



Course Specification

(Bachelor)

Course Title: Bioremediation and Biodegradation of hazardous waste

Course Code: APEP3602

Program: Diploma - Technology of Environmental Protection

Department: Department of Biology

College: Faculty of Sciences

Institution: Umm Al-Qura University

Version: 2

Last Revision Date: 12 / 2024

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A. General information about the course:

1. Course Identification

1. Credit hours: (2)

2. Course type

A. ☐ University ☐ College ☒ Department ☐ Track ☐ Others
B. ☒ Required ☐ Elective

3. Level/year at which this course is offered: (2nd Year /5th Level)

4. Course General Description:

In this course: introduction to environmental pollutions, biodegradation and bioremediation of different chemical and biological pollutants including plant and animal wastes, home bio-wastes, pesticide, dyes, heavy metals will be covered. In additions, waste-water treatments, physical, chemical and biological factors affecting biodegradation and bioremediation will be discussed. Roles and use bacteria, fungi, algae, special plants in bioremediation and removing pollutants will be discussed. Mechanisms and pathways of bioremediation and biodegradation of pollutant will be discussed. Roles of microorganisms in biodegradation of plastic materials.

5. Pre-requirements for this course (if any):

Applied and Fundamentals of Environmental Microbiology

6. Co-requisites for this course (if any):

7. Course Main Objective(s):

Course Main Objective

- After completing this course students should be able to:
- List the major types of Microorganisms in the environment.
- Understand of the risks of the environmental pollutants on human, animal and plants.
- List the benefits and hazardous roles of the microorganisms in the environment and life.
- Differentiation between bioremediation and biodegradation.
- List the type of environmental pollutants.
- Understand the Pathways of microbial bioremediation of pollutants.
- Summarize physical, chemical and biological factors affecting pollutants degradation.
- Understand biodegradation and bioremediation of plant and animal organic matter, home bio-waste, pesticides, insecticides, textile dyes, and heavy metals.
 - Roles of microorganisms in biodegradation of plastic materials.
 - Discuss the concept of the polluted soil, Phytoremediation, Biodegradation of pesticides, insecticides, roles of soil microorganisms in biodegradation of pesticides and insecticides.



- Roles of algae, bacteria, actinomycetes and fungi in bioremediation and biodegradation.

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	30	80%
2	E-learning		20%
3	Hybrid <ul style="list-style-type: none"> Traditional classroom E-learning 		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	Lectures	30 h
2.	Laboratory/Studio	14 h
3.	Field	
4.	Tutorial	
5.	Others (specify)	
Total		

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	Knowledge and understanding			



1.1	<ul style="list-style-type: none"> • Having successfully completed the course students should be • Understand of the risks of the environmental pollutants on human, animal and plants • List the benefits and hazardous roles of the microorganisms in the environment and life. • List the type of environmental pollutants • List the type of environmental pollutants • Summarize physical, chemical and biological factors affecting pollutants degradation • List the methods used for biological treatment • Familiar with Microorganisms used in bioremediation of plastic wastes • List of the Microorganisms used in bioremediation of heavy metals • Understand the roles of algae, bacteria, actinomycetes and fungi in bioremediation and biodegradation • List plants that used in phytoremediation 	K1, K2 & K3	<ul style="list-style-type: none"> • Lectures which must start with preliminary one showing course contents • Using images and movies • Studying microorganisms from different environmental specimens in the lab. • Encouraging students to collect new information about different important microorganisms used in bioremediation and biodegradation of the different pollutants • Enable the reference books and scientific sites concerning environmental pollutants. 	<ul style="list-style-type: none"> •Periodical exam and reports 10% •Mid-term theoretical exam 20%. •Mid-term practical exam 5%. •Final practical exam 15%. •Final exam 50%
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Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
2.0	Skills			
2.1	Cognitive skills to be developed <ul style="list-style-type: none"> • Having successfully completed the course students should be able to: <ul style="list-style-type: none"> • Differentiation between bioremediation and biodegradation . • Understand of the risks of the environmental pollutants on human, animal and plants • Discuss the benefits and hazardous roles of the microorganisms in the environment and life. • Discussed the mechanisms and pathways of pollutant bioremediation and biodegradation. • Explain why some microorganisms could degrade the pollutant and others couldn't. • Understand of the roles and use bacteria, fungi, algae, special plants in bioremediation and removing pollutants • Describe and explain how some microorganisms could degrade plastic materials and others could not. • Describe the roles of bacteria, fungi, algae, special plants in bioremediation of pollutants • Understand biodegradation and bioremediation of organic matter, pesticides, insecticides, crude oil wastes, textile dyes, and heavy metals, • Discuss the concept of the polluted soil, Phytoremediation, Biodegradation of pesticides, 	S1, S2, S3, S4, S5 & S6	<ul style="list-style-type: none"> • Lectures. • Brain storming. • Discussion. 	<ul style="list-style-type: none"> • Exam must contain questions that can measure these skills. • Quiz and exams. • Discussions after the lecture.



Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	insecticides, roles of soil microorganisms in biodegradation of pesticides and insecticides <ul style="list-style-type: none"> • Understand the roles of algae, bacteria, actinomycetes and fungi in bioremediation and biodegradation • Understand the role some plant in phytoremediation 			
2.2	Psychomotor Skills <ul style="list-style-type: none"> • Upon successful completion of this course, the student is expected to be able to: • Perform the laboratory experiments precisely • Operate all devices in the lab • Perform aseptic microbiological techniques. • Preparation different media for isolation and cultivation of microorganisms 		- Follow up students the students in lab and carry out all the laboratory experiments	-Giving additional marks for the students they have accurate laboratory results and good seminar presentation -Practical exam.
3.0	Values, autonomy, and responsibility			
3.1	<ul style="list-style-type: none"> • Upon successful completion of this course, the student is expected to be able to: • Developing oral presentations. • Communicating personal ideas and thoughts. • Work independently and as part of a team to finish some assignments. • Communicate results of work to others. • Use of needed precautions when dealing with pathogen microorganisms 	V1, V2, V3 & V4	<ul style="list-style-type: none"> - Case Study - Active learning - Small group discussion - Homework (preparing a report on some topics related to the course depending on web sites). - Seminars presentation - 	<ul style="list-style-type: none"> - Oral exams. - Evaluate the efforts of each student in preparing the report. - Evaluate the scientific values of reports. - Evaluate the work in team - Evaluation of the role of each student in lab group assignment



Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	<ul style="list-style-type: none"> • Demonstrate professional attitudes and behaviors towards others. • Propose the smart questions • Understand and dissect the problem so that it is fully solved understood. • Demonstrate the assertiveness for his decision. • Demonstrate his capability for the responsibility and Accountability • Show Effective verbal communication with clarity and must be characterized with the following interpersonal attributes; (verbal communication, Non-verbal communication, good listening for the others, questioning, good manners, problem-solving, social awareness, self-management, responsibility, and accountability) • Enhancing the ability of students to use computers and the internet. • Interpret the laboratory data. • Know how to write a report. 			- Evaluation of students presentations

C. Course Content

No	List of Topics	Contact Hours
1.	Bioremediation its History ,Identification and Elements <ul style="list-style-type: none"> - Differentiation between bioremediation and biodegradation - Concept of environmental pollutions - Environmental hazards 	2
2.	<ul style="list-style-type: none"> - principles of Bioremediation - Biological treatment -Advantages of Bioremediation and biodegradation 	2





	<ul style="list-style-type: none"> - Problems face the biological treatments - Pollutants suitable for biological treatment - methods for biological treatment -Microorganisms involved in bioremediation 	
3.	-bioremediation Strategies *In situ bioremediation Techniques - bioventing - In situ biodegradation- biosparging -biougmentation *Ex situ bioremediation - landfarming - composting -biopiles -bioreactors *Advantages and disadvantages of bioremediation	2
4.	* Pathways of microbial bioremediation -Dichlorination - Hydrolysis - Cleavage - Oxidations - Dehydrogenation - Dehalogenation * Factors affect the bioremediation of pollutants * Bioavailability of environmental pollutions	2
5.	Bioremediation of heavy metals-polluted ecosystems - Sources of pollution with heavy metals - Biological removal of heavy metals - Mechanisms of removal of heavy metals - Microorganisms used in the bioremediation of heavy metals - Biomining and bioleaching	2
6.	Midterm - Exam	2
7.	- Biological treatment of wastewater - Microbial and chemical composition of domestic wastewater and sewage -Chemical composition -Microbial composition -Physical characteristics Treatment methods of wastewater and sewage	2
8.	Stages of wastewater and sewage treatment: (a)- preliminary treatment -Screen -Grit chambers -Primary sedimentation. Stages of wastewater and sewage treatment: (b)- biological treatment - Biological filters- Rotatable biological discs -Activated sludge -Anaerobic hybrid system-Oxidation ditches -Oxidation ponds -Aerated lakes.	2
9.	Methods of sludge treatments -Sludge composition -Sludge treatment -Practical benefits of treated sludge -Preparation of sludge of use	2
10.	Phytoremediation	2





