



Course Specification

(Bachelor)

Course Title: Applied and Fundamentals of Environmental Microbiology

Course Code: APEP2603

Program: Diploma - Technology of Environmental Protection

Department: Biology

College: Faculty of applied science

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:

3 Credits (2 theoretical + 1 Practical)

2. Course type

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

3. Level/year at which this course is offered: (1st Year / 2nd Level)

4. Course General Description:

In this course, introduction about general microbiology; including historical background.

General characteristics of prokaryotic cells, different between the prokaryotes and Eukaryotes cells, an overview about the beneficial and hazardous roles of microorganisms in the environment and their applications in different fields, distribution of microorganisms in the environment, short description about the different microorganisms (bacteria, cyanobacteria, fungi, Actinomycetes, protozoa, viruses).

Environmental microbiology is designed to introduce students to understand environmental concepts, principals and the world of microorganisms from the point-view of interaction and reaction of microbial impacts and role of microorganisms in the environment. Control and resolve environmental problems that affect our live. Characterized the microorganisms and their activities exists in air, water and soil environment in combination with factors that influencing their activity and development. Microbial community dynamics, Microbial habitats (air, soil, subsurface, freshwater, marine and the deep sea), Natural microbial communities with emphasis on biofilms, Also, it covered biodeterioration and biodegradation of the environmental pollutants. Microbial interactions: microbe-microbe interactions, plants as microbial habitats, animals as microbial habitats.

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

General Biology

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

7. Course Main Objective(s):

After completing this course students should be able to:

- List the major types of Microorganisms in the environment
- Discuss the positive and negative roles of the microorganisms in the environment
- List the factors affecting the growth of microorganisms
- Analyze requirements of microbial growth.
- Explain why some microorganisms live well in some extreme environments
- List different methods of sterilization and understand which on suitable for sterilizing any material.
- Identify the main concepts of microbial ecology



- Discuss the applications and use of microbial power in the control of some environmental pollution and how it is applied to study and resolve environmental problems
- List the negative roles of microorganisms in the environment (Biodegradation of paints, - Biodegradation and concrete corrosion, Biodegradation and Metal corrosion)
- Discuss the effect of general characteristics of the different environments of its microflora.
- Explain the impacts of environmental factors on microbial activities.
- Explain how microorganisms can survive, spread, adaptive, resistant and tolerant in the extreme environments.
- Summarize the microbe-microbe interaction, microbe-plant interaction, microbe-animal interaction
- Apply the scientific methods in environmental microbiology e.g. collection, isolation and investigation of microbial flora from various environments.
- List microorganisms in air, water, soil, extreme environment and man-made environment, its role and activities.

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom		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	30h
2.	Laboratory/Studio	14h
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	Upon successful completion of this course The student will be able to:	K1	-Themethodology includes a combination of lectures by the lecturer, seminar presentation by the students and web-interactions. -At the end of the programme, students will be divided into groups for seminar presentation on important areas of the course to assess their understanding and comprehension of the course. -All students will be involved in on-line learning process and each student is required to create an E-mail address to facilitate student web interactions. - Using images and movies - Encouraging students to collect the new information about what the new in microbial ecology. -Availability of the reference books and scientific sites	<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%.
	• Identify the main concepts of microbial ecology	K2		
	• List the positive and negative roles of microorganisms in the environment.	K3		
	• list the general characteristics of the different environments			
	• Describe the effect of general characteristics of the different environments of its microflora.			
	• Summarize the microbe-microbe interaction, microbe-plant interaction, microbe-animal interaction			
	• Identify the concept of of some environmental phenomena such: biomagnification, Eutrophication, Spring blooming, Self-purification.			
	• Describe the biodegradation process.			
	• List microorganisms in air, water, soil, extreme environment and man-made environment, its role and activities.			
	• List levels of microbial ecological organization.			
	• Describe microbial communities.			



Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	<ul style="list-style-type: none"> • Write microorganisms used in remediation technologies • Recognize characteristics of soil microorganisms 		concerning microbial ecology	
2.0	Skills			
2.1	Cognitive skills	S3	<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.
2.2	<ul style="list-style-type: none"> • Explain microbial mechanisms of adaptation, resistant and tolerant in the environment. 	S4		
...	<ul style="list-style-type: none"> • Predict impacts of environmental factors on microbial activities. • Compare characteristic features of thermophiles, psychrophiles, methanogens, methylotrophs, acidophiles, alkalophiles, halophiles and their survival strategies. • Summarize scope and applications of environmental microbiology • List the negative roles of microorganisms in the environment (Biodegradation of paints, - Biodegradation and concrete corrosion, Biodegradation and Metal corrosion). • list the general characteristics of the different environments • Explain the impacts of environmental factors on microbial activities. • Explain how microorganisms can 			





Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	<p>survive, spread, adaptive, resistant and tolerant in the extreme environments.</p> <ul style="list-style-type: none"> Summarize the microbe-microbe interaction, microbe-plant interaction, microbe-animal interaction Compare between the following environmental phenomena : biomagnification, Eutrophication, Spring blooming, Self-purification. List microorganisms in air, water, soil, extreme environment and man-made environment, its role and activities. 			
3.0	Values, autonomy, and responsibility			
3.1	<ul style="list-style-type: none"> Developing oral presentations. 	V1		
3.2	<ul style="list-style-type: none"> 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 Demonstrate professional attitudes and behaviors towards others. Propose the smart questions Understand and dissecting the problem so that it is fully solved understood. 	V2 V3 V4		
...				





Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	<ul style="list-style-type: none"> • Demonstrate the assertiveness for his decision. • Demonstrate his capability for the responsibility and Accountability • Show Effective verbal communication with clarity and must be characterize 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 internet. • Interpret the laboratory data. • Know how to write a report. 			

C. Course Content

No	List of Topics	Contact Hours
1.	<p>❖ History of microbiology:</p> <ul style="list-style-type: none"> - introduction about general microbiology; including historical background. - General characteristics of prokaryotic cells, differentiation between the prokaryotes and Eukaryotes cells. - an overview about the beneficial and hazardous roles of microorganisms in the environment and their applications in different fields. 	2
2.	<p>❖ Short discription about the microorganisms and their roles on the soil and plants:</p> <ul style="list-style-type: none"> - Distribution of microorganisms in the environment, type of microorganisms in the environment. -Short discription of Bacteria, cyanobacteria, fungi, Actinomycetes, protozoa, viruses. 	2



3	- Bacterial cell morphology and structure	2
4	- Factors affecting microbial activity and growth - Control of microbial activity including the different sterilization methods	2
5	- Applied Environmental Microbiology - An Historical Overview about the microbial ecology - Important expression in microbial ecology. Microbial life in the environment: Mechanisms of adaptation, resistant and tolerant: - Survival and spread of microorganism. - Mechanisms of adaptation, resistant and tolerant. - Microbes in the natural biomes - Microbes in extreme environments - Environment induced genetic and physiological adaptations in microbes. - Characteristic features of thermophiles, psychrophiles methanogens, methylotrophs, acidophiles, alkalophiles, halophiles and their survival strategies.	2
6	❖ Microbial life in the environment: Mechanisms of adaptation, resistant and tolerant: - Survival and spread of microorganism. - Mechanisms of adaptation, resistant and tolerant. - Microbes in the natural biomes - Microbes in extreme environments - Environment induced genetic and physiological adaptations in microbes. - Characteristic features of thermophiles, psychrophiles methanogens, methylotrophs, acidophiles, alkalophiles, halophiles and their survival strategies.	2
7	❖ Midterm Exam	2
8	❖ Distribution of the microorganisms in the different environments: Microorganism in air - The air as an environment of microorganism - Adaptation of microorganisms to the air environment - Biological aerosols - Investigation of microbiological air pollutions.	2
9	❖ Methods used for study of the microbial communities in the different environments: - direct Microscope - culturing and pleating methods - Determination of microbiological activity - PCR and molecular technique	2
10	❖ Microbial interactions	2





