Course Specifications

Course Title:	**Plant Physiology II**
Course Code:	**4013272-**
Program:	**BSc Biology**
Department:	**Biology Department**
College:	**Applied science**
Institution:	**Umm Al-Qura university**

Table of Contents

A. Course Identification

1. Credit hours:
2. Course type **a.** University ☐ College ☐ Department ■ Others ☐ **b.** Required ■ Elective ☐
3. Level/year at which this course is offered:
4. Pre-requisites for this course (if any)**:** **Plant Physiology I (4013261-3)**
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	3 hrs per weeks	100%
2	Blended		
3	E-learning		
4	Correspondence		
5	Other		

7. Actual Learning Hours (based on academic semester)

No	Activity	Learning Hours
Contact Hours		
1	Lecture	42
2	Laboratory/Studio	3
3	Tutorial	
4	Others (specify)	
	Total	
Other Learning Hours*		
1	Study	
2	Assignments	
3	Library	
4	Projects/Research Essays/Theses	
5	Others (specify)	
	Total	

* 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

This course will cover the concepts and importance of enzymes and plant metabolism (photosynthesis, respiration, and metabolite anabolism & catabolism). It focuses on the machinery of enzyme action, CO_2 reduction, glucose oxidation, and associated metabolic cycles. Also, it includes the relations between C3, C4 and CAM plants as well as between glycolysis, fermentation and Krebs cycle. Moreover, biosynthesis and biodegradation of 1-ry metabolic products (the energy-rich compounds) as well as ATP yielded from anaerobic and

aerobic respiration. Using instruments in chemical and quantitative analyses of metabolic products will be also covered. The course aims to give the student an idea of the basics of the various processes within the plant in terms of metabolic activity as well as a brief picture of the chemistry of organic compounds manufactured within the plant.

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2. Course Main Objective

After completing this course student should be able to:

- Know the fundamental concepts, importance of enzymes, plant metabolism and the underlying processes.
- Understand the structure, properties, occurrence, nomenclature, mechanism of action, specificity and classification of enzymes as well as enzyme activators and inhibitors, and factors affecting enzyme activity.
- Understand the relationship between photosynthesis and respiration on one hand, and between anabolism and catabolism of 1-ry plant metabolites (carbohydrates, lipids, proteins & nucleic acids) on the other hand.
- Differentiate between the structure and functions of metabolic organelles as well as those of the photosynthetic pigments and systems.
- Give a description of the photosynthetic and respiratory phosphorylation (electron transport).
- Acquire a comprehensive knowledge and understanding about the machinery of CO2 reduction and glucose oxidation as well as between the underlying mechanisms of each process.
- Build and design the various photosynthetic and respiratory cycles.
- Determine and deduce the similarities and differences between C3, C4 and CAM plants as well as between glycolysis, fermentation and Krebs cycle.
- Learn and discuss the biochemical reactions involving in the biosynthesis and biodegradation of the 1-ry plant metabolites (carbohydrates, lipids, proteins & nucleic acids)
- Develop understanding about the biosynthesis of the energy-rich compounds (GTP, ATP, FADH2, NADH2 and NADPH2), and about the net ATP yielded from anaerobic and aerobic respiration.
- Understand the photorespiration process, and recognize the factors affecting photosynthesis and respiration.
- Acquire the essential practical skills relevant to the use of instruments in chemical analysis.
- Develop their abilities to apply laboratory equipment in studying kinetics of chemical reactions, carry-out quantitative analysis and determine physiological criteria

Know the fundamental concepts, importance of enzymes, plant metabolism and the underlying processes.

3. Course Learning Outcomes

	CLOs	Aligned PLOs
1	**Knowledge:**	
1.1	After completing this course student should be able to: Know the fundamental concepts, importance of enzymes, plant metabolism and the underlying processes.	
1.2	Understand the structure, properties, occurrence, nomenclature, mechanism of action, specificity and classification of enzymes as well as enzyme activators and inhibitors, and factors affecting enzyme activity.	
1.3	Understand the relationship between photosynthesis and respiration on one hand, and between anabolism and catabolism of 1-ry plant metabolites (carbohydrates, lipids, proteins & nucleic acids) on the other hand.	
1.4	Differentiate between the structure and functions of metabolic organelles as well as those of the photosynthetic pigments and systems.	
1.5	Give a description of the photosynthetic and respiratory phosphorylation (electron transport).	
1.6	Acquire a comprehensive knowledge and understanding about the machinery of CO2 reduction and glucose oxidation as well as between the underlying mechanisms of each process.	
1.7	Acquire the essential practical skills relevant to the use of instruments in chemical analysis.	
2	**Skills :**	
2.1	After successfully completed the course students should be able to: Compare between metabolic cycles, between C3, C4 and CAM plants, and between glycolysis, fermentation and Krebs cycle.	
2.2	Differentiate between the biosynthesis and biodegradation of the 1-ry plant metabolites, and the energy-rich compounds.	
2.3	Calculate the ATP yielded from anaerobic and aerobic respiration	
2.4	Aquire the essential practical skills relevant to the use of instruments in chemical analysis.	
2.5	Carry-out quantitative analysis and determine physiological criteria	
2.6	Analyse physiological experimental data and draw sensible conclusions from such data.	
2.7	Interpret results of oriented problems, whether graphically or algebraically	
3	**Competence:**	
3.1	- Developing oral presentations.	
3.2	- Communicating personal ideas and thoughts.	
3.3	- Work independently and as part of a team to finish some assignments.	
3.4	- Communicate results of work to others	

C. Course Content

No	List of Topics	Contact Hours
1	Introduction to the course. • Main physiological concepts Course syllabus and grading	2

2	Enzymes. • Definition, occurrence, nomenclature and properties. • Structural composition of proteins and enzymes. • Mechanism of enzyme action and activation energy. • Specificity of enzymes. • Factors affecting enzyme activity. • Enzymatic reaