



Course Specifications

Revised November 2019

Course Title:	Petroleum Microbiology and Bioremediation
Course Code:	4014412-3
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

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 offered: Year 4 (second semester) 4 th Year / Level 7
4. Pre-requisites for this course (if any): Organic Chemistry (4022301-4) / Microbial Physiology (4012452-3) / Bacteriology (4012422-3)
5. Co-requisites for this course (if any):

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

This course explores microbial activities related to petroleum, microbial metabolism of hydrocarbons aliphatic and cyclic aromatic hydrocarbons under anaerobic and aerobic conditions. Also, this course will be covered physical, chemical and biological factors affecting petroleum degradation. Microbial degradation of petroleum products and use of microorganisms in oil clean-up operations; oil spillage. By the end of the semester, students are provided with knowledge on microbial activities and their applications in microbial enhanced oil recovery, microbial indicators in oil prospecting.

2. Course Main Objective

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

- List the paraffinic and aromatic components of different kinds of crude oil.
- Discuss the formation of petroleum from fossils and microfossils.
- Discuss the Origins and distribution of petroleum in the environment
- Summarize physical, chemical and biological factors affecting petroleum degradation.
- List bacteria that attack metals and cause rusting of oil pipes.
- Describe the roles of microorganisms in bioexploration.
- Explain microbial aspects and indicators of oil prospecting.
- Differentiate between biodegradation, bioremediation.
- Use the microorganisms in oil clean-up operations; oil spillage.
- Write the roles of microorganisms in biodegradation, bioremediation or cleanup during oil pollution.
- Predict the degradation products of crude oil.
- Explain the role of microorganisms in corrosion of oil field equipment.
- Diagram the microbial metabolism of hydrocarbons aliphatic and cyclic aromatic hydrocarbons under anaerobic and aerobic conditions
- Identify the Methane-utilizing bacteria (methanotrophs)
- Write Biotechnology and enhanced crude oil recovery
- Summarize the role Sulphate reducing bacteria and its role in crude oil recovery process .

3. Course Learning Outcomes

CLOs		Aligned PLOs
1	Knowledge:	
	Upon successful completion of this course, the student will be able to: <ul style="list-style-type: none"> • List the paraffinic and aromatic components of different kinds of crude oil. • Describe the formation of petroleum from fossils and microfossils. • Outline the origins and distribution of petroleum in the environment • Summarize physical, chemical and biological factors affecting petroleum degradation. • Write the role of Biotechnology for enhancing crude oil recovery 	

CLOs		Aligned PLOs
	<ul style="list-style-type: none"> • Write the roles of biotechnology in biodegradation, bioremediation or cleanup during oil pollution. • List bacteria that attack metals and cause rusting of oil pipes. • Memorize the roles of microorganisms in bioexploration. • List crude oil degrading microorganisms and oil clean-up operations; oil spillage. • Describe the microbial metabolism of hydrocarbons aliphatic and cyclic aromatic hydrocarbons under anaerobic and aerobic conditions • Identify the Methane-utilizing bacteria (methanotrophs) 	
2	Skills:	
2.1	<p>Cognitive skills to be developed</p> <p>Having successfully completed the course students should be able to:</p> <ul style="list-style-type: none"> • List the paraffinic and aromatic components of different kinds of crude oil. • Interpret formation of petroleum from fossils and microfossils. • Discuss the Origins and distribution of petroleum in the environment. • Summarize physical, chemical and biological factors affecting petroleum degradation. . • Describe the microbial aspects and indicators of oil bioexploration and prospecting • Differentiate between biodegradation, bioremediation. • Write the roles of microorganisms in cleanup during oil pollution. • Predict the degradation products of crude oil • Explain the role of microorganisms in corrosion of oil field equipment. • Diagram the microbial metabolism of hydrocarbons aliphatic. and cyclic aromatic hydrocarbons under anaerobic and aerobic conditions. • Write Biotechnology and enhanced crude oil recovery • Summarize the role of Sulphate reducing bacteria and its role in crude oil recovery process. • Characterize and identify the microorganisms responsible for degradation of crude oil and its degradation products. • Estimate the potentiality of the microorganisms in crude oil degradation. 	
2.4.	<p>Psychomotor Skills</p> <p>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 petroleum microbiology lab 	

CLOs		Aligned PLOs
	<ul style="list-style-type: none"> Draw the pathway of the crude oil degradation analyze any data obtained from the lab experiments 	
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. Demonstrate professional attitudes and behaviors towards others. Demonstrate his capability for the responsibility and accountability Show Effective verbal communication with clarity. Propose the smart questions. Understand and dissecting the problem so that it is fully solved understood. Demonstrate the assertiveness for his decision. 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"> - General introduction about petroleum Microbiology -An overview about composition and nature of crude oil around the world. - Origins and distribution of petroleum 	1	2
<ul style="list-style-type: none"> ❖ Biological origin and accumulation of petroleum from microfossils and sedimentary basis. <ul style="list-style-type: none"> - Microbial aspects of oil prospecting. 	1	2
<ul style="list-style-type: none"> ❖ Microbial metabolism of aliphatic hydrocarbons (straight and branched chains) under aerobic and anaerobic conditions 	2	4
<ul style="list-style-type: none"> ❖ Microbial metabolism of hydrocarbons aliphatic and cyclic aromatic hydrocarbons under anaerobic and aerobic conditions 	3	6
<ul style="list-style-type: none"> ❖ Methane-utilizing bacteria (methanotrophs) microbial metabolism of methane 	1	2

❖ Taxonomy of methane producing bacteria Identification, Nomenclature, classification of methane producing bacteria	1	2
❖ Biotechnology and crude oil recovery - Microbial enhanced crude oil recovery ❖ Sulphate reducing bacteria and its role in crude oil recovery process .	1	2
❖ Biodegradation of crude oil -Microbial degradation of petroleum products and use of microorganisms in oil clean-up operations; oil spillage. - Isolation of methane producing bacteria -Identification and characterization (phenotypic and genotypic characterization) -Growth of crude oil degrading bacteria on the monomer of petroleum compounds. -Determination of crude oil degradation products by GC Mass	2	4
❖ Biodegradation of petroleum derivatives: Isolation and characterization of Diesel, Benzene and Oil degrading bacteria	1	2
❖ Role of microorganisms in corrosion of oil field Equipment Hydrocarbonoclastic bacteria; Metallomonas bacteria that cause rusting of oil pipes;	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"> List the paraffinic and aromatic components of different kinds of crude oil. Describe the formation of petroleum from fossils and microfossils. Outline the origins and distribution of petroleum in the environment Summarize physical, chemical and biological factors affecting petroleum degradation. Write the role of Biotechnology for enhancing crude oil recovery Write the roles of biotechnology in biodegradation, bioremediation 	<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</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>or cleanup during oil pollution.</p> <ul style="list-style-type: none"> List bacteria that attack metals and cause rusting of oil pipes. Memorize the roles of microorganisms in bioexploration. List crude oil degrading microorganisms and oil clean-up operations; oil spillage. Describe the microbial metabolism of hydrocarbons aliphatic and cyclic aromatic hydrocarbons under anaerobic and aerobic conditions Identify the Methane-utilizing bacteria (methanotrophs) 	<p>address to facilitate student web interactions.</p> <p>Using images and movies</p> <p>-Encouraging students to collect the new information about what the new in Petroleum microbiology</p> <p>-Availability of the reference books and scientific sites concerning Petroleum microbiology.</p>	
2.0 Skills			
2.1	<p>Cognitive skills</p> <ul style="list-style-type: none"> List the paraffinic and aromatic components of different kinds of crude oil. Interpret formation of petroleum from fossils and microfossils. Discuss the Origins and distribution of petroleum in the environment. Summarize physical, chemical and biological factors affecting petroleum degradation. . Describe the microbial aspects and indicators of oil bioexploration and prospecting Differentiate between biodegradation, bioremediation. Write the roles of microorganisms in cleanup during oil pollution. Predict the degradation products of crude oil Explain the role of microorganisms in corrosion of oil field equipment. Diagram the microbial metabolism of hydrocarbons 	<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
	<p>aliphatic. and cyclic aromatic hydrocarbons under anaerobic and aerobic conditions.</p> <ul style="list-style-type: none"> • Write Biotechnology and enhanced crude oil recovery • Summarize the role of Sulphate reducing bacteria and its role in crude oil recovery process. • Characterize and identify the microorganisms responsible for degradation of crude oil and its degradation products. • Estimate the potentiality of the microorganisms in crude oil degradation. 		
2.2	<p>Psychomotor Skills</p> <ul style="list-style-type: none"> • Perform the laboratory experiments precisely • Operate all devices in petroleum microbiology lab • Draw the pathway of the crude oil degradation • analyze any data obtained from the lab experiments 	<p>- Follow up students the students in lab and during carryout all the laboratory experiments</p>	<p>-Giving additional marks for the students they have accurate laboratory results and good seminar presentation</p> <p>-Practical exam.</p>
3.0	Competence		
	<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. • Demonstrate professional attitudes and behaviors towards others. • Demonstrate his capability for the responsibility and accountability • Show Effective verbal communication with clarity. • Propose the smart questions. • Understand and dissecting the problem so that it is fully solved understood. • Demonstrate the assertiveness for his decision. • Show Effective verbal 	<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>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).</p> <ul style="list-style-type: none"> • 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)- Ollivier, B. and Magot, M. (2005) <i>Petroleum Microbiology</i>. ASM Press, Washington DC, USA.</p> <p>(2)- Atlas, RM, and Philp, J. (2005) <i>Bioremediation: Applied Microbial Solutions for Real-World Environmental Cleanup</i>. ASM Press, Washington DC, USA.</p>
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Essential References Materials	Ernest Beerstecher Jr. (2013) Petroleum Microbiology: An Introduction to Microbiological Petroleum Engineering.
Electronic Materials	http://www.ncbi.nlm.nih.gov/pmc/articles/PMC309048/
Other Learning Materials	Book note prepared by Associate professor Dr. Hussien Hassan Abulreesh

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, 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 Resources (AV, data show, Smart Board, software, etc.)	<ul style="list-style-type: none"> Digital lab containing 15 computers.
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	<ul style="list-style-type: none"> Incubators, autoclaves, measuring equipment, water bath, digital balances, pH meters, safety facilities. Glass fermenter, Automated small fermenter, Shaker incubators, Centrifuge , Availability of some reference crude oil degrading strains Availability all kits for identification of the microorganisms isolated from different habitates Availability of GC mass device for rapid identification of degradation products of crude oil and its derivatives

G. Course Quality Evaluation

1. Strategies for Obtaining Student Feedback on Effectiveness of Teaching <ul style="list-style-type: none"> Questionaries Open discussion in the class room at the end of the lectures.
2. Other Strategies for Evaluation of Teaching by the Instructor or by the Department <ul style="list-style-type: none"> Revision of student answer paper by another staff member. Analysis the grades of students.
3. Processes for Improvement of Teaching <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.
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) <ul style="list-style-type: none"> After the agreement of Department and Faculty administrations
5 Describe the planning arrangements for periodically reviewing course effectiveness and planning for improvement. <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

Faculty member responsible for the course:

Prepared by faculty staff: 1. Dr. Hussien Hassan 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 Prof.	Signature:
Date:	