



Course Specifications

Revised November 2019

| | |
|----------------------|--|
| Course Title: | Environmental Microbiology |
| Course Code: | 4014472-3 |
| Program: | BSc Microbiology |
| Department: | Department of Biology |
| College: | Faculty of Applied Science – Department of Biology |
| Institution: | UM AL – QURA UNIVERSITY |
| Revision Date | November 2019 |

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A. Course Identification

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|--|
| 1. Credit hours: 3 hours |
| 2. Course type |
| a. University <input type="checkbox"/> College <input type="checkbox"/> Department <input checked="" type="checkbox"/> Others <input type="checkbox"/> |
| b. Required <input checked="" type="checkbox"/> Elective <input type="checkbox"/> |
| 3. Level/year at which this course is (second semester) 4th Year /(8) |
| 4. Pre-requisites for this course (if any): Bacteriology (4012422-3) / Microbial Physiology (4012452-3) |
| 5. Co-requisites for this course (if any): Microbial physiology (4012452-3) |

6. Mode of Instruction (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|----|-----------------------|---------------|------------|
| 1 | Traditional classroom | 30 | 50 % |
| 2 | Blended | | - |
| 3 | E-learning | | - |
| 4 | Correspondence | | - |
| 5 | Other | 30 | 50 % |

7. Actual Learning Hours (based on academic semester)

| No | Activity | Learning Hours |
|------------------------------|---------------------------------|----------------|
| Contact Hours | | |
| 1 | Lecture | 30 |
| 2 | Laboratory/Studio | 42 |
| 3 | Tutorial | - |
| 4 | Practical/Field work/Internship | 6 |
| 5 | Others (specify) | 30 |
| | Total | 102 |
| Other Learning Hours* | | |
| 1 | Study | 30 |
| 2 | Assignments | 8 |
| 3 | Library | 15 |
| 4 | Projects/Research Essays/Theses | 10 |
| 5 | Others (specify) | - |
| | Total | 63 |

* The length of time that a learner takes to complete learning activities that lead to achievement of course learning outcomes, such as study time, homework assignments, projects, preparing presentations, library times

B. Course Objectives and Learning Outcomes

1. Course Description

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.

2. Course Main Objective

❖ **After completing this course student should be able to:**

- 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)
- list the general characteristics of the different environments
- 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
- Differentiate between biodegradation and biodeterioration
- Identify the concept of of some environmental phenomena such: biomagnification, Eutrophication, Spring blooming, Self-purification.
- Describe the biodegradation process.
- 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.
- Differentiate between the Ecosystems and Environments

3. Course Learning Outcomes

| CLOs | | Aligned PLOs |
|------|--|--------------|
| 1 | Knowledge: <ul style="list-style-type: none"> ❖ Upon successful completion of this course The student will be able to: <ul style="list-style-type: none"> • Identify the main concepts of microbial ecology • List the positive and negative roles of microorganisms in the environment. • list the general characteristics of the different environments • Describe the effect of general characteristics of the different | |

| CLOs | | Aligned PLOs |
|----------|--|--------------|
| | <p>environments of its microflora.</p> <ul style="list-style-type: none"> Summarize the microbe-microbe interaction, microbe-plant interaction, microbe-animal interaction Differentiate between biodegradation and biodeterioration Identify the concept 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. Differentiate between the Ecosystems and Environments List levels of microbial ecological organization. Describe microbial communities. Write microorganisms used in remediation technologies Recognize characteristics of soil microorganisms | |
| 2 | Skills: | |
| 2.1 | <p>Cognitive skills to be developed</p> <ul style="list-style-type: none"> Having successfully completed the course students should be able to: <ul style="list-style-type: none"> Explain microbial mechanisms of adaptation, resistant and tolerant in the environment. Predict impacts of environmental factors on microbial activities. Compare characteristic features of thermophiles, psychrophiles, methanogens, methylotrophs, acidophiles, alkalophiles, halophiles and their survival strategies. Differentiate between bioremediation and biodegradation 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 survive, spread, adaptive, resistant and tolerant in the extreme environments. Summarize the microbe-microbe interaction, microbe-plant interaction, microbe-animal interaction Differentiate between biodegradation and biodeterioration Compare between the following environmental phenomena : 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. Differentiate between the Ecosystems and Environments | |
| 2.4. | <p>Psychomotor Skills</p> <ul style="list-style-type: none"> Upon successful completion of this course, the student is expected to be able to: | |

