



# Course Specifications

**Revised November 2019**

<b>Course Title:</b>	<b>Soil Microbiology</b>
<b>Course Code:</b>	<b>4014492-3</b>
<b>Program:</b>	<b>Microbiology</b>
<b>Department:</b>	<b>BSc Microbiology</b>
<b>College:</b>	<b>UM AL – QURA UNIVERSITY</b>
<b>Institution:</b>	<b>Faculty of Applied Science – Department of Biology</b>
<b>Revision Date</b>	<b>November 2019</b>

## Table of Contents

<b>A. Course Identification</b> .....	<b>3</b>
6. Mode of Instruction (mark all that apply) .....	3
<b>B. Course Objectives and Learning Outcomes</b> .....	<b>3</b>
1. Course Description .....	4
2. Course Main Objective.....	4
3. Course Learning Outcomes .....	4
<b>C. Course Content</b> .....	<b>6</b>
<b>D. Teaching and Assessment</b> .....	<b>8</b>
1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods .....	8
2. Assessment Tasks for Students .....	11
<b>E. Student Academic Counseling and Support</b> .....	خطأ! الإشارة المرجعية غير معرّفة.
<b>F. Learning Resources and Facilities</b> .....	<b>11</b>
1. Learning Resources .....	11
2. Facilities Required.....	12
<b>G. Course Quality Evaluation</b> .....	خطأ! الإشارة المرجعية غير معرّفة.
<b>H. Specification Approval Data</b> .....	<b>13</b>

## A. Course Identification

<b>1. Credit hours:</b> 3 hours
<b>2. Course type</b>
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"/>
<b>Level/year at which this course is offered:</b> 4 <sup>th</sup> <b>Year / Level 8:</b>
<b>4. Pre-requisites for this course (if any):</b>  Bacteriolog (4012422-3) / Mycology (4012432-3)
<b>5. Co-requisites for this course (if any):</b>  None

### 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
<b>Contact Hours</b>		
1	Lecture	30
2	Laboratory/Studio	42
3	Tutorial	-
4	Practical/Field work/Internship	6
5	Others (specify)	30
	<b>Total</b>	<b>102</b>
<b>Other Learning Hours*</b>		
1	Study	30
2	Assignments	8
3	Library	15
4	Projects/Research Essays/Theses	10
5	Others (specify)	-
	<b>Total</b>	<b>63</b>

\* 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

- ❖ Role of microorganisms in soil, Decomposition of organic residues in soils; Legume bacteriology; Transformations of sulphur, iron, manganese in soils, decomposition of pesticide. Biological nitrogen fixation: symbiosis (including grain legumes, trees, Azolla) and non symbiotic; Biochemistry of nitrogen fixation (symbiotic and non symbiotic), methods of measuring biological nitrogen fixation (BNF); Legume bacteriology, inoculation, mycorrhiza; Biochemistry of nitrification, denitrification and nitrate reduction; Biochemical transformation of phosphorus, sulphur, hydrocarbons and pesticides (including herbicides). Biochemical processes in the rhizosphere. Microbial relationships, plant- microb interaction, Biofertilizers, Preparation of Silage and compost.

### 2. Course Main Objective

- ❖ **After completing this course student should be able to:**
  - List the major types of organisms found in soils and be familiar with their classification based on physiological and taxonomic criteria
  - Discuss the positive and negative roles of the microorganisms in soil.
  - Aware with the microbial role in the transformation of the organic matter in the soil.
  - Discuss the microbial role in carbon, nitrogen, phosphorus, sulfur, and iron cycles in the soil.
  - Understand the factors influencing presence of and activities of microorganisms in different soils.
  - Isolate and identify the microorganisms that contribute to the soil fertility such:
    - Isolation and identification of Cellulose, starch, lignin, pectin-degrading bacteria
    - Isolation and identification of nitrifying bacterial.
    - Isolation and identification of nitrogen fixing bacteria from plant nodules
    - Isolation of phosphate dissolving bacteria.
    - Isolation and identification of sulphur reducing and oxidizing bacteria
    - Isolation and identification iron reducing and oxidizing bacteria
  - Describe the relationships between the microorganisms in soil
  - Describe plant-microbe interactions especially rhizosphere, mycorrhizae and nitrogen fixation
  - Understand and interpret primary source materials on a variety of topics related to microbial communities and processes
  - Familiar with preparation of the inocula from the benefit microorganisms that suitable for each crop.
  - List the benefit roles of Lactic acid bacteria in Silage processing.

