve) was 53 % deficient (blue). In this indicator, students should have basic knowledge of mathematics, otherwise, students are going to have problems to reach the competition achievement in problem statement (Identify). In the overall evaluation, the outstanding category represents the highest value (35 %, represented with purple color), whereas the deficient category had the lowest value (18 %, blue).

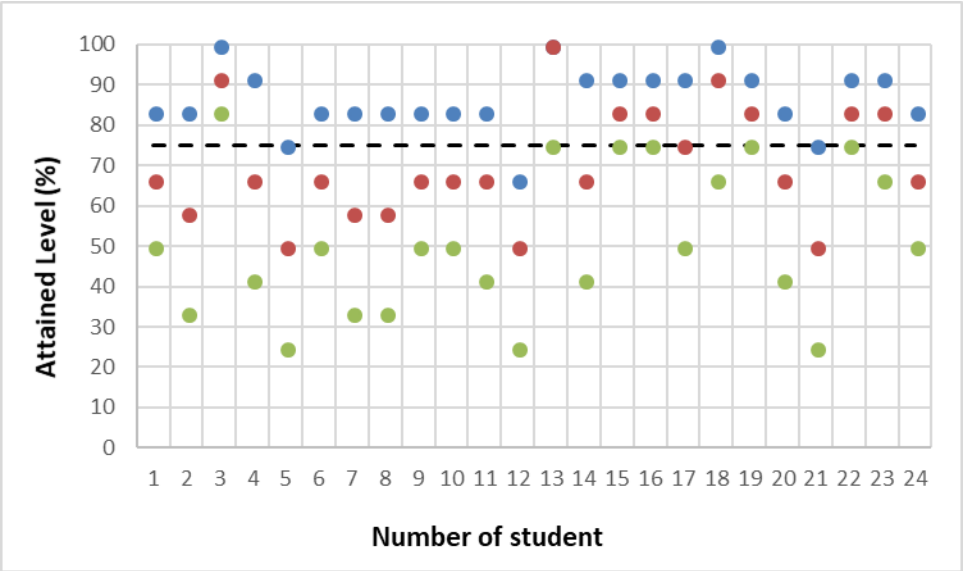


Figure 4.2. Assessment results for student outcome (e) in Unit operations: Problem Statement (●), Procedure (●) and Final Solution (●).

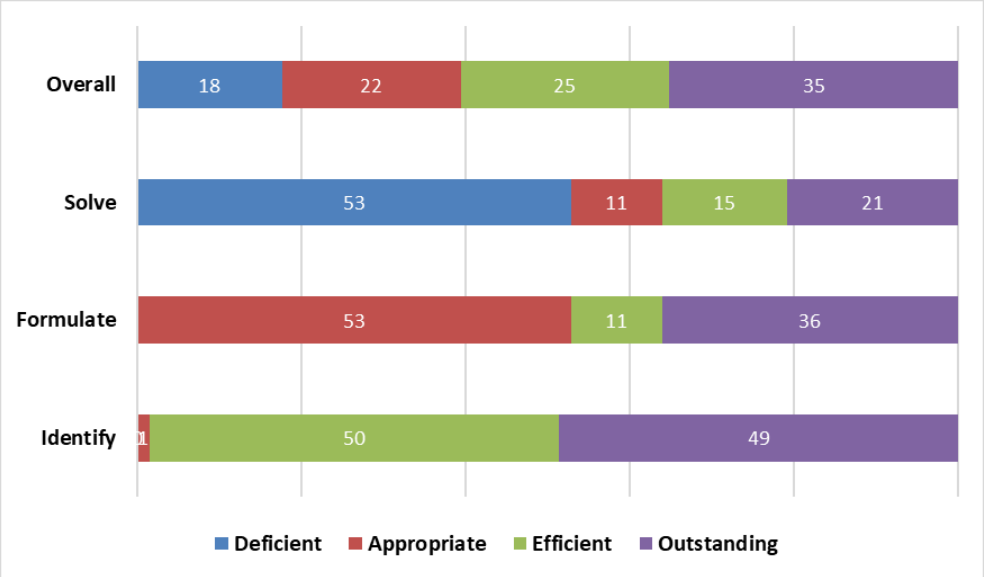


Figure 4.3. Assessment results for student outcome (e) in Unit operations.

On the following sections, we analyze separately each outcome assessment. Figures and Tables are in Appendix 10.

