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**Department of Biology**

**College of Science**

**University of Salahaddin/Hawler**

**Subject: Plant Physiology**

**Course Book of Academic Year: 2018/2019 Dr. Abdulghany Omer Ismaeel Sarmamy**

1. **Theory Lectures of 4th stage students of Biology:**
2. **Practical teacher: Mr Mehdi H. Ibraheem MSc**

**With assistant of Mrs Hiam Younis**

**Course Book**

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| **1. Course name** | **Plant Physiology** |
| **2. Lecturer in charge** | **Prof. Dr. Abdulghany Omer Ismaeel Sarmamy** |
| **3. Department/ College** | **Biology/ College of Science** |
| **4. Contact** | **e-mail: Abdulghany.ismaeel@su.edu.krd** |
| **5. Time (in hours) per week**  | **Theory: 2 and Practical: 3**  |
| **6. Office hours** | **To be Return to the schedule on the office door** |
| **7. Course code** |  |
| **8. Teacher's academic profile**  | Abdulghany Omer Ismaeel Sarmamy (PhD)**\*** I **graduated** from Baghdad University, College of Agriculture in 1978(**Ranked 3rd in the department**), B.Sc.**\*** In 1983 I obtained M.Sc. degree in Baghdad University (with **excellent** degree). The Title of the thesis: **تأثير بعض المبيدات الكيمياوية والعزق ومواعيد الاضافة والتداخل بينهما على مكافحة الحلفا في العراق**.In the same year I moved to the University of Salahaddin-Erbil and worked as Assistant Lecturer, teaching Weed Science: Physiology and control of weed plants.**\*** PhD in 2001 from Baghdad University, College of Agriculture, Department of Field Crops Sciences and the Dissertation Title: **تأثير مستخلصات بعض نباتات الادغال على بعض انواع البكتريا****\*** **Instructor** In the college of Medicine, Department of Medicinal Chemistry (1987-1993), teaching Practical Clinical Medicine until and manager of the library of College of Medicine . **\*** **Instructor** In the college of Science, Biology Department (1993-1996), teaching Practical Molecular Biology, Biostatistics and Experimental Design. **\*** **Dean of Erbil Technical Institute** 1996.**\*** **Instructor** in the college of Agriculture (1996-2005), teaching Crop Science, Plant Physiology, Weed Science, herbicides and their Mode of Action, Statistics and Experimental Design as well as supervising and teaching graduated students (M. Sc. and PhD). . **Instructor** In the College of Science, Department of Biology (2005) teaching Plant Physiology, Biostatistics, and Experimental Design as well as supervising and teaching graduated students (M. Sc. and PhD). Administrative Positions: 1- **Superintendent** of the Lybrary of the College of Medicine, 1978.  2- **Manager** of the Bookshop of the University of Salahaddin-Erbil 1994. 3- **Superintendent** of the Bookshop of the College of Agriculture, 1997.  4- **Manager General** of the Central Library of the University of Salahaddin-Erbil, 1995. 5. **Dean of Erbi1Technical Institute**, 1996.\* **I obtained the title of Assistant lecturer in 1983,** **\* Lecturer in 1988,** **\*Assist. Prof. In 2001, and** **\* Professor in 2017**.I **published more than 30 papers** in the national and international periodicals and conferences and translated a book titled \***Herbicides and Plant Growth Regulators** from English to Arabic Language with my partner Dara Jaff (PhD).  |
| **9. Keywords** | **Plants, Physiology, structure, water, photosynthesis, respiration, hormones, IAA, Stress, gametophyte** |
| **10. Course overview:** * ***The importance of studying the subject***

The course will cover plant physiology topics together with printed media and internet articles which deal with current plant organs issues. Instructional stratigies attemp to strike a balance between developing the students ability to cope with plant physiology, extending their general academic reading skills, and increasing their basic knowledge of and understanding of plant physiology. The course will give students a better understanding of a number of plant organs activities topics, the followings are examples but not restricted to: growth, water relations, respiration, photorespiration, growth hormones, hormones pathways, plant metabolites, plant chemicals and plant relationships, and finally plant stress physiology. * ***Understanding of the fundamental concepts of the course***