### 3. Course Learning Outcomes

CLOs		Aligned PLOs
1	<b>Knowledge:</b> <ul style="list-style-type: none"> <li>❖ Having successfully completed the course students should be               <ul style="list-style-type: none"> <li>• Understand the positive and negative roles of microorganisms in soil.</li> <li>• List the major types of organisms found in soils and be familiar with their classification based on physiological and taxonomic criteria.</li> </ul> </li> </ul>	

CLOs		Aligned PLOs
	<ul style="list-style-type: none"> <li>Recognize the characteristics of soil microorganisms.</li> <li>List the factors influencing on presence of and activities of microorganisms in different soils.</li> <li>List the microorganisms that play important roles in : nitrogen fixation, organic compound degradation, phosphorous solubilization.</li> <li>Differentiate between the heterotrophs and autotrophs in the soils</li> <li>Discuss the degradation process for organic compounds in the soil by microorganisms.</li> <li>Define the following processes: ammonification, Nitrification, nitrate reduction, denitrification,</li> <li>List the factors that affect nitrogen fixation in soil.</li> <li>Summarize the role of microorganisms in elements transformations such carbon, nitrogen, sulpher, phosphorus, Iron, ...etc.</li> <li>List the relationships between the microorganisms in soil as well as describe plant-microbe interactions.</li> <li>List the benefit roles of Lactic acid bacteria in Silage processing</li> </ul>	
<b>2</b>	<b>Skills:</b>	
2.1	<p><b>Cognitive skills to be developed</b></p> <ul style="list-style-type: none"> <li>❖ Having successfully completed the course students should be able to: <ul style="list-style-type: none"> <li>Understand the benefit relationships between the microorganisms, soil, plants.</li> <li>Understand benefits and hazards roles of the microorganisms in soil.</li> <li>.Discuss the roles of microorganisms in degradation of organic compounds</li> <li>Discuss the C/N ratio and its role in transformation of the organic matter in soil.</li> <li>Differentiate between aerobic and anaerobic degradation process for the organic compounds</li> <li>Discuss roles of soil microorganisms for increasing the soil fertility.</li> <li>Explain why some microorganisms could fix nitrogen, while the threes could not.</li> <li>Differentiate between pathway for symbiotic and non- symbiotic nitrogen fixation</li> <li>Explain the phosphorous solubilization by some microorganisms</li> <li>Describe and draw the cycles of carbon, nitrogen, phosphorous, Sulpher and Iorn that happen in the soils.</li> <li>Explain why nitrate loss under anaerobic conditions</li> <li>Discribe how ammonia transformed into nitrite and nitrate in soils</li> <li>Give the evidences for: why some microorganisms preferred to live in rhizophore area and others do not preferred that?</li> <li>Explain the relationship between plant and microbe, microbe-microbe in soil.</li> <li>Understand the roles of plant growth promoter's microorganisms to</li> </ul> </li> </ul>	