Assessment artifacts are collected during the course and the evaluation of the artifacts is done semesterly. We performed our first assessment for the semester autumn 2016. The results of this cycle made it clear that the rubrics several assessment instruments needed to be updated and improved. As a result, we have reliable assessment data for four assessment semesters: Autumn 2016, Spring 2017, Autumn 2017 and Spring 2018. All assessments are done in our courses FIE (sophomores, juniors and seniors. Details about the assessment assignments for each outcome are shown in Table 4.2.

Table 4.2. Student outcomes of the educational program in Food Industry Engineer with descriptions of evaluation instruments (the Autumn 2016, Spring 2017, Autumn 201 and Spring 2018)

Student Outcomes In order to comply with the Program Educational Objectives of FIE program the student who graduates must have:	**Description of Assessment Artifacts**
a. an ability to apply knowledge of mathematics, science, and engineering	***551Mass and Energy Balances.*** An Exam that evaluate students' ability to: a) solve problems related elementary material balances on single and multi-unit process, for both nonreactive and reactive processes, b) apply the first law of thermodynamics to batch and flow processes, c) Locate thermophysical property data in the literature and estimate properties when data are not available. d) conduct combined material and energy balances around continuous multi-unit processes with and without chemical reaction, e) perform process calculations using engineering charts, enthalpy concentration diagrams and steam tables, and f) Derive and solve differential equations for transient heat and material balances on dynamic system.
a. an ability to apply knowledge of mathematics, science, and engineering	***542 Physical chemistry***: An Exam that evaluate students' ability to: apply physico-chemical principles underlying the structures and functions of biological macromolecules, b) apply thermodynamic concepts associated, c) electrochemistry, chemical equilibrium, d) proficiency with the fundamentals of chemical kinetics, and e) understanding of chemically reacting systems kinetics.
b. an ability to design and conduct experiments, as well as to analyze and interpret data	***559 Research and Development of Food Industry***. An integrative learning product (Experimental Report) will be evaluated, which includes the ability to perform statistical data analysis of univariate data sets, calculate the error/uncertainty propagation for calculations that include multiple terms, to design and plan experiments using Minitab, use common measurement equipment, describe basic Design of Experiments techniques and compare theoretical predictions with actual experimental results in diverse, practical food engineering experiments.
b. an ability to design and conduct experiments, as well as to analyze and interpret data	***558 Meat Science and Technology.*** An integrative learning product will be evaluated, which includes the ability to perform statistical data analysis of univariate data sets, calculate the error/uncertainty propagation for calculations that include multiple terms, to design and plan experiments using Excel, use common measurement equipment, describe basic Design of Experiments techniques and compare theoretical predictions with actual experimental results in diverse, practical food engineering experiments.
c. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	***552 Automatic Control Systems.*** An integrative learning product will be evaluated, which includes the design and construction of an automatic control systems applied to agro-industrial processes. The prototype should be able to establish design specifications, generate creative and feasible alternative solutions, using methods such as brainstorming or functional block diagrams, use common methods for comparing alternatives and making engineering decisions, apply engineering analysis for the design/sizing of mechanical components based on likely failure modes and meaningful factors of safety, select machine elements to satisfy specific functional requirements, deal of engineering standards and most of the following constraints in engineering design: economic, health and safety, environmental, ethical, social, political, manufacturability, sustainability, apply planning, prioritizing, and scheduling tasks use basic manufacturing skills machining, and the ability to work to build and assemble prototypes of a control system design, achieve specified objectives in food processing and agricultural practices, evaluate and use test results for design improvement and validation, re-design, implement and evaluate once more the control system and application of heat transfer to thermal design.

c. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	***560 Design of Food Industries.*** An integrative learning product will be evaluated, which includes the design of a Food Plant (identification of the needs of the consumer, information on the development of the product (formulation, critical design parameters, raw materials), process design, design of facilities and economics).The food plant design should be contain design specifications, brainstorming or functional block diagrams, use common methods for comparing alternatives and making engineering decisions, apply engineering analysis for the design/sizing of mechanical components based on likely failure modes and meaningful factors of safety, select machine elements to satisfy specific functional requirements, deal of engineering standards and most of the following constraints in engineering design: economic, health and safety, environmental, ethical, social, political, manufacturability, sustainability, apply planning, prioritizing, and scheduling tasks use basic manufacturing skills machining, and the ability to work to build and assemble prototypes of a control system design, achieve specified objectives in food processing, evaluate and use test results for design improvement and validation, re-design, implement and evaluate once more the control systems and application of heat transfer to thermal design, general project management tools such as Gantt charts, Pareto charts, and critical path analysis for planning, prioritizing, and scheduling tasks in a design project generate creative and feasible alternative solutions, using methods such as, use basic food manufacturing skills and the ability to work with vendors / part suppliers to build and assemble of a plant design.
d. an ability to function on multidisciplinary teams	***553 Science and Technology of Milk.*** An ability to work effectively on *Laboratory practices* in both member and leader roles, with team members who may have different backgrounds and technical skill levels. The reports will be evaluated, which includes work cooperatively with others, analyze ideas objectively, encourage active participation of others, build consensus, deal productively without conflict, take leadership roles as the need arises to accomplish the group's objective.
d. an ability to function on multidisciplinary teams	***558 Science and Technology of Milk***. An ability to work effectively on *Laboratory practices* in both member and leader roles, with team members who may have different backgrounds and technical skill levels. The reports will be evaluated, which includes work cooperatively with others, analyze ideas objectively, encourage active participation of others, build consensus, deal productively without conflict, take leadership roles as the need arises to accomplish the group's objective.
e. an ability to identify, formulate, and solve engineering problems	***555 Unit operations.*** Exam that evaluate students' ability to solve design problems of heat exchangers of concentric centers and piping and shield, problems about the design of single and multiple effect evaporators; as well as, solving design problems of recipients by the McCabe method that lead to get the correct answer, the rubric was scored separately.
e. an ability to identify, formulate, and solve engineering problems	***546 Material and Fluid Mechanics***. An integrative learning product will be evaluated, which includes the design and construction of a prototype applying techniques, skills and modern engineering tools, scored separately. The students will solve 3 problems, as well as have 3 exams and an integrative learning product (functional model and document where they demonstrate the acquired knowledge on a) piping networks. Rotational flow, b) flow in porous media, c) Newtonian and non-Newtonian fluids, pumping of food products, both homogeneous and non-homogenous, d) special requirements for pumps and piping systems for food and other products that may have special requirements (e.g., high pH), e) Cavitation. f) Fans and fan control, g) Flow control in pipes and open channels, h) Hydraulic jumps).
f. an understanding of professional and ethical responsibility	***571 Management and Disposal of Wastes.*** An integrative learning product will be evaluated, which includes the industry design applicable professional codes and regulations for management of wastes with ability to promote safety and health in all aspects of the food processing and solve ethical issues for suitable disposal of wastes.
f. an understanding of professional and ethical responsibility	***556 Science and Technology of Cereals***. An integrative learning product will be evaluated, which includes the industry design applicable professional codes and regulations for developing of new food products with ability to promote safety and health in all aspects of the food processing and solve ethical issues that may occur in professional practice; as well as, possible patents and intellectual property rights.

g. an ability to communicate effectively	***401 Heavy Metals in Food.*** An ability to work effectively on Laboratory practices. The reports will be evaluated, which includes a) Written and graphical communication skills appropriate to the profession of food engineering, including: i) Hand writing and editing clear and effective reports, including technical content that is factually correct, supported with evidence, explained with sufficient detail, and properly documented ii) Writing and editing clear and effective laboratory reports, including the creation of high quality graphics for figures, tables, plots and charts, iii) An ability to synthesize a report, iv) Documenting report work properly in a notebook, and v) Documenting experimental data properly in a lab notebook, .b) Oral and visual communication skills appropriate to the profession of food engineering, including: i) Preparing and making clear and effective formal presentations, including the preparation of high quality visual aids and ii) The ability to participate in technical discussions.
g. an ability to communicate effectively	***557 Sensorial Evaluation***. An ability to work effectively on Presentation of Laboratories Reports. The reports will be evaluated, which includes a) Written and graphical communication skills appropriate to the profession of food engineering, including: i) Hand writing and editing clear and effective reports, including technical content that is factually correct, supported with evidence, explained with sufficient detail, and properly documented ii) Writing and editing clear and effective laboratory reports, including the creation of high quality graphics for figures, tables, plots and charts, iii) An ability to synthesize a report, iv) Documenting report work properly in a notebook, and v) Documenting experimental data properly in a lab notebook, b) Oral and visual communication skills appropriate to the profession of food engineering, including: i) Preparing and making clear and effective formal presentations, including the preparation of high quality visual aids and ii) The ability to participate in technical discussions.
h. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	***459 Agro-Industrial Hygiene.*** The assigned task focused on the evaluation of the students' perspective on the global and social problems around the engineering solutions, qualified rubric, separately, including as follows: a) ability to explain how science and technology have been applied to the agro-industrial hygiene, b) integration of engineering and business (market awareness, customer satisfaction, quality, continuous improvement, profit, mission/vision/core values, etc.), c) international standards and quality standards.
h. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	***571 Management and Disposal of Wastes.*** A homework will be evaluated, which includes a detailed report with interactions of plant tours, and professional organizations. Each student reports the information obtained from the plant staff and complements with references of books and internet websites.
i. a recognition of the need for, and an ability to engage in life-long learning	***544 Industrial Microbiology***. The assignment will be the evaluation of a Seminar and each student should prepare a Review. The Review includes: a) ability to find, evaluate and use resources to learn independently recent technology in industrial microbiology for development of new food products, b) recognition of the need to accept personal responsibility for learning and of the importance of lifelong learning in the use of microorganisms to innovation of food products and c) an ability for self-evaluation, leading to improvement using news regulations in food safety.
j. a knowledge of contemporary issues	***539 Food Biotechnology***.Two activities are qualified: 1) Oral presentation on current issues of food biotechnology and 2) Seminar based on a scientific article where biotechnology is applied to the improvement of food production. Qualified heading, separately and including as follows: a) Contextualize the impact of biotechnology on food production, b) explain the genetic maps and their usefulness in a biotechnological process, c) Understand and interpret the use of molecular techniques applied to genetic engineering to improve food production, d) present and explain the results of a biotechnological process applied to the improvement of food production.
j. a knowledge of contemporary issues	***560 Design of Food Industries.*** The assignment will be the evaluation of a Presentation and each student should prepare a Report. The Report includes: a) Three examples of food technologies applied to current food engineering issue, paragraph form, using more than one sentence, no mistakes in spelling or grammar, source included, c) source included, written with audience (professor) in mind, no errors in spelling or grammar, d) clear presentation and explanation of the issue, includes source and respecting the program.