11.	Mycoremediation of Environmental pollutants	2
12.	bioremediation of Petroleum Contamination	2
13.	Biodegradation of nitrogen-containing pollutants -Biodegradation of Azo dyes	2
14.	Bioremediation of polluted soil (pesticides) - Effect of heavy metal on microorganisms and plants - Consequences of soil deterioration - Biodegradation of pesticides, insecticides -Roles of soil microorganisms in biodegradation of pesticides and insecticides	2
15.	Bioremediation of air pollution - Phytoremediation of pollutant air - Examples of phytoremediation of air pollutants	2
16.	Evaluation of bioremediation - Methods for flow and evaluation of biological treatment - Evaluation of toxicity risks - Environmental biomarkers	2
Total		

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Quiz 1 (Theory)	3	10%
2.	Midterm examination (Theory)	6	30%
4.	Group project	9-10	10%
6.	Final examination (Theory)	16	50%
	TOTAL	100%	

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	<p>(1) Rashed Zaghloul, Hussien Abulreech, Khaled Elbanna (2021), Bioremediation of environmental pollutants, Tkween Publisher, Saudi arabia</p> <p>(2)- Ollivier, B. and Magot, M. (2005) <i>Petroleum Microbiology</i>. ASM Press, Washington DC, USA.</p>
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	<p>(3)- Atlas, RM, and Philp, J. (2005) <i>Bioremediation: Applied Microbial Solutions for Real-World Environmental Cleanup</i>. ASM Press, Washington DC, USA.</p> <p>(4)- Book Title: Bioremediation of Environmental Pollutants Author: Alaa El-Din Bayoumi Abdel Khaleq Year: 1441</p> <p>(5)- Handbook of Water and Wastewater Treatment Technologies. Editor Nicholas P. Cheremisinoff Elsevier 2002. ISBN 978-0-7506-7498-0.</p> <p>(6)-Introduction to Wastewater Treatment Processes - 2nd Edition, R. Ramalho (Editor) EBook ISBN: 9780080925332- Hardcover ISBN: 9780125765602</p>
Supportive References	<u>Ernest Beerstecher Jr.</u> (2013) <i>Petroleum Microbiology: An Introduction to Microbiological Petroleum Engineering</i> .
Electronic Materials	http://www.ncbi.nlm.nih.gov/pmc/articles/PMC309048/
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	<ul style="list-style-type: none"> Class room is already provided with data show The area of class room is suitable concerning the number of enrolled students (68) and air conditioned
Technology equipment (projector, smart board, software)	<ul style="list-style-type: none"> Digital lab containing 15 computers.
Other equipment (depending on the nature of the specialty)	<ul style="list-style-type: none"> Incubators, autoclaves, measuring equipment, water bath, digital balances, pH meters, safety facilities. Availability of some reference bacterial strains Cultural media and all chemical that needed

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	<ul style="list-style-type: none"> ➤ Class discussion. ➤ Written feedback by individuals. ➤ Satisfaction survey at the end of each semester.
Effectiveness of Students assessment	Course instructor Peer reviewer	<ul style="list-style-type: none"> ➤ Course development according to the analysis of student feedback.





Assessment Areas/Issues	Assessor	Assessment Methods
	Program director	<ul style="list-style-type: none"> ➤ Monitoring students' performance throughout the semester using formative assessment. ➤ Analyzing students' progress. ➤ Using statistics to analyze students' achievement at the end of each semester and implement data comparison. ➤ Department council discussion. ➤ Peer evaluation of the instructor.
Quality of learning resources	Course instructor	<ul style="list-style-type: none"> ➤ Attending staff development workshops and programs. ➤ Continuous education. ➤ Implementing student feedback. ➤ Variations of teaching strategies including tutorials, PBL and more emphasizing on the practical sessions
The extent to which CLOs have been achieved		
Other		

Evaluation areas (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)

Evaluators (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify))

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	Umm Al-Qura University Council
REFERENCE NO.	851141114462/190635
DATE	22/11/1446