Today plant sciences are a fusion of the traditional components with the modern aspects of biochemistry, molecular biology and biotechnology. Over years, plant science (Botany) has shown enormous gain in information and applications owing to tremendous inputs from research in all its aspects. With global recognition of the need for conservation, field plant biologists have contributed significantly in assessing plant diversity. Taxonomists have explored newer dimensions for the classification of plants. New insights have been gained in functional and structural aspects of plant development by utilizing novel tools and techniques for botanical research. Challenging areas of teaching and research have emerged in ecology and reproductive biology. Concern for ever increasing pollution and climate change is at its highest than ever before. Keeping these advancements in view, a revision of the curriculum at the undergraduate level is perfectly timed.These courses shall provide the biology students hands on experience and professional inputs. On the whole, the curriculum is a source of lot of information and is supported by rich resource materials. It is hoped that a student graduating in biology with the new curriculum will be a complete botanist at Honours level.* ***Principles and theories of the course***

The principles and theories of the subject are the teaching of General characteristics; Ecology and distribution; range of thallus organization and reproduction; Cell structure and components; cell wall, pigment system, reserve food (of all groups represented in the syllabus), flagella; methods of reproduction; Classification; criteria, the system of Bold and Wynne, and evolutionary classification of Lee (only up to groups); Significant contributions of important phycologists (G.M. Smith, R.E. Lee, Bold and Wynne, and others). Role of algae and archegoniates in the environment, agriculture, biotechnology, human life, and industry.* ***Major areas of the subject***

Algae and Archegoniates are suitable for upper-level undergraduate and graduate students following courses in phycology, limnology or biological oceanography.Emphasis is placed on those algae that are commonly covered in phycology courses, and encountered by students in marine and freshwater habitats.  |
| **11. Course objective:**The course will cover algae and archegoniate groups of plant communities topics together with printed media or internet articles which deal with current plant lifecycle issues. Instructional strategies attempt to strike a balance between developing the students’ ability to cope with algae and archegoniates, extending their general academic reading skills and increasing their basic knowledge and understanding of algae and archegoniates. The course will give students a better undestanding of a number of plant life cycle topics, the followings are examples but not restricted to: groeth, productivity, life cycles, form of plants, ecosystems of plants, morphological appearance, evolutionary relationships, and lastly the taxonomy of algae and archegoniates. |
| **12. Student's obligation**\***Exam policy:** Student should get at least 3 exam during the year. There will be no make-up exams for absence students without medical report. **\*Classroom polices:****1- Attendance:** You are strongly encouraged to attend class on a regular basis, as participation is important to your understanding of the material. This is your opportunity to ask questions. **Students are responsible for obtaining any information they miss due to absence.** 2- **Lateness:** Lateness to class is disruptive3- **Electronic devices:** Allcell phones are to be turned off at the beginning of class and put away during the entire class.4-**Talking:** During class please refrain from side conversations. These can be disruptive to other students and the professor, and **not** **Disrespectful to both the professor and to other students**.  |
| **13. Forms of teaching**Using of Course Book and PowerPoint |
| **14. Assessment scheme**

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| --- | --- | --- |
| Component | Date | Percent |
| Exam1 | --/--/2018 | 12.5 % |
| Exam 2 | --/--/2019 | 12.5 % |
| Practical exam. |  | 15% |
| Final exam (Theoretical) |  | 40% |
| Final exam (Practical) |  | 20% |
| Total |  | 100% |

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| **15. Student learning outcome:**After completion of this year, student will be able to:* Define common terms used in botany and plant physiology.
* How plant uptake water from roots till highest point of stem.
* Plant and water relationship.
* Effect of light, water, and CO2 on plant life.
* Photosynthesis and its pathways.
* Respiration and photorespiration and their pathways.
* Plant Metabolites and their role in plant life.
* Plant hormones, their pathways, effect, role in plant life and parts that present in.
* The physiology of stress.
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| **16. Course Reading List and References‌:****Course references**1. ▪ Key references: Plant Physiology, 3rd Ed. by Lincoln Taiz and Eduardo Zeiger (2003).

