

**Department of: Soil and Water**

**College of: Agriculture**

**University of: Salahaddin**

**Subject: Soil Microbiology**

**Course Book for post graduate/Diploma**

**Lecturer's name:Dr.Khunaw Abdulla Rahman**

**Academic Year: 2023/2024**

**Course Book**

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| **1. Course name** | First semester\ Autumn Semester | | |
| **2. Lecturer in charge** | Khunaw A. Rahman | | |
| **3. Department/ College** | Soil and Water Dept., College of Agriculture | | |
| **4. Contact** | **e-mail: khunaw.rahman @su.edu.krd**  **Tel: 07504635810** | | |
| **5. Time (in hours) per week** | **Theory: 1 (2hr)**  **Practical: 2 (3hr)** | | |
| **6. Office hours** | **Availability of the lecturer to the student during the week** 2hr\day | | |
| **7. Course code** |  | | |
| **8. Teacher's academic profile** | **B.Sc in biology(microbiology)college of science ,Salahaddin Un. Erbil ,2001-2002.**  **MSc. 2007**  **phD. in soil microbiology , UPM –Malaysia ,2017.** | | |
| 9. Keywords | Soil microbe , bacteria , fungi , viruses | | |
| **10. Course overview**:  The purpose of this semester of Microbiology is to familiarize the student with those concepts that are basic to soil microbiology and the primary focus involved the study of the biota living in soil and concerned itself with the cycling of nutrients and their availability to agricultural plants.  Soil microbiology today is more of an interdisciplinary study, involving agricultural production, aquatic and biogeochemical sciences, bioremediation, environmental quality, biodiversity, and global climate change.  The molecular biology of bacteria currently is the best defined of that of all living organisms.  Molecular techniques are rapidly being applied to in situ soils and sediments, thus allowing microbiologists to characterize the wide array of non-culturable organisms in nature.  Scientists study soil microbiology by taking two basic approaches:  Approach 1: to study the mechanical, physical, and biochemical functions of living organisms  Physiology – how they grow and metabolize  Taxonomy – what they look like and how they are related to one another  Pathology – how they cause disease of plants, animals and humans  Symbioses – how they interact with more complex organisms  Approach 2: to study the chemical, physical, geological and biological process and reactions that governs the composition of the natural environment  Biogeochemistry – how they affect our environment chemically  Nutrient cycling – how they recycle compounds in soil  Global change – how they affect global properties such as temperature and atmospheric chemistry  Ecology – how they interact with their environment and with other microorganisms. Soil Microbiology influences everything in our lives from the air we breathe, the food we eat and the water we drink.  An understanding of soil microbiology is critical to further understanding agricultural and environmental impacts on our lives.  Ultimately, the study of soil microbiology equips us with knowledge to address issues related to the functions of other biological systems on earth.  Microbes can make [nutrients](https://en.wikipedia.org/wiki/Nutrient) and minerals in the soil available to plants, produce [hormones](https://en.wikipedia.org/wiki/Hormones) that spur growth, stimulate the plant [immune system](https://en.wikipedia.org/wiki/Immune_system) and trigger or dampen stress responses. In general a more diverse soil microbiome results in fewer plant diseases and higher yield.  Learning activities will include reading and evaluation scientific papers, learning basic Microbiological techniques, identifying unknown bacteria, answering questions in lecture and writing scientific papers. | | | |
| **11. Course objective:**  1. Provide students with an understanding of the importance of microorganisms and biotic processes to soil properties, ecosystem function and agriculture.  2. Impart students with a knowledge of soil as a habitat for organisms.  3. Introduce students to the morphology, physiology and ecology of the major groups’ of soil microorganisms.  4. Familiarize students with the roles of microorganisms in biogeochemical processes occurring in soil.  5. Introduce students to some practical applications of soil microbiology to problems in agriculture and environmental quality.  6. Aid students in relating soil microbiology and biochemistry to their own areas of applied or research interest.  Students should acquire a good understanding of the concepts above. They should be able to show their mastery of them in oral and written form, in lecture, in the laboratory and in exams. They should be able to design experiments to identify microorganisms, interpret the data and communicate it. | | | |