| CLOs | | Aligned PLOs |
|----------|--|--------------|
| | <ul style="list-style-type: none"> • Perform the laboratory experiments precisely • Operate all devices in lab • Diagram solid wastes recycle. • Illustrate factors affecting the microbial flora in different environments. | |
| 3 | Competence: | |
| 3.1 | <ul style="list-style-type: none"> ❖ Upon successful completion of this course, the student is expected to be able to: <ul style="list-style-type: none"> • 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 • Demonstrate professional attitudes and behaviors towards others. • Propose the smart questions • Understand and dissecting 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 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

| 1 Topics to be Covered | | |
|--|-------------|---------------|
| Topic | No of Weeks | Contact hours |
| <ul style="list-style-type: none"> ❖ General Introduction: <ul style="list-style-type: none"> - An Historical Overview about the microbial ecology - Important expression in microbial ecology. | 1 | 2 |
| <ul style="list-style-type: none"> ❖ Microbial life in the environment: Mechanisms of adaptation, resistant and tolerant: <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. | | |

| | | |
|---|----------|----------|
| <ul style="list-style-type: none"> ❖ Distribution of the microorganisms in the different environments: Microorganism in air <ul style="list-style-type: none"> - The air as an environment of microorganism - Adaptation of microorganisms to the air environment - Biological aerosols - Investigation of microbiological air pollutions. | 1 | 2 |
| <ul style="list-style-type: none"> ❖ <u>Microorganism in terrestrial environment</u> <ul style="list-style-type: none"> - The characteristics of soil microorganisms - Factors affecting soil micro-flora - The role of microorganisms in organic metabolism- the carbon cycle. - The role of microorganisms in nitrogen processes in soil -the nitrogen cycle. - Symbiosis forms | | |
| <ul style="list-style-type: none"> ❖ Microorganism in aquatic environment <ul style="list-style-type: none"> - Water as microbial habitat - Polluted water organisms - Wastewater treatment and technology. | | |
| <ul style="list-style-type: none"> ❖ Methods used for study of the microbial communities in the different environments: <ul style="list-style-type: none"> - direct Microscope - culturing and plating methods -Determination of microbiological activity -PCR and molecular technique | 2 | 4 |
| <ul style="list-style-type: none"> ❖ Microbial interactions <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 | 2 | 4 |
| <ul style="list-style-type: none"> ❖ Study of some Environmental problems caused by Microorganisms: <ul style="list-style-type: none"> - Biodegradation of plane oil - Biodegradation of paints - Biodegradation and concrete corrosion - Biodegradation and Metal corrosion | 2 | 4 |
| <ul style="list-style-type: none"> ❖ Roles of microorganisms in biodegradation of some pollutants: <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 | 2 | 4 |
| <ul style="list-style-type: none"> ❖ Biodegradation of chemical compounds that are very difficult to degrade. <ul style="list-style-type: none"> - Biodegradation of synthetic polymers -Microbial degradation of Xenobiotics (pesticides, insecticides) | 1 | 2 |

| | | |
|--|-----------------|--------------|
| ❖ Study of some environmental phenomena - biomagnification - Eutrophication - Spring blooming Self-purification | 1 | 2 |
| ❖ Bioremediation and its roles in cleaning the environment: - Definition of bioremediation -Bioremediation of oil contaminated soil - Bioremediation groundwater | 1 | 2 |
| ❖ Extreme Environments - 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. | 1 | 2 |
| | 14 weeks | 28hrs |

D. Teaching and Assessment

1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|------|--|--|---|
| 1.0 | Knowledge | | |
| 1.1 | <p>Upon successful completion of this course The student will be able to:</p> <ul style="list-style-type: none"> Identify the main concepts of microbial ecology List the positive and negative roles of microorganisms in the environment. 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 Differentiate between biodegradation and biodeterioration Identify the concept of of some environmental phenomena such: biomagnification, Eutrophication, Spring blooming, Self-purification. Describe the biodegradation process. List microorganisms in air, water, | <p>-Themethodology includes a combination of lectures by the lecturer, seminar presentation by the students and web-interactions.</p> <p>-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.</p> <p>-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</p> | <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% |