**SUGGESTED READINGS:**▪ Useful references: 1. Plant Physiology. By Philip Steuart & Sabine Globig
2. Plant Physiology& Development, 6th Ed. by Lincoln Taiz and Eduardo Zeiger.
3. Introduction to Plant physiology, 2004. W.G. Hopkins and Norman P. A. Huner, 3rd Edition, John Wiley & Sons. Inc., New York,

▪ Magazines and review (internet)Any book titled as Plant Physiology  |

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| No. | **17.The Topics** |
| 1 | Water and Plant Cells. |
| 2 | Mineral Nutrition.  |
| 3 | Water Balance of Plants. |
| 4 | Solute Transport. |
| 5 | Photosynthesis: Photochemical Reactions. |
| 6 | Examination Number One |
| 7 | Photosynthesis: Biochemical Reactions (Carbon Reduction Reactions). |
| 8 | Respiration and Lipid Metabolism. |
| 9 | Assimilation of Mineral Nutrients. |
| 10 | Assimilation of Mineral Nutrients (Continuous). |
| 11 | Examination Number two |
| 12 | Energy and Enzymes. |
| 13 | Secon Semester: |
| 14 |  Auxins |
| 15 | Auxins (Continuous). |
| 16 | Gibberellins |
| 17 | Cytokinins |
| 18 | Ethylene |
| 19 | Third Examination |
| 20 | Abscisic Acid |
| 21 | Stress Physiology: 1. Water Stress |
| 22 | Heat Stress. |
| 23 | Salinity Stress. |
| 24 | Oxygen Deficiency. |
| 25 | Fourth Examination |
| 26 | Secondary Metabolites and Plant Defense.  |
| 27 | Secondary Metabolites (Continue) |
| 28 | Secondary Metabolites (Continue) |
|  | In this section the lecturer shall write titles of all topics he/she is going to give during the term. This also includes a brief description of the objectives of each topic, date and time of the lecture Each term should include not less than 16 weeks  |

**18. The Practical Topics and Date**

**Syllabus of Practical Plant Physiology**

**Course weekly outline**

Lab. 1 Introduction of plant physiology.

Lab. 2 Method expressed on solution concentration.

Lab. 3 Type of solutions and some properties of colloidal system (A).

Lab. 4 Properties of colloidal system (B).

Lab. 5 Water and determining field capacity

Lab. 6 Soil and soil texture analysis.

Lab. 7 Plant - water relationship (permeability).

Lab. 8 Plant - water relationship (osmosis).

Lab. 9 Plant - water relationship (Diffusion).

Lab. 10 Plant - water relationship (Imbibition).

1st examination

Lab. 11 Seed and seed germination

Lab. 12 Seed germination in relation to light and hormones

Lab. 13 α-amylase activity and gibberellic acid in wheat seed

Lab. 14 Plant Growth and Development

Lab. 15 Study of plant hormone

Lab. 16 Photosynthesis I estimation of pigments

Lab. 17 Photosynthesis II oxygen production

Lab. 18 Respiration

Lab. 19 Transpiration

2nd examination

Lab. 20 Study of plant stress.

Lab. 21 Plant enzyme (A)

Lab. 22 Study of plant enzyme (B)

Lab. 23 Plant secondary metabolites/a- Detection of phenolic acid and lignin in plant tissues by thin layer chromatography

Lab. 24 Alkaloid detection in plant tissues

Lab. 25 Extraction of caffeine from tea leaves.

Lab. 26 Digestion of plant dry matter.

Lab. 27 Estimation of some elements in plant dry matter (Nitrogen).

Lab. 28 Phosphorus

Lab. 29 Calcium and Magnesium

Lab. 30 Estimation of protein in plant

Lab. 31 Estimation of oil in plant

3rd examination

**19. Examinations:**

**Theoretical Examination**

An example of a Final Examination

Q1- Fill in the blanks, with the words between brackets. (10 Marks)

1. A variety of signalling molecules that play roles in resistance to pathogens and defence against herbivores are -------------, ---------------- and-------------------. (Jasmonic acid, ABA, ethylene, salicylic acid, systemin).
2. Under conditions of--------------, ABA in the leaves can increase 50-fold within 4 to 8 hours. (Salinity stress, water stress, water abundant).
3. -----------------deserves pride of place in any discussion of plant hormones because it was the first growth hormone to be discovered in plants. (Gibberellin, Auxin, ABA).
4. --------------- is believed to be a root signal that helps reduce the transpiration rate. (Ethylene, ABA, Auxin).
5. In general, meristematic regions and nodal regions are the most active in ---------------------------. (Ethylene biodegradation, ethylene biosynthesis).
6. Halophytes are native to ------------------ soils and complete their life cycles in that environment. (Non-saline, saline).
7. The critical oxygen pressure (COP) is the oxygen pressure at which the -------------rate is first slowed by O2 deficiency. (Respiration, transpiration, photosynthesis).
8. Roots usually obtain sufficient oxygen (O2) for aerobic respiration directly from the ----------------space in the soil.(Gaseous, liquid (the soil water), solid).