CLOs		Aligned PLOs
	<p>improve the plant growth.</p> <ul style="list-style-type: none"> <li>• Explain how PGPR improve growth of plants</li> <li>• Discuss why Lactic acid bacteria important in Silage processing.</li> <li>• Discuss roles the anaerobic microorganisms in methane production .</li> </ul>	
2.2.	<p><b>Psychomotor Skills</b></p> <ul style="list-style-type: none"> <li>❖ Upon successful completion of this course, the student is expected to be able to: <ul style="list-style-type: none"> <li>• Perform the laboratory experiments precisely</li> <li>• Operate all devices in lab</li> <li>• Diagram carbon, nitrogen, and phosphorus cycles.</li> <li>• Perform how organic fertilizers formed.</li> <li>• Perform how the silage formed.</li> </ul> </li> </ul>	
<b>3</b>	<b>Competence:</b>	
	<ul style="list-style-type: none"> <li>❖ Upon successful completion of this course, the student is expected to be able to: <ul style="list-style-type: none"> <li>• Developing oral presentations.</li> <li>• Communicating personal ideas and thoughts.</li> <li>• Work independently and as part of a team to finish some assignments.</li> <li>• Communicate results of work to others.</li> <li>• Use of needed precautions when dealing with pathogen microorganisms</li> <li>• Demonstrate professional attitudes and behaviors towards others.</li> <li>• Propose the smart questions</li> <li>• Understand and dissecting the problem so that it is fully solved understood.</li> <li>• Demonstrate the assertiveness for his decision.</li> <li>• Demonstrate his capability for the responsibility and Accountability</li> <li>• 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)</li> <li>• Enhancing the ability of students to use computers and internet.</li> <li>• Interpret the laboratory data.</li> <li>• Know how to write a report.</li> </ul> </li> </ul>	

## C. Course Content

1 Topics to be Covered		
List of Topic	No of Weeks	Contact hours
❖ History of soil microbiology, soil profile, weathering factors affect the soil formation,	1	2

❖ The role of soil microorganisms in soil fertility, positive and negative roles of the microorganisms in soil.	1	2
❖ Soil Macro and microflora: Bacteria, cyanobacteria, fungi, Actinomycetes, protozoa, viruses		
❖ Microbial role in the transformation of the organic matter in the soil.	1	2
❖ <b>Carbon cycle.</b> Degradation and mineralization of organic substances such cellulose, starch, hemicellulose, pectin, lignin .....etc	3	6
❖ <b>Nitrogen cycle:</b> -Ammonification - Nitrification. -Denitrification -Nitrate reduction -Biological Nitrogen fixation (symbiotic and non symbiotic). -Factors that affect nitrogen fixation in soil. -C/N ratio and its role in transformation of the organic matter in soil	4	8
❖ <b>Phosphorus, sulfur, and iron cycles</b> and the role of the microorganisms in transformation of mineral elements	2	4
❖ Microorganisms in the rhizosphere and plant- microbe interaction ❖ Microbial relationships ❖ Biofertilizers ❖ Preparation of Silage and compost	2	4
Total learning weeks and Contact hours	<b>14 weeks</b>	<b>28hrs</b>

## 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	<b>Knowledge</b>		
1.1	<ul style="list-style-type: none"> <li>❖ <b>After completing this course student should be able to:</b></li> <li>• Understand the positive and negative roles of microorganisms in soil.</li> <li>• List the major types of organisms found in soils and be familiar with their classification based on physiological and taxonomic criteria.</li> <li>• Recognize the characteristics of soil microorganisms.</li> <li>• List the factors influencing on presence of and activities of microorganisms in different soils.</li> <li>• List the microorganisms that play important roles in : nitrogen fixation, organic compound degradation, phosphorous solubilization.</li> <li>• Differentiate between the heterotrophs and autotrophs in the soils</li> <li>• Discuss the degradation process for organic compounds in the soil by microorganisms.</li> <li>• Define the following processes: ammonification, Nitrification, nitrate reduction, denitrification,</li> <li>• List the factors that affect nitrogen fixation in soil.</li> <li>• Summarize the role of microorganisms in elements transformations such carbon, nitrogen, sulphur, phosphorus, Iron, ...etc.</li> <li>• List the relationships between the microorganisms in soil as well as describe plant-microbe interactions.</li> <li>• List the benefit roles of Lactic acid bacteria in Silage</li> </ul>	<ul style="list-style-type: none"> <li>• Lectures which must start with preliminary one showing course contents</li> <li>• Using images and movies</li> <li>• Studying soil microorganisms specimens in lab.</li> <li>• Encouraging student to collect the new information about different important microorganisms in plant and soil.</li> <li>• Enable the reference books and scientific sites concerning soil microorganisms in internet.</li> </ul>	<ul style="list-style-type: none"> <li>• Periodical exam and reports 10%</li> <li>• Mid- term theoretical exam 20%</li> <li>• Mid-term practical exam 5%</li> <li>• Final practical exam 15%</li> <li>• Final exam 50%</li> </ul>



Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
	processing.		
<b>2.0</b>	<b>Skills</b>		
2.1	<p><b>Cognitive skills to be developed</b></p> <ul style="list-style-type: none"> <li>❖ Having successfully completed the course students should be able to: <ul style="list-style-type: none"> <li>• Understand the benefit relationships between the microorganisms, soil, plants.</li> <li>• Understand benefits and hazards roles of the microorganisms in soil.</li> <li>• .Discuss the roles of microorganisms in degradation of organic compounds.</li> <li>• Discuss the C/N ratio and its role in transformation of the organic matter in soil.</li> <li>• Differentiate between aerobic and anaerobic degradation process for the organic compounds</li> <li>• Discuss roles of soil microorganisms for increasing the soil fertility.</li> <li>• Explain why some microorganisms could fix nitrogen, while the threes could not.</li> <li>• Differentiate between pathway for symbiotic and non- symbiotic nitrogen fixation</li> <li>• Explain the phosphorous solubilization by some microorganisms</li> <li>• Describe and draw the cycles of carbon, nitrogen, phosphorous, Sulpher and Iorn that happen in the soils.</li> <li>• Explain why nitrate loss under anaerobic conditions</li> <li>• Discribe how ammonia transformed into nitrite and nitrate in soils</li> <li>• Give the evidences for: why some microorganisms preferred to live in rhizophore area and others do not preferred that?</li> <li>• Explain the relationship between plant and microbe, microbe-microbe in soil.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Lectures.</li> <li>• Brain storming.</li> <li>• Discussion.</li> </ul>	<ul style="list-style-type: none"> <li>• Exam must contain questions that can measure these skills.</li> <li>• Quiz and exams.</li> <li>• Discussions after the lecture.</li> </ul>

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
	<ul style="list-style-type: none"> <li>Understand the roles of plant growth promoter's microorganisms to improve the plant growth.</li> <li>Explain how PGPR improve growth of plants</li> <li>Discuss why Lactic acid bacteria important in Silage processing.</li> <li>Discuss roles the anaerobic microorganisms in methane production .</li> </ul>		
2.2	<p><b>Psychomotor Skills</b></p> <ul style="list-style-type: none"> <li>❖ Upon successful completion of this course, the student is expected to be able to: <ul style="list-style-type: none"> <li>Perform the laboratory experiments precisely</li> <li>Operate all devices lab.</li> <li>Diagram carbon, nitrogen, and phosphorus cycles.</li> <li>Perform how organic fertilizers formed.</li> <li>Perform how the silage formed.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>- Follow up the students in lab and during carryout all the laboratory experiments</li> </ul>	<ul style="list-style-type: none"> <li>-Giving additional marks for the students they have accurate laboratory results and good seminar presentation</li> <li>-Practical exam.</li> </ul>
2.3			
<b>3.0</b>	<b>Competence</b>		
	<ul style="list-style-type: none"> <li>❖ Upon successful completion of this course, the student is expected to be able to: <ul style="list-style-type: none"> <li>Developing oral presentations.</li> <li>Communicating personal ideas and thoughts.</li> <li>Work independently and as part of a team to finish some assignments.</li> <li>Communicate results of work to others.</li> <li>Use of needed precautions when dealing with pathogen microorganisms</li> <li>Demonstrate professional attitudes and behaviors towards others.</li> <li>Propose the smart questions</li> <li>Understand and dissecting the problem so that it is fully solved understood.</li> <li>Demonstrate the assertiveness for his decision.</li> <li>Demonstrate his capability for the</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>- Lab work</li> <li>- Case Study</li> <li>- Active learning</li> <li>- Small group discussion</li> <li>- Homework (preparing a report on some topics related to the course depending on web sites).</li> <li>- Seminars presentation</li> <li>- Practical during carryout the experiments in the lab.</li> </ul>	<ul style="list-style-type: none"> <li>- Oral exams.</li> <li>- Evaluate the efforts of each student in preparing the report.</li> <li>- Evaluate the scientific values of reports.</li> <li>- Evaluate the work in team</li> <li>- Evaluation of the role of each student in lab group assignment</li> <li>- Evaluation of students presentations</li> </ul>

