Universidad Juárez del Estado de Durango

Facultad de Ciencias Forestales

Learning Unit Programme
With an integral professional competences approach

I. LEARNING UNIT GENERAL DATA

1. learning Unit Name				**2. Code**	
Soil Bioremediation				**8511**	
3. Academic Unit					
FORESTRY SCIENCES FACULTY					
4. Academic programme				**5. Level**	
Environmental Management Engineering				**Higher**	
6. Training Area					
Discipline					
7. Academy					
Environmental engineering					
8. Modality					
Mandatory	**X**	**Course**	**X**	**Attendance**	**X**
Elective		**Course-workshop**		**Non-attendance**	
		Workshop		**Mixed**	
		Seminar			
		Laboratory, field practice, etc.	**X**		
		Professional Practice			
		Academic Stay			
9. Pre-requirements					
Environmental Biology, Biochemistry, Microbiology, Biotechnology, Physic-chemistry, Soil Pollution and Pollution Process					

Management				
10. Theory hours	**Practice hours**	**Independent study hours**	**Total hours**	**Credits**
4	2	0	6	6
11. Names of the teachers who participated in the development and/or modification of the programme				
ROBERTO FLORES ZAMORA				
12. Date of development		**Date of modification**		**Date of approval**
08/08/2016				04/10/2016

II. LEARNING UNIT SPECIFIC DATA	
13. Presentation	
Bioremediation or bioremediation systems consist primarily of the use of natural microorganisms (bacteria, fungi, protozoa, plants of some species) existing in the medium to decompose or degrade hazardous substances into less toxic substances for the environment and for the population. The types and factors that influence the degradation processes of the pollutants will be described, applying the methods in practical exercise.	
14. Integral professional competences to develop in the student	
Generic competences	Instrumental 1. Capability for analysis and synthesis. 2. Capability for organization and planning. 3. Oral and written communication. 4. Computer skills related to the field of study. 5. Information management capability. 6. Problem solving. 7. Decision making. Personal 8. Team work 9. Critical thinking Systemic 10. Ethical commitment 11. Self-directed learning

	12. Creativity 13. Leadership and entrepreneurial spirit 14. Motivation for quality 15. Sensitivity to environmental issues 16. Ability to apply theoretical knowledge in practice 17. Use of the internet as a means of communication and as a source of information 18. Ability to communicate with non-experts in the field
Professional competences	Management in the quality and treatment of the soil. The graduate designs and manages soil bioremediation programs.
General purpose of the course	Identify techniques and methods of bioremediation of contaminated soils.

15. Joint of axes

The learning unit is articulated with the transversal axes established from the educational model and congruence and strengthen the axes of research, ethics and values and environmental awareness. The unit is integrated into the disciplinary training area.

16. development of the course

Module 1	Physical and chemical properties of the soil			
Intended learning	**Learning contents**	**Learning product(s)**	**Strategies**	**Teaching resources and materials**
The student characterizes the basic elements of soil formation and its biological dynamics.	Physical properties of the soil (texture, pH, electrical conductivity, porosity, density, volume, soil structure). Main groups of pollutants that affect the soil system and its components.	Prepare a report and explain the various concepts and importance of edaphic characteristics that influence microbial activity. Make a conceptual map of the bioremediation theme identifying the techniques and determining factors.	Read the general documents on the subject. Write synthesis and prepare electronic exhibition and develop conceptual map	Documents, projector, PPW presentation, posters, internet use.

	Leaching and percolation processes, surface water and groundwater	Identifies conditions that favor the flow of water into the soil.	Investigate the factors and prepare synopsis.	Documents, projector, PPW presentation, posters, internet use.
Module 2	Pollution factors and forms of bioremediation			
Intended learning	**Learning contents**	**Learning product(s)**	**Strategies**	**Teaching resources and materials**
Identify the factors that affect soil contamination and the types of remediation of contaminated soils.	Industrial and urban pollutants. Volatile and non-volatile organic compounds. Hydrocarbons. Inorganic compounds and heavy metals. Physicochemical characteristics.	Report of comparative analysis of industrial pollutants. Classification table for hydrocarbons	He presents his comparative analysis to the plenary session. Promotes discussion and practices co-evaluation	Projector, reading documents, evaluation tools, internet use.
	Enzymatic remediation, Microbial remediation, Phytoremediation.	Essay on the factors that determine the influence of soil organisms on bioremediation.	The results are discussed in the plenary session and conclusions are reconciled, the discussion is promoted and co- evaluation is practiced	Presentation in sheets, evaluation instruments
Module 3	Remediation techniques and methods and evaluation parameters			
Intended learning	**Learning contents**	**Learning product(s)**	**Strategies**	**Teaching resources and materials**
Understand and apply remediation techniques and	Techniques: Aerobic and anaerobic, in-situ, Ex situ	Exercise designed for the application of techniques in controlled conditions	Experimental design for the application of an ex situ technique for the treatment of soil	Site of the experiment, containers to contain contaminated soil, use of laboratory techniques. Temporary disposal of hazardous waste resulting

methods, identifying the main evaluation parameters			contaminated with hydrocarbons	from the exercise
	Methods: bioventing, Bio-stimulation, attenuation, bio-piles, composting.	Exercise designed for the application of techniques in controlled conditions. Visit report to a company or bioremediation project.	Experimental design for the application of two methods for the treatment of soil contaminated with hydrocarbons. Visit to a company that applies bioremediation methods.	Site of the experiment, containers to contain contaminated soil, use of laboratory techniques. Temporary disposal of the hazardous waste resulting from the exercise.

17. Performance assessment:

Performance evidence(s)	Performance criteria	Application scopes	percentage
Reports, conceptual map Presentation, Comparative analysis, Essay, checklists of self- assessment and co-evaluation	In all the works content, extension and presentation, use of tools, capability for explanation, analysis and synthesis, understanding and handling of the debate, defence to group, team work, delivery opportunity, value judgment issuance are valued.	In the issuance of reports. In the management, design of presentations. In the review of documents and construction of abstracts. Debate management, team integration. In the issuance of reports and judgments on the subject	Formative evaluation 25% Summative evaluation 60% Self-evaluation 10% Co-evaluation 5%

18. Evaluation criteria:

Criterion	Value
Formative Evaluation	Teamwork, attendance and punctuality, timeliness in delivery, attitude and respect for people and property. 25%
Summative evaluation	Form and content of products, management of the files, handling of the debate, daily participation in class, written test results, field practice report. 75%
Criteria summation	100%

19. accreditation

The ideal condition is that the development of the competition is evident and adheres to the percentages established in the different criteria, however minimums are established to assess the degree of mastery of the competence and obtain the credits of the Learning Unit, in accordance with the following: 50% of their performance or summative evaluation; 10% of the formative evaluation; (self- assessment and co-evaluation).

20. Information sources

Basic	Alarcón A., Ferrrera-Cerrato R., 2013. Biorremediacion de Suelos y Aguas Contaminadas con compuestos orgánicos e inorgánicos. Ed Trillas, ISBN 978-607-17-1617-0 Alexander M. 1980. Introducción a la microbiología del suelo. AGT Editor, S.A. ISBN 968-462-002-0 Henry, J.G. y Heinke, G.W., 1999. Ingeniería Ambiental. Edit. Prentice Hall. I.Marín, J.L. Sanz y R. Amils. 2005. Biotecnología y Medio Ambiente, Editorial Ephemera ISBN: 84-609-7344-1 R. M. Atlas, R. Bartha.2001. Ecología microbiana y microbiología ambiental ISBN: 8478290397. Madrid, Addison Wesley. Volke Sepúlveda T., Velasco Trejo J.A. 2002, Tecnologías de remediación para suelos contaminados. , INE SEMARNAT. Volke Sepúlveda T., Velasco Trejo J.A. 2003, El composteo: una alternativa tecnológica para la remediación de suelos en México. Gaceta Ecológica, INE SEMARNAT.
Complementary	INE. SEMARNAT. 2004. Environmental Microbiology. Irma Rosas, Alejandro Cravioto, Exequiel Ezcurra, Compilers Nebel, B.J. and Wright, R.T. 1999. Environmental Sciences. Ecology and sustainable development. Pearson Education. Westamn, W.E., 1985. Ecology, impact assessment and environmental planning. Edit. JohnWiley and Sons. A Singh and O.P.Ward. 2004. Biodegradation and Bioremediation. Springer-VerlagBerlin Heidelberg ISBN: 978-3-540-

	21101-3 A. Singh and O.P.Ward. 2004. Applied Bioreaction and Phytoremediation. Springer-VerlagBerlin Heidelberg ISBN: 3-540-21020

21. Profile for the teacher who imparts this learning unit

Postgraduate in environmental matters and specialist soils and contamination, as well as experience in the incidents of soil contamination with hydrocarbons and participation and supervision of soil remediation work. Training in the management of groups with focus on competencies and teaching strategies to promote learning