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|-------------------|---|---|---|
| | <p>soil, extreme environment and man-made environment, its role and activities.</p> <ul style="list-style-type: none"> • Differentiate between the Ecosystems and Environments • List levels of microbial ecological organization. • Describe microbial communities. • Write microorganisms used in remediation technologies • Recognize characteristics of soil microorganisms | <p>movies</p> <ul style="list-style-type: none"> -Encouraging students to collect the new information about what the new in microbial ecology. -Availability of the reference books and scientific sites concerning microbial ecology | |
| 2.0 Skills | | | |
| 2.1 | <p>Cognitive skills</p> <ul style="list-style-type: none"> • Explain microbial mechanisms of adaptation, resistant and tolerant in the environment. • Predict impacts of environmental factors on microbial activities. • Compare characteristic features of thermophiles, psychrophiles, methanogens, methylotrophs, acidophiles, alkalophiles, halophiles and their survival strategies. • Differentiate between bioremediation and biodegradation • 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 survive, spread, adaptive, resistant and tolerant in the extreme environments. • Summarize the microbe-microbe interaction, microbe-plant interaction, microbe-animal | <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 | Teaching Strategies | Assessment Methods |
|------|---|---|---|
| | <ul style="list-style-type: none"> interaction Differentiate between biodegradation and biodeterioration Compare between the following environmental phenomena : 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. Differentiate between the Ecosystems and Environments | | |
| 2.2 | <p>Psychomotor Skills Upon successful completion of this course, the student is expected to be able to:</p> <ul style="list-style-type: none"> Perform the laboratory experiments precisely Operate all devices in lab Diagram growth curve of bacteria. assemble and collect important bacterial isolates Prepare different media Cultivate the bacterial isolates Carry out bacterial identification techniques. | <ul style="list-style-type: none"> - Follow up students the students in lab and during carryout all the laboratory experiments | <ul style="list-style-type: none"> -Giving additional marks for the students they have accurate laboratory results and good seminar presentation -Practical exam. |
| 3.0 | <p>Competence</p> <ul style="list-style-type: none"> 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 Demonstrate professional attitudes and behaviors towards others. Propose the smart questions Understand and dissecting the problem so that it is fully solved | <ul style="list-style-type: none"> - Lab work - Case Study - Active learning - Small group discussion - Homework (preparing a report on some topics related to the course depending on web sites). - Seminars presentation - Practical during carryout the experiments in the lab. | <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 - Evaluation of students presentations |

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|------|---|---------------------|--------------------|
| | <p>understood.</p> <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. | | |

2. Assessment Tasks for Students

5. Schedule of Assessment Tasks for Students During the Semester

| Assessment | Assessment task (eg. essay, test, group project, examination etc.) | Week due | Exam duration | Proportion of Final Assessment |
|------------|--|-----------|--------------------|--------------------------------|
| 1 | Periodical Exam (s) | 4 | 15 min | 10 % |
| 2 | Mid Term Exam (Theoretic) | 8 | 60 min | 20 % |
| 3 | Mid Term Exam (practical) | 9 | 30 min | 10 % |
| 4 | Reports and essay | 11 | -- | 5 % |
| 5 | Final Practical Exam | 15 | 60 min | 15 % |
| 6 | Final Exam | 16 | 120 min | 40 % |
| | | | Total Marks | 100% |

*Assessment task (i.e., written test, oral test, oral presentation, group project, essay, etc.)

E. Student Academic Counseling and Support

Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice :

Office hours: 10hrs.