k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	***437 Programming Languages.*** Computer Program for applying techniques, skills, and modern engineering tools, scored separately. The computer program should be based in an application of using food processing. The computer program should work properly and including the appropriate documentation, which algorithm building, Java commands, control structure, arrays, different kinds of methods, principles of object-oriented programming, collections, dynamic data structures and files manipulations.
k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	***438 Computer Aided Design.*** Homework assignments for applying techniques, skills, and modern engineering tools, scored separately. Portfolio with multiple technical graphic documents for the communication of various design and packing items. All drawings will be completed via ANSI industry specifications in both traditional manual methods as well as with modern state-of-the-art computer software and should apply the latest technology and engineering tools to solve technical problems in the practice of food and demonstrate independent thinking, self-management in design environment.

The assessment artifacts are all stored on the secure ABET computer drive in the office of head of department. Most of the artifacts are printed and stored in a filing cabinet for each term assessment. The senior learning integrative products (final reports (written and oral)) are not included in the folder. These files are kept on the computer and are easier to review electronically.

B. Continuous Improvement

Outcome a. As mentioned previously, 75% is the attained expectation percentage, any assessment below that value is addressed to continuous improvement strategies. For this outcome the results indicated that the performance indicators were under 75% attained level for Balance of Matter and Energy and Physical chemistry (Table 4.3). Therefore, Mathematical principles, Calculus in solving, Mathematical Interpretation and Calculations performed need to be improved because Mathematics is a crucial engineering tool and a prerequisite for many courses of FIE curriculum.

Outcome b. In the course Research and Development of Food Industry the performance indicators reached more than 75%, while in Meat Science & Technology only in term of Spring 2017 a performance indicator reached more than 75% (Table 4.3).

Outcome c. In the last three semesters of assessments, the students of Automatic Control Systems of reached more than 75% in the performance indicators of this outcome. However, in Design of Food Industries, the students during the four semesters of assessments, obtained more than 75% in the performance indicators of this outcome (Table 4.3).

Outcome d. In both courses Milk Science & Technology and Meat Science & Technology, the students during the four semesters of assessments, obtained more than 75% except in the term of Spring 2018 (Meat Science & Technology) (Table 4.3).

Outcome e. In the course Material and Fluid Mechanics, the students did not meet 75%, in each performance indicator of this outcome in four terms, while in Unit Operations only a performance indicator level (Problem Statement (Identify)) was attained (75%) only in three semesters (Table 4.3).

Outcome f. In both courses Management and Disposal of Wastes and Science and Technology of Cereals, the students during the four semesters of assessments, obtained more than 75% except in the term of Spring 2018 (Science and Technology of Cereals) (Table 4.3).