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
	responsibility and Accountability <ul style="list-style-type: none"> <li>• 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)</li> <li>• Enhancing the ability of students to use computers and internet.</li> <li>• Interpret the laboratory data.</li> <li>• Know how to write a report.</li> </ul>		

## 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 %
			<b>Total Marks</b>	<b>100%</b>

\*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	<ul style="list-style-type: none"> <li>• Course note and PPT prepared by faculty member responsible for the course: Associate Prof. Dr. Khaled Elbanna</li> </ul>
Essential References Materials	<ol style="list-style-type: none"> <li>1. Paul, E. A. and Clark, F. E. (1989). Soil Microbiology and Biochemistry. Academic Press, Inc. San Diego: California</li> </ol>

	<p>92101.</p> <ol style="list-style-type: none"> <li>2. Power, C. B. and Dagainawala, H. F. (1991). General Microbiology Vol II. Himalaya Publishing House, "Ramdoot". Dr. Bhalerao mary, Girgaon, Bombay-400004.</li> <li>3. Martin Alexander (1977). Introduction to Soil Microbiology, second Edition. John Wiley and Sons, USA.</li> <li>4. Saad Zaky Mahmoud, Abdelwahab Abdelhafez, and Elsayy Mobark (1988). Soil Microbiology, Egyptian Anglo.</li> </ol> <p>- Saad Zaky Mahmoud (1988). Practical Applied Microbiology, Egyptian Anglo.</p>
<b>Electronic Materials</b>	<ul style="list-style-type: none"> <li>• <b>PPT prepared by Prof. Dr. Khaled Elbanna</b></li> </ul>
<b>Other Learning Materials</b>	

## 2. Facilities Required

Item	Resources
<p><b>Accommodation</b> (Classrooms, laboratories, demonstration rooms/labs, etc.)</p>	<ul style="list-style-type: none"> <li>• Class room is already provided with data show</li> <li>• The area of class room is suitable concerning the number of enrolled students (68) and air conditioned</li> </ul>
<p><b>Technology Resources</b> (AV, data show, Smart Board, software, etc.)</p>	<ul style="list-style-type: none"> <li>• Digital lab containing 15 computers.</li> </ul>
<p><b>Other Resources</b> (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)</p>	<ul style="list-style-type: none"> <li>• Incubators, autoclaves, measuring equipment, water bath, digital balances, pH meters, safety facilities.</li> <li>• Availability of some reference bacterial strains</li> <li>• Availability all kits for identification of the microorganisms isolated from different habitates</li> <li>• Availability of <b>VITEK</b> device for rapid identification of soil microorganisms.</li> <li>• Cultural media and all chemical that needed</li> </ul>

## G. Course Quality Evaluation

<p><b>1. Strategies for Obtaining Student Feedback on Effectiveness of Teaching</b></p> <ul style="list-style-type: none"> <li>• <b>Questionaries</b></li> <li>• <b>Open discussion in the class room at the end of the lectures.</b></li> </ul>
<p><b>2. Other Strategies for Evaluation of Teaching by the Instructor or by the Department</b></p> <ul style="list-style-type: none"> <li>• <b>Revision of student answer paper by another staff member.</b></li> <li>• <b>Analysis the grades of students.</b></li> </ul>
<p><b>3. Processes for Improvement of Teaching</b></p> <ul style="list-style-type: none"> <li>• <b>Preparing the course as PPT.</b></li> <li>• <b>Using scientific movies.</b></li> <li>• <b>Coupling the theoretical part with laboratory part</b></li> <li>• <b>Periodical revision of course content.</b></li> </ul>

**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)**

- **After the agreement of Department and Faculty administrations**

**5 Describe the planning arrangements for periodically reviewing course effectiveness and planning for improvement.**

- **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

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