UNIVERSIDAD AUTÓNOMA DE BAJA CALIFORNIA

COORDINACIÓN GENERAL DE FORMACIÓN BÁSICA
COORDINACIÓN GENERAL DE FORMACIÓN PROFESIONAL Y VINCULACIÓN UNIVERSITARIA
LEARNING UNIT PROGRAM

I. IDENTIFICATION DATA

1. **Academic Unit**: Faculty of Chemical Sciences and Engineering, Tijuana campus; Faculty of Mexicali, Mexicali campus; Faculty of Engineering, Architecture and Design, Ensenada campus, Faculty of Engineering and Business, Tecate, School of Engineering Sciences and Technology Valle de las Palmas.

2. **Educational program:** Industrial Engineer

3. **Educational plan:** 2019-2

4. **Name of the Learning Unit:** Cleaner Production

5. **Code**: 34938

6. **HC:** 02 **HL:** 00 **HT:** 02 **HPC:** 00 **HCL:** 00 **HE:** 02 **CR:** 06

7. **Formation Stage to Which Belongs**: Disciplinary

8. **Type of the Learning Unit**: Optional

9. **Requirements to take the Learning Unit:** None

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Learning Unit design team	**Signature**
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Approval of deputy director (s) of Academic Unit (s)	**Signature**
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Date: September 6, 2018

II. PURPOSE OF THE LEARNING UNIT

Cleaner Production (CP) is a learning unit that is in the disciplinary stage of Industrial Engineering Program, and have an optional character. Has as a purpose to offer the student the theoretical-practical knowledge to increase the global efficiency of a production system of goods or services from an environmental and economic perspective. This knowledge will allow students to enter into cutting-edge topics of eco-efficiency, new fields of application of Industrial Engineering and therefore new opportunities for their use in "green" companies.
This learning unit that is located in an optional disciplinary stage, belongs to the Production area.

III. COMPETENCE OF THE LEARNING UNIT

Implement sustainable improvements in the production processes of goods or services, through pollution prevention techniques, optimization of resources and compliance with regulations to increase efficiency, reduce the generation of waste, improve quality and the environment, and increase competitiveness by decreasing costs, with a high sense of responsibility and ethics.

IV. EVIDENCE (S) OF PERFORMANCE

Deliver an implementation plan for a real case in industry, using Cleaner Production technics. The document must be in the IMRaC format (Introduction, Methodology, Results and, Conclusions). The references used should be current and must be no more than five years old.

V. DEVELOPMENT PER UNITS

UNIT I. Principles of cleaner production

Competence:
Identify the factors that intervene in cleaner production, using the definitions and concepts about waste to visualize the possible fields of application, in a responsible and proactive way.

Content: **Duration:** 4 hours

1.1 Definition of cleaner production
1.2 What it means to minimize waste and emissions
1.3 Cleaner Production versus End-of-Tube
1.4 Factors that cause waste and emissions
1.5 Barriers to cleaner production implementation

UNIT II. The basis for cleaner production

Competence:
Identify the necessary data using a material flow analysis to discover the appropriate actions in cleaner production, with a responsible and analytical attitude.

Content: **Duration:** 6 hours

2.1 Data collection and validation
2.2 Classification of waste for the origin
2.3 Mass flow within the company
2.4 Team, policy and motivation
2.5 PML vs. ISO 14001

UNIT III. Evaluation and feasibility studies

Competence:
Apply feasibility methods through the different techniques of productive system analysis, to prioritize cleaner production options, differentiating those that can implement immediately and those that need a more detailed analysis, in an honesty and integrity way.

Content: **Duration:** 12 hours

3.1 What is a process?
3.2 Components of a process
3.3 Analysis of inputs and outputs
3.4 Material flow analysis
3.5 Energy flow analysis
3.6 Evaluation of PML options identified
3.7 Tools for financial analysis

UNIT IV. Implementation of cleaner production

Competence:
Prepare the implementation plan by establishing detailed technical specifications and continuous monitoring, to increase competitiveness by combining quality and environmental aspects, with a responsible and proactive attitude.

Content: **Duration:** 10 hours

4.1 Implementation of good practices / low-cost options
4.2 Implementation of medium and long-term options
4.3 Design and construction
4.4 Monitoring, monitoring, and evaluation of results
4.5 Continuous Improvement