Outcome g. In both courses, Heavy Metals in Food and Sensorial Evaluation, the student's outcome performance indicators reached the attained level of up 75% (Table 4.3).

Outcome h. In both courses, Agro-Industrial Hygiene and Management and Disposal of Wastes, the student's outcome performance indicators reached the attained level of up 75% (Table 4.3).

Outcome i. In the last three semesters of assessments, the students of Industrial Microbiology

of reached more than 75% in the performance indicators of this outcome except a student's outcome performance indicator in the Autumn of 2017 did not meet the 75% (Table 4.3).

Outcome j. In both courses, Food Biotechnology and Design of Food Industries, the students reached the outcome performance indicators (level of up 75%) in the four terms; however, one student's outcome performance indicator in the course Food Biotechnology of Autumn of 2017 did not meet the 75% (Table 4.3).

Outcome k. In both courses, Programming Languages and Computer Aided Design, the students reached the outcome performance indicators (level of up 75%) in the four terms, except in the Autumn of 2017, which students did not meet the 75% in the outcome performance indicators of Computer Aided Design (Table 4.3).

Table 4.3. Results for the Autumn 2016, Spring 2017, Autumn 201 and Spring 2018 assessment semesters, including details of evaluation instruments and specific results of each performance indicator in the rubrics.

SO	Artifact	Rubric Category	% attained in each Performance Indicator per class			
			Autumn 2016	Spring 2017	Autumn 2017	Spring 2018
a	551Mass and Energy Balances **Exam**	Mathematical principles	33%	42%	30%	45%
		Calculus in solving materials science a n d engineering	47%	45%	54%	71%
		Mathematical Interpretation	72%	49%	60%	69%
		Calculations performed	62%	61%	59%	73%
a	541 Physical chemistry **Exam**	Mathematical principles	N.A.	53%	44%	47%
		Calculus in solving materials science a n d engineering	N.A.	54%	41%	47%
		Mathematical Interpretation	N.A	50%	39%	43%
		Calculations performed	N.A.	60%	43%	47%
b	559 Research and Development of Food Industry **Article Review**	Design an experimental strategy	N.A.	73%	83%	91%
		Develop experimental work and data acquisition	N.A.	95%	98%	87%
		Analyze, interpret and compare experimental data appropriately	N.A	97%	94%	86%
b	558 Meat Science & Technology	Design an experimental strategy	65%	61%	58%	52%
		Develop	61%	64%	48%	57%

	Innovation of Meat Product	experimental work and data acquisition				
		Analyze, interpret and compare experimental data appropriately	**66%**	**82%**	**59%**	**60%**
c	552 Automatic Control Systems **Final Design Report**	Formulate the problem (identify the "need") and analyze constraints	**54%**	**90%**	**77%**	**82%**
		Establish "fitness" criteria for evaluating potential solutions and tradeoffs	**57%**	**86%**	**78%**	**82%**
		Generate alternative solutions	**56%**	**86%**	**85%**	**83%**
		Build a prototype and analyze performance	**70%**	**90%**	**87%**	**87%**
c	560 Design of Food Industries **Final Design Report**	Formulate the problem (identify the "need") and analyze constraints	**80%**	**78%**	**80%**	**78%**
		Establish "fitness" criteria for evaluating potential solutions and tradeoffs	**79%**	**77%**	**81%**	**77%**
		Generate alternative solutions	**81%**	**77%**	**81%**	**78%**
		Build a prototype and analyze performance	**84%**	**80%**	**81%**	**78%**
d	553 Milk Science & Technology **Teamwork Report**	Contributes to the Project or Team Work	**87%**	**85%**	**84%**	**81%**
		Assume Responsibility	**86%**	**78%**	**75%**	**76%**

		Recognizes the work of Team Members	83%	86%	78%	74%
		Creativity	88%	82%	80%	77%
d	558 Meat Science & Technology **Teamwork Report**	Contributes to the Project or Team Work	N/A	82%	81%	81%
		Assume Responsibility	N/A	88%	83%	84%
		Recognizes the work of Team Members	N/A	90%	76%	78%
		Creativity	N/A	77%	78%	84%
e	555 Unit Operations **Exam**	Problem Statement (Identify)	87%	74%	80%	77%
		Procedure (Formulate)	71%	64%	66%	64%
		Final Solution (Solve)	51%	51%	57%	54%
e	546 Material and Fluid Mechanics **An Integrative Learning Product**	Problem Statement (Identify)	61%	67%	74%	72%
		Procedure (Formulate)	61%	67%	74%	72%
		Final Solution (Solve)	66%	64%	68%	71%
f	571 Management and Disposal of Wastes **Learning Integrative Product**	Basic concepts	82%	92%	90%	90%
		Basic analysis of ethics and professionalism	81%	92%	89%	90%
		Application of ethics and professionalism	83%	86%	83%	85%
		Discussion of ethics and professionalism	83%	82%	91%	83%
f	556 Science and Technology of Cereals	Basic concepts	N/A	83%	88%	77%
		Basic analysis	N/A	79%	86%	76%