	<ul style="list-style-type: none"> • Microbe-Microbe interactions: (+ ve interaction –ve interactions): Neutralism, Commensalism, Symbiosis, Antagonisms, Predation, Parasitism • Plant-Microbe interaction • Animal-Microbe interaction 	
11	<p>❖ Study of some Environmental problems caused by Microorganisms:</p> <ul style="list-style-type: none"> - Biodegradation of plane oil - Biodegradation of paints - Biodegradation and concrete corrosion - Biodegradation and Metal corrosion 	2
12	<p>❖ Roles of microorganisms in biodegradation of some pollutants:</p> <ul style="list-style-type: none"> - Biodegradation of crude oil - Biodegradation of heavy metals - Biodegradation of petrochemical - Role of microorganisms in metals separation and purification. <p>❖ Biodegradation of chemical compounds that are very difficult to degrade.</p> <ul style="list-style-type: none"> - Biodegradation of synthetic polymers - Microbial degradation of Xenobiotics (pesticides, insecticides) 	2
13	<p>❖ Study of some environmental phenomena</p> <ul style="list-style-type: none"> - biomagnification - Eutrophication - Spring blooming - Self-purification 	2
14	<p>❖ Applied Microbiology</p> <ul style="list-style-type: none"> - Production of biofuels - Production of bioplastic - Production of biofertilizer 	2
15	<p>❖ Extreme Environments</p> <ul style="list-style-type: none"> - Survival and spread of microorganism. - Mechanisms of adaptation, resistant and tolerant. - Microbes in the natural biomes - Microbes in extreme environments - Environment induced genetic and physiological adaptations in microbes. - Characteristic features of thermophiles, psychrophiles, methanogens, methylotrophs, acidophiles, alkalophiles, halophiles and their survival strategies. 	2
Total		30



D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Quiz 1 (Theory)	3	5%
2.	Midterm examination (Theory)	7	15%
3.	Midterm examination (practical)	7	10%
4.	Group project	9-10	10%
5.	Final examination (practical)	15	20%
6.	Final examination (Theory)	16	40%
	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-Brock Biology of Microorganisms, Twelfth edition by Madigan, Martinko, Dunlap and Clark; Publisher: Pearson Prentice-Hall, ISBN: 0132324601 (2008).</p> <p>2-Benson, H.J. (2002). Microbiological Applications. Laboratory Manual in General Microbiology, eighth edition.</p> <p>3-Prescott, L., Harley, J. and Klien, D. (2005). Microbiology, MacGraw</p> <p>4-Larry McKane & Judy Kandel (1996) Microbiology–Essential and Applications, International Edition.</p> <p>5- Maier, R. M., Pepper, I. L. and Gerba, C. P. (2008) Environmental Microbiology 2nd edition. Academic Press, San Diego, CA, USA</p> <p>6- Madsen, E. L. (2008) Environmental Microbiology: from Genomes to Biogeochemistry. Blackwell Publishing, Malden, MA, USA</p> <p>7- McArther, J. V. (2006) Microbial Ecology: an Evolutionary Approach. Academic Press, San Diego, CA, USA</p> <p>8- Hurst, C. J., Crawford, R. L., Garland, J. L., Lipson, D. A. and Mills, A. L. (2007) Manual of Environmental Microbiology 3rd edition. ASM Press, Washington DC, USA</p>
Supportive References	<ul style="list-style-type: none"> - Kirchman, D. L. 2012. Processes in Microbial Ecology. Oxford University Press, Inc., New York, NY. - Madigan, M. T., and J. M. Martinko. 2010. Brock Biology of Microorganisms, 13th Ed., Pearson Benjamin Cummings, San Francisco, CA. [Study Aid; 14th Edition that came out in Jan. 2104 is OK too]. - Atlas, R. M., and R. Bartha. 1998. Microbial Ecology, 4th Ed. Benjamin/Cummings Publishing Co., Inc. Menlo Park, CA. 694 p. - Burdlage, R. S., R. Atlas, D. Stahl, G. Geesey, and G. Saylor (eds.). 1998. Techniques in Microbial Ecology. Oxford University Press, New York.



Electronic Materials	- http://www.cdc.gov/mmwr/
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 • Availability all kits for identification of the microorganisms isolated from different habitats • Availability of VITEK device for rapid identification of microorganisms • Cultural media and all chemical that needed

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Faculty	Course report
Effectiveness of Students assessment	Students	Course Evaluation Template
Quality of learning resources	Program leader / Head of the Department Quality Committee	Annual program report
The extent to which CLOs have been achieved		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify))

Assessment Methods (Direct, Indirect)

G. Specification Approval

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