| **12. Student's obligation**  When they have finished the course, students will have been introduced to a working knowledge of basic bacterial laboratory techniques, as well as to the foundations of Microbiology - the concepts of activity, evolution and distribution of soil microorganisms, as well as a factual and laboratory knowledge of specific microorganism types - In addition, they should have developed an understanding of microbial ecology and of medical and practical uses for microorganisms, and how they relate to basic biological concepts. It is the intent of the course to provide an opportunity to learn the skills necessary to understand and get a feel for the basic ideas embodied within the various facts that they will encounter, and how those ideas are related. This should allow them to establish a firm foundation for future Microbiology courses and/or a good appreciation of concepts needed to make reasoned choices in their everyday lives. In general, they should understand how microorganisms survive where they do, how they are related, and how they interact with us. In the laboratory they should acquire basic bacteriological skills and should be able to successfully use them. | | | |
| **13. Forms of teaching**: Different forms of teaching will be used to reach the objectives of the course: power point presentations for the head titles and definitions. Description of Soil microorganisms and their habitats and any other illustrations, besides worksheet will be designed to let the chance for practicing on several aspects of the course in the classroom.  Graduate students will be required to review a scientific paper that relates to one of the course topics. The review will consist of a paper that is at a maximum of five pages (typed) in length and an oral presentation of the review (15 minutes in length). The goal is to have each student relate to the class an application of microbiology in solving an environmental problem. The format for the paper and presentation will be discussed in class. | | | |
| **14. Assessment scheme**  I will give two examinations before the final one. The grade is distributed among the theoretical examination,(70%), at least two quizzes (15%), class activity(10%) and student attendance(5%).  ‌ Finally we take the mean of two or three examination and group project: 25%  Practical Examination 15%  Final examination: 60% | | | |
| **15. Student learning outcome:**  Soil microbiology is designed for Biology majors who want to expand their knowledge of the microscopic world, in general, or for use in professional or graduate school. Students need to be able to understand both the concepts presented as well as have a basic understanding of the factual nature of the course. They have to know what kinds of organisms are out there, in order to go on to higher learning, or to better understand the world. In order to achieve that goal, feedback will be given on questions asked in lecture and laboratory, exams and on the final laboratory report in as prompt fashion as possible so that the students will always understand how they stand. These will consist of lectures, laboratory demonstrations, laboratory work (including independent investigation to identify unknown organisms), reading assigned scientific papers, writing a final laboratory report and answering those questions that are asked in lecture and laboratory. Outside the formal lecture/ laboratory structure, the student is expected to read assignments in the text, as well as assigned papers from the scientific literature, and study the concepts presented in lecture, laboratory and in the text. Hopefully this mix of learning styles will create a deeper appreciation of Soil Microbiology.  Initiative on the part of each individual student in asking pertinent questions and inviting conversation on related outside topics will be noted in the final grade. Selected articles; resource texts and reserve library materials may be assigned as required. Prescott, Harley and Klein (text) as assigned. Lectures cannot cover all that is in the text, and are designed to be complementary to, instead of a repetition of, the text. Exams will be on the lecture material and on those portions of the text directly relating to it. Assigned text readings are listed by chapter; a given lecture might not cover all the subjects in the chapter(s) listed. Most topics will be outlined in notes published on the web prior to the lecture, if possible. These notes are study guides, and are only a part of what is required for exams. | | | |