	Final Design **Oral Presentation**	of ethics and professionalism				
		Application of ethics and professionalism	**N/A**	**78%**	**84%**	**73%**
		Discussion of ethics and professionalism	**N/A**	**76%**	**83%**	**73%**
g	401 Heavy Metals in Food **Laboratory Reports Notebook**	Organization of the presentation	**82%**	**87%**	**N/A**	**N/A**
		Presentation of content in your own words to demonstrate understanding	**82%**	**87%**	**N/A**	**N/A**
		Presentation of data to support the information of the subject in the presentation	**82%**	**87%**	**N/A**	**N/A**
		Demonstrates proper use of Spanish	**82%**	**87%**	**N/A**	**N/A**
g	557 Sensorial Evaluation **New Food Product**	Organization of the presentation	**94%**	**89%**	**97%**	**89%**
		Presentation of content in your own words to demonstrate understanding	**95%**	**88%**	**95%**	**88%**
		Presentation of data to support the information of the subject in the presentation	**93%**	**89%**	**97%**	**92%**
		Demonstrates proper use of Spanish	**96%**	**92%**	**98%**	**92%**

h	459 Agro-Industrial Hygiene **Oral Presentation**	Engineering solutions	**86%**	**84%**	**84%**	**80%**
		Engineering decisions	**87%**	**82%**	**86%**	**80%**
h	571 Management and Disposal of Wastes **Oral Presentation**	Engineering solutions	**N/A**	**82%**	**81%**	**87%**
		Engineering decisions	**N/A**	**81%**	**78%**	**86%**
i	544 Industrial Microbiology **Review and Seminar**	It explores a topic in depth, producing a great awareness and / or little-known information that indicates an intense interest in the subject.	**59%**	**85%**	**92%**	**93%**
		Complete the required work, generate and look for opportunities to expand knowledge and skills.	**45%**	**84%**	**90%**	**89%**
		Educational interests and activities exist and thrive outside of the classroom requirements. Knowledge and / or experiences are carried out independently	**45%**	**79%**	**82%**	**87%**
		It refers explicitly to prior learning and is applied in an	**48%**	**78%**	**73%**	**88%**

		innovative (new and creative) way than the knowledge and skills to demonstrate understanding and performance in novel situations.				
		Review previous learning (past and present in and outside the classroom) on the surface, without revealing clear meaning or indicating a broader perspective on educational or life events.	**58%**	**78%**	**88%**	**92%**
j	539 Food Biotechnology **Oral Presentation**	Identify contemporary issues related to engineering	**77%**	**95%**	**83%**	**89%**
		Explain potential solutions	**73%**	**97%**	**84%**	**91%**
j	**560** Design of Food Industries	Identify contemporary issues related to engineering	**81%**	**79%**	**82%**	**78%**
		Explain potential solutions	**82%**	**76%**	**81%**	**75%**
k	437 Programming Languages **Computer Program**	Identify engineering tools for a given practical situation	**79%**	**84%**	**78%**	**79%**
		Explain engineering tools to use in engineering practice	**93%**	**80%**	**77%**	**78%**

		Apply engineering tools to use in engineering practice	**93%**	**96%**	**88%**	**94%**
k	438 Computer Aided Design Drawing	Identify engineering tools for a given practical situation	**84%**	**100%**	**74%**	**82%**
		Explain engineering tools to use in engineering practice	**84%**	**100%**	**74%**	**82%**
		Apply engineering tools to use in engineering practice	**84%**	**100%**	**74%**	**84%**

Table 4.4. Assessment results for the Autumn 2016, Spring 2017, Autumn 201 and Spring 2018 that did not meet the attained level of 75%. (Revised June 2018)

- *Key: (✔) (Good); R(Revise); X(Eliminate);N(New)*

SO	Rubric Category	Spring 2018	Rub.	Assig.	Class	Recommendation	Status June 2018
a	Mathematical principles	45%	✔	✔	R	Give to students several guides (step by step) to apply it in problem solving. Give to student's homework (3 sets of exercises to solve) Implement a program for students who requires mathematical advising, including tutorials in websites.	Class contents revised. Class Teaching Strategies revised. Application to Dean of School of Agronomy for implementation of Mathematical advising Program
	Calculus in solving materials science and engineering	71%	✔	✔	R		
	Mathematical Interpretation	69%	✔	✔	R		
	Calculations performed	73%	✔	✔	R		
a	Mathematical principles	47%	✔	✔	R	Give to students several guides (step by step) to apply it in problem solving. Give to student's homework (3 sets of exercises to solve) Implement a program for students who requires mathematical advising, including tutorials in websites.	Class contents revised. Class Teaching Strategies revised. Application to Dean of School of Agronomy for implementation of Mathematical advising Program
	Calculus in solving materials science and engineering	47%	✔	✔	R		
	Mathematical Interpretation	43%	✔	✔	R		
	Calculations performed	47%	✔	✔	R		

b	Design an experimental strategy	**52%**	✔	✔	**R**	Give to students several guides (step by step) to apply it in problem solving. Give to student's homework (3 sets of exercises to solve)	Class contents revised. Class Teaching Strategies revised.
	Develop experimental work and data acquisition	**57%**	✔	✔	**R**	Implement a program for students who requires Statistical Methods advising, including tutorials in websites and use of Software (Excel).	Application to Dean of School of Agronomy for implementation of Statistical Methods advising Program
	Analyze, interpret and compare experimental data appropriately	**60%**	✔	✔	**R**		
d	Recognizes the work of Team Members	**74%**	✔	✔	**R**	Before starting the first semester, the students will take a course on Teamwork	Application to Dean of School of Agronomy for implementation of Teamwork course
e	Procedure (Formulate)	**64%**	✔	✔	**R**	Give to students several guides (step by step) to apply it in problem solving. Give to student's homework (3 sets of exercises to solve)	Class contents revised. Class Teaching Strategies revised.
	Final Solution (Solve)	**54%**	✔	✔	**R**	Give to students several guides (step by step) to apply it in problem solving. Give to student's homework (3 sets of exercises to solve)	Application to Dean of School of Agronomy for Implementation of Mathematical advising Program

						Implement a program for students who requires mathematical advising, including tutorials in websites.	
e	Problem Statement (Identify)	**72%**	✔	✔	**R**	Give to students several guides (step by step) to apply it in problem solving. Give to student's homework (3 sets of exercises to solve)	Give to students several guides (step by step) to apply it in problem solving. Give to student's homework (3 sets of exercises to solve)
	Procedure (Formulate)	**72%**	✔	✔	**R**		
	Final Solution (Solve)	**71%**	✔	✔	**R**	Give to students several guides (step by step) to apply it in problem solving. Give to student's homework (3 sets of exercises to solve) Implement a program for students who requires mathematical advising, including tutorials in websites.	Give to students several guides (step by step) to apply it in problem solving. Give to student's homework (3 sets of exercises to solve) Implement a program for students who requires mathematical advising, including tutorials in websites.
f	Application of ethics and professionalism	**73%**	✔	✔	**R**	Write original works	Give to students the document of Honor Code
	Discussion of ethics and professionalism	**73%**	✔	✔	**R**	Don't make up data to accomplish the food industry standards and regulations	

C. Semesterly SO Assessment Results

The results, obtained from this evaluation, allow defining the continuous improvement activities as follows:

Next year goals (2019) (according to results obtained in Table 4.4.).

Outcome (a) and (e)

- Give to students several guides (step by step) to apply them in problem solving (Appendix 11).
- Give to student's homework (3 sets of exercises to solve).
- Implement a program for students who requires mathematical advising, including tutorials in websites.

Outcome (b)

- Give to students several guides (step by step) to apply them in problem solving (Appendix 11).
- Give to student's homework (3 sets of exercises to solve).
- Implement a program for students who requires Statistical Methods advising, including tutorials in websites and use of Software (Excel).

Outcome (d)

- Give to students several guides (step by step) to apply them in problem solving (Appendix 11).
- Give to student's homework (3 sets of exercises to solve).

Outcome (f)

- Write original works using text evaluation and check list for academic reports (Appendix 12 and Appendix 13).
- Follow Honor Code to accomplish the food industry standards and regulations.