VI. STRUCTURE OF WORKSHOP PRACTICES				
No. of Practice	**Competences**	**Description**	**Support material**	**Duration**
1	Identify the elements of cleaner production through the review of case studies, to visualize the possible application according to different productive sectors, with a critical attitude.	The student through different readings of recent articles will become familiar with the possible applications of cleaner production. After he elaborates a table of comparison with the different elements that they have in each case of study of the previous readings.	Notes of the subject, library database to obtain articles on cleaner production case studies, computer, white sheets, pencil, eraser, notebook, blackboard.	4 hours
2	Elaborate calculations and diagrams using different tools of analysis and evaluation of cleaner production, to identify the ideal tool for the conditions of operation of the productive system, with a responsible attitude.	The student develops a portfolio with the different diagrams obtained in the input and output analysis, material flow analysis, energy flow analysis applied to the case study of the final project. The activity is as a team.	Notes of the subject, library database to obtain articles on cleaner production case studies, computer, white sheets, pencil, eraser, notebook, blackboard.	8 hours
3	Develop an application project applying the different techniques of cleaner production, to achieve a balance between cost, quality and a product/service friendly to the environment, with responsibility and honesty.	The students prepare a cleaner production project applied to the study of a real case, which includes a pre-feasibility, technical-economic and environmental feasibility study. The project will be delivered with the IMRaC structure. The student will use the articles obtained in the database of the library for the comparison of their results. The activity is as a team. The project must be delivered electronically and exposed to the class.	Notes of the subject, Office and Visio software, library database to obtain articles on cleaner production case studies, computer, white sheets, pencil, eraser, notebook, blackboard.	20 hours

VII. WORK METHOD

Framing: The first day of class the teacher must establish the work form, evaluation criteria, quality of academic work, rights and obligations teacher-student. The information will always be available on the Blackboard platform.

Teaching strategy (Teacher)
The teacher will provide material, propose various activities to complement the information, and explain the base exercises of the different units. To give a guide to the student, the teacher will rely on information, communication and collaboration technologies (TICC's). The feedback provided by the teacher will be in classes or through the Blackboard platform.

Learning strategy (student)
The student will make reports of the different activities and solve different exercises and case studies for the understanding of the topics seen. Finally, as a team, will carry out a project in which show an implementation plan to a real case of cleaner production in the industry.

VIII. EVALUATION CRITERIA

The evaluation will be carried out permanently during the development of the learning unit as follows:

Accreditation criteria

- In order to have the right to ordinary and extraordinary exam, the student must comply with the percentages of attendance established in the current School Statute.
- Scaled from 0 to 100, with a minimum approval of 60

Evaluation criteria

- 3 Exams……30%
- Participation ……10%
- Workshop reports ……...30%
- Final project ……30%

Total……100%

The exams will include the theoretical and practical aspects of the subject. Workshop reports have qualification and validity only if is delivered on time. The final project should be for a real application.

IX. REFERENCES

Basics

Boons F., Montalvo C., Quist J., Wagner M. (2013) *Sustainable innovation, business models and economic performance: an overview*. Journal of Cleaner Production. 45, 1-8.

Dieleman H. (2007) *Cleaner production and innovation theory. Social experiments as a new model to engage in cleaner production.* Revista Internacional de Contaminación Ambiental. 23, 79-94. [clásica]

Jha N.K. (2015) *Green design and manufacturing for sustainability*. 1st Edition, USA: CRC Press. Taylor & Francis Group, 794 pp

Mclean T. (2014) *Grow your factory, grow your profits. Lean for small and medium-sized manufacturing enterprises*. 1st Edition, USA: CRC Press. Taylor & Francis Group, 175 pp

Nazzal D., Batarseh O., Patzner J., Martin D. (2013) *Product servicing for lifespan extension and sustainable consumption: An optimization approach*. International Journal of Production Economics. 142, 105-114.

Pampanelli A., Trivedi N., Found P. (2015) *The Green Factory: Creating Lean and Sustainable Manufacturing*. 1st Edition, USA: CRC Press. Taylor & Francis Group, 165 pp

(Articulos varios) Journal of Cleaner Production. ISSN 0959-6526. Elsevier.

Complementary

Da Silva M.E., Gabriel de Oliveira A.P., Pasa Gómez C.R. (2013) *Can collaboration between firms and stakeholders stimulate sustainable consumption? Discussing roles in the Brazilian electricity sector.* Journal of Cleaner Production. 47, 236-244.

Rivas Quinto J.F. (2012) *Negocios verdes. La nueva realidad de los negocios del siglo XXI.* 1era edición, Colombia: Datanexos S.A.S., 440 pp

Tseng M.L., Chiu S.F., Tan R.R., Siriban-Manalang A.B. (2013) *Sustainable consumption and production for Asia: sustainability through green design and practice*. Journal of Cleaner Production. 40, 1-5.

Wills B. (2009) *Green Intentions: Creating a Green Value Stream to Compete and Win*. 1st Edition, USA: CRC Press. Taylor & Francis Group, 296 pp [clásica]

X. TEACHER'S PROFILE

The professor of the subject must have a degree of Industrial Engineer, or Environmental Engineer, or Environmental Sciences Area, preferably with a postgraduate degree in topics of Engineering.
Preferably with experience of three years in the professional area and/or in teaching, in both cases with ascertainable knowledge in the topic of application of sustainable production systems. Preferably with teacher training courses during the last year.
The teacher must be respectful, responsible, proactive, innovative, analytical, with the ability to propose solutions, to encourages teamwork and an interest in teaching.