| **16. Course Reading List and References‌:**  ▪ Key references:  1-E. A. Paul (2007).Soil-Microbiology-Ecology-Biochemistry. Third ed. Academic press in an imprint of Elservier.USA.  2-[D. M. Sylvia](http://www.amazon.com/s/ref=ntt_athr_dp_sr_1?_encoding=UTF8&sort=relevancerank&search-alias=books&field-author=David%20M.%20Sylvia), [J. J. Fuhrmann](http://www.amazon.com/s/ref=ntt_athr_dp_sr_2?_encoding=UTF8&sort=relevancerank&search-alias=books&field-author=Jeffry%20J.%20Fuhrmann), [P. G. Hartel](http://www.amazon.com/s/ref=ntt_athr_dp_sr_3?_encoding=UTF8&sort=relevancerank&search-alias=books&field-author=Peter%20G.%20Hartel), and [D. A. Zuberer](http://www.amazon.com/s/ref=ntt_athr_dp_sr_4?_encoding=UTF8&sort=relevancerank&search-alias=books&field-author=David%20A.%20Zuberer). (2008). Principles and Applications of Soil Microbiology. 2nd ed. Willing and WilkingCo., London**.**  3-V. A. O. Ralf (2009). Advanced Techniques in Soil Microbiology. Willing and Wilking Co, NewYork.  Useful references  1-D. V. Elsas, J. K. Jansson and J. T. Trevors (2006). Modern-Microbiology-Second-Plants-Environment .Mosbey, Inc.  2-R. L. Tate (2006). Soil-Microbiology. 2nd ed. Mosbey, Inc.  3-M. S. Coyne (1999). Introduction to Soil-Microbiology. Willing and Wilking Co, NewYork.  Journals and internet sites  1-<http://www.amazon.com/>  2-[www.aol.com](http://www.aol.com)  3-Journal of Soil microbiology  4-Journal of Applied Microbiology | | | |
| **17. The Topics:** | | | **Lecturer's name** |
| |  |  |  |  | | --- | --- | --- | --- | | **Weeks** | **Subjects** | | **Notes** | | 1st. | Introduction to Soil components and Soil microbiology and brief history on soil microbiology | | Description of Soil components and Soil microbiology , and Studding brief history Historical accounts and the “Golden Age” of soil microbiology | | 2nd. | Microbial Diversity in soil and  Microbial Biomass in soil | | Study the type of Soil microorganisms and their proportion in soil include ( Viruses- Bacteria- Actinomycetes- Fungi- Algae- Protozoa and Microbial Interactions | | 3nd. | Factors affecting the quality and quantity of soil microorganisms | | Study the main factors (pH- temperature- light- soil moisture-  organic matter content………) briefly on the activity, quality and quantity of soil microorganisms | | 4rd. | Importance of soil microorganisms and Microbial processes in soil | | Study the role and importance of soil microorganisms in soil briefly include (organic matter decomposition- nutrient cycle- Biofertilizers, humus formation….) | | | 5th. | Nitrogen transformations and cycling | | Study nitrogen cycle briefly and all biological process which  takes place by soil microorganisms like (nitrification- denitrification- Amonification…) | | 6th. | Biological Nitrogen fixation | | Studding briefly symbiotic and non symbiotic nitrogen fixation and their importance in agriculture | | 7th | First examination | | | | 8th | Carbon Cycle | Study carbon cycle briefly and all biological process which takes place by soil microorganisms like mineralization and immobilization | | | **9th** | Phosphorus cycle | Studing Phosphorus cycle briefly and role of microorganisms in mineralization and immobilization of soil phosphorus and studing their role in phosphorus availability | | | **10th** | Biofertilizer  Advantage of Biofertilizer  Type of biofertilizer | Definition of biofertilizer and studding the advantage of biofertilizer and dis advantage of chemical fertilizers and their effects on plant growth , and studding the type of biofertilizers and soil microorganisms that can be use as a biofertilizer | | | **11th** | Mycorrhizae | Definition of Mycorrhizae and Study the classification of Mycorrhizae , and importance of Mycorrhizae on phosphate availability in soil and study the effect of Mycorrhizae on plant growth. | | | **12th.** | Soil microorganisms and plants- (Rhizosphere microorganisms)  - | Studding the effect of soil microorganisms on plant growth (plant growth hormone production- provide plants with different nutrients-………..) | | | **13th** | Applied soil microbiology | Studding Soil management and soil microorganisms  - Manipulations of soil microorganisms for agriculture  - Bioremediation of environmental contaminants | | | **14th** | Relationships between soil microorganisms | Studding the Relationships between soil microorganisms include (symbiosis, antagonism, parasitism…………. | | | **15th** | biofertilizer | What is biofertilizer, type of biofertilizer, application of biofertilizer, advantage if biofertilizers | | | **16th** | Second examination | | | | | | ex: 10/2/2022  dr. Aras  17\2/2022  Dr. Aras  14\2/2022  Dr. Aras  21\2/2022  Dr. aras  28\2/2022  Dr. aras  4\2/2022  Dr. aras  12\3/2022  Dr. aras  18\3/2022  Dr. aras  25\3/2022  Dr. aras  2\4/2022  Dr. aras  9\4/2022  Dr. aras  16\4/2022  Dr. aras  23\4/2022  Dr. aras  30\4/2022  Dr. aras  7\5/2022  Dr. aras |
| **18. Practical Topics (If there is any)** | |  | |
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| **19. Examinations**:  Samples of question  Q1-what is myccorihza, its type and its important to plants?  Q2-explain briefly the ammonification of organic matter, and what is its important to microorganisms and to plants.  Q3-Write the scientific name of the following organisms:  Nitrogen fixer bacteria  Nitrifier bacteria  c-Phosphate solubilizer fungi  Q4- Complete the following sentences with suitable scientific information  Clay is important for soil microorganisms because….. | | | |
| **20. Extra notes:**  I have no any extra notes. | | | |
| **21. Peer review**  **Peer review** | | | |