Others

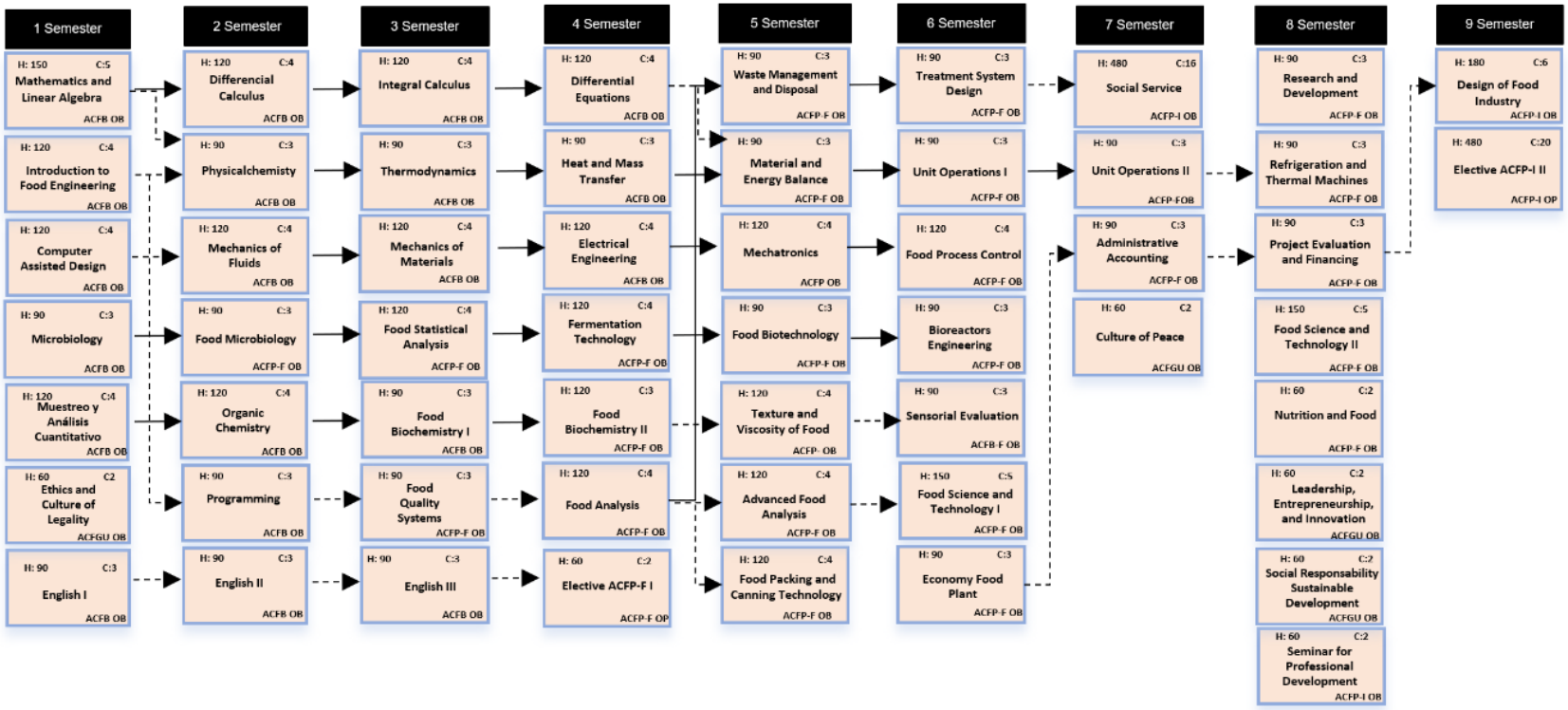
- Practice final integration products and conduct experiments for data analysis & interpretation looking for improving designs.
- Approach real problems related to industry that allows recognition of the need and ability to engage in life-long learning.
- Within of the propaedeutic course program for all first-semester students it will be implemented obligatorily, a workshop on group dynamics which includes effective communication, cooperation and harmony, positive integration, synergy and commitment.
- The outcomes of the students will be assessed with a diagnostic test prepared by the QC-FIE, which is proposed in fifth semester and if the student's score is not satisfactory, it will take a refresher course and once again take the exam next semester.
- Because of the Autonomous University of Nuevo Leon Academic Model and ABET-EAC recommendations, it has been developed a new FIE Constituents Study in July 2017 and finally a new curriculum has been created and approved for the university and it will start on January of 2018 (Table 4.5).

Table 4.5. New Curriculum for Educational Program of Food Industry Engineer to start up in January of 2019.

UANL
UNIVERSIDAD AUTÓNOMA DE NUEVO LEÓN

FACULTAD DE AGRONOMÍA

Curriculum: Food Industry Engineer



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