F. Learning Resources and Facilities

1. Learning Resources

| | |
|---------------------------------------|--|
| Required Textbooks | <p>(1)- Maier, R. M., Pepper, I. L. and Gerba, C. P. (2008) <i>Environmental Microbiology 2nd edition</i>. Academic Press, San Diego, CA, USA</p> <p>(2)- Madsen, E. L. (2008) <i>Environmental Microbiology: from Genomes to Biogeochemistry</i>. Blackwell Publishing, Malden, MA, USA</p> <p>(3)- McArthur, J. V. (2006) <i>Microbial Ecology: an Evolutionary Approach</i>. Academic Press, San Diego, CA, USA</p> <p>(4)- Hurst, C. J., Crawford, R. L., Garland, J. L., Lipson, D. A. and Mills, A. L. (2007) <i>Manual of Environmental Microbiology 3rd edition</i>. ASM Press, Washington DC, USA</p> |
| Essential References Materials | <p>Kirchman, D. L. 2012. <i>Processes in Microbial Ecology</i>. Oxford University Press, Inc., New York, NY.</p> <p>Madigan, M. T., and J. M. Martinko. 2010. <i>Brock Biology of Microorganisms</i>, 13th Ed., Pearson Benjamin Cummings, San Francisco, CA. [Study Aid; 14th Edition that came out in Jan. 2104 is OK too].</p> <p>Atlas, R. M., and R. Bartha. 1998. <i>Microbial Ecology</i>, 4th Ed. Benjamin/Cummings Publishing Co., Inc. Menlo Park, CA. 694 p.</p> <p>Burdlage, R. S., R. Atlas, D. Stahl, G. Geesey, and G. Saylor (eds.). 1998. <i>Techniques in Microbial Ecology</i>. Oxford University Press, New York.</p> <p>Gerhardt, P., R. G. E. Murray, W. A. Wood, and N. R. Krieg (eds.). 1994. <i>Methods for General and Molecular Bacteriology</i>. American Society for Microbiology. Washington, DC.</p> <p>Guerrero, R., and C. Pedrós-Alió (eds). 1993. <i>Trends in Microbial Ecology. Proceedings of the Sixth International Symposium on Microbial Ecology</i>. Spanish Society for Microbiology. Barcelona, Spain.</p> <p>Hurst, C. J., G. R. Knudsen, M. J. McInernney, L. D. Stetzenback, and M. V. Walter (eds.). 1997. <i>Manual of Environmental Microbiology</i>. American Society for Microbiology. Washington, DC.</p> <p>Kemp, P. F., B. F. Sherr, B. Sherr, and J. J. Cole (eds.). 1993. <i>Handbook of Methods in Aquatic Microbial Ecology</i>. Lewis Publishers. Ann Arbor, MI.</p> <p>Kirchman, D. L. (ed.). 2000. <i>Microbial Ecology of the Oceans</i>. John Wiley & Sons, Inc. New York, NY.</p> <p>Levin, M. A., R. J. Siedler, M. Rogul (eds.). 1992. <i>Microbial Ecology: Principles, Methods, and Applications</i>. McGraw-Hill, Inc. New York, NY. 945 p.</p> <p>Lynch, J. M., and N. J. Poole (eds.). 1979. <i>Microbial Ecology - A Conceptual Approach</i>. Blackwell Scientific Publications. Oxford, England.</p> <p>Martins, M. T., et al. 1997. <i>Progress in Microbial Ecology. Proceedings of the Seventh International Symposium on Microbial Ecology</i>. Brazilian</p> |

| | |
|---------------------------------|---|
| | <p>Society for Microbiology. Sao Paulo, Brazil.</p> <p>McAthur, J. V. 2006. Microbial Ecology, An Evolutionary Approach. Elsevier, Burlington, MA. 416 p.</p> |
| Electronic Materials | - http://www.cdc.gov/mmwr/ |
| Other Learning Materials | <ul style="list-style-type: none"> • Book note prepared by Associate professor Dr. Hussien Hassan Abulreesh |

2. Facilities Required

| Item | Resources |
|--|---|
| <p>Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)</p> | <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 |
| <p>Technology Resources (AV, data show, Smart Board, software, etc.)</p> | <ul style="list-style-type: none"> • Digital lab containing 15 computers. |
| <p>Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)</p> | <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 habitates • Availability of VITEK device for rapid identification of microorganisms • Cultural media and all chemical that needed |

G. Course Quality Evaluation

| |
|--|
| <p>1. Strategies for Obtaining Student Feedback on Effectiveness of Teaching</p> <ul style="list-style-type: none"> • Questionaries • Open discussion in the class room at the end of the lectures. |
| <p>2. Other Strategies for Evaluation of Teaching by the Instructor or by the Department</p> <ul style="list-style-type: none"> • Revision of student answer paper by another staff member. • Analysis the grades of students. |
| <p>3. Processes for Improvement of Teaching</p> <ul style="list-style-type: none"> • Preparing the course as PPT. • Using scientific movies. • Coupling the theoretical part with laboratory part • Periodical revision of course content. |
| <p>4. Processes for Verifying Standards of Student Achievement (eg. check marking by an independent faculty member of a sample of student work, periodic exchange and remarking of a sample of assignments with a faculty member in another institution)</p> <ul style="list-style-type: none"> • After the agreement of Department and Faculty administrations |
| <p>5 Describe the planning arrangements for periodically reviewing course effectiveness and planning for improvement.</p> <ul style="list-style-type: none"> • Periodical revision by Quality Assurance Units in the Department and institution |

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)

H. Specification Approval Data

| | |
|--|-------------------|
| Prepared by faculty staff: 1. Dr. Hussein H. Abulreesh | Signature: |
| Date Report Completed: November 2019 | |
| Revised by: 1. Prof. Dr. Khaled Elbanna 2. Dr. Hussein H. Abulreesh 3. Prof. Dr. Shady Elshahawy | Signature: |
| Date: November 2019 | |
| Program Chair Dr. Hussein H. Abulreesh | Signature: |
| Dean | Signature: |
| Date: | |