Q2- Define the following: (10 Marks)

Sodicity, salinity, phototropism, Zeatin

Q3- Explain **why** (4 marks)

1. Water rises higher in small diameter tubes than large one proof by equations
2. Red drop was happened in light exposing of Emersons first experiment

Q4- Define the following (6 marks)

1. ***Anchored proteins***
2. ***Specific heat***
3. ***Light***

Q5-What are the role of the following products in plant life 10 marks)

1. ***Azadirachtin***
2. ***Phytoecdysones***
3. ***Tannins***
4. ***Isoflavonoids***
5. ***Anthocyanins***

The Answers are the following

Q1)

1-A variety of signaling molecules that play roles in resistance to pathogens and defense against herbivores are jasmonic acid, salicylic acid, and systemin.

2-Under conditions of water stress, ABA in the leaves can increase 50-fold within 4 to 8 hours.

3-Auxin deserves pride of place in any discussion of plant hormonesbecause it was the first growth hormone to be discoveredin plants.

4- ABA is believed to be a root signal that helps reduce the transpiration rate.

5-In general, meristematic regions and nodal regions are the most active in ethylene biosynthesis.

6- Halophytes are native to saline soils and complete their life cycles in that environment.

7-The critical oxygen pressure (COP) is the oxygen pressure at which the respiration rate is first slowed by O2 deficiency.

8-Roots usually obtain sufficient oxygen (O2) for aerobic respiration directly from the gaseous space in the soil.

Q2)

Sodicity: high concentrations of Na+ in the soil, referred to as sodicity.

Salinity: high concentrations of total salts in the soil, referred to as salinity.

Phototropism: Growth with respect to light and bending of plants towards the lightdue tothe activity of plant hormone auxin.

Zeatin: Zeatin is the most abundant natural cytokine, found in the extracts of immature endosperm of corn, has the same biological effect as kinetin.

Q3- Explain why (4 marks)

1. Water rises higher in small diameter tubes than large one proof by equations

Together, adhesion and surface tension pull on the water molecules, causing them to move up the tube until the upward force is balanced by the weight of the water column. The smaller the tube, the higher the capillary rise.

$$Capillary=\frac{14.9×10^{-6}m^{2}}{radius (m)}$$

1. Red drop was happened in light exposing of Emersons first experiment

Because at 700nm light the Photosystem II, which working at 680nm, will stop working and the electron flow for Photosystem I, which working at 700nm, will stopped hence Red Drop happens.

Q4- Define the following (6 marks)

1. *Anchored proteins:* These are cell membrane proteins bound to the membrane surface via lipid molecules, to which they are covalently attached.
2. *Specific heat:* is the heat energy required to raise the temperature of a sub­stance by a specific amount.
3. *Light:* is an electromagnetic waves formed of tiny particles named as photons or quanta the energy of these particles are different as the wavelength differs and this energy gives the color of light.

Q5-What are the role of the following products in plant life (10 marks)

1. *Azadirachtin*: is a feeding deterrent to some insects at doses as low as 50 parts per billion, and it exerts a variety of toxic effects.
2. *Phytoecdysones*: are a group of plant steroids that have the same basic structure as insect molting hormones. Ingestion of phytoecdysones by insects disrupts molting and other developmental processes.
3. *Tannins* : are general toxins that significantly reduce the growth and survivorship of many herbivores when added to their diets. In addition, tannins act as feeding repellents to a great diversity of animals.
4. *Isoflavonoids*, such as the rotenoids, have strong insecticidal actions; others have anti-estrogenic effects. For example, sheep grazing on clover rich in isoflavonoids often suffer from infertility.
5. *Anthocyanins* are involved in these plant–animal interactions, helping to attract animals to flowers and fruit by providing visual and olfactory signals.

**20. Extra notes:-**

*Prof. Dr. Abdulghany O. I. Sarmamy PhD*

*Theoretical lecturer*

Mr. Mahdi Hashim Ibrahim

MSc Asst. Lecturer

Practical Lecturer

**21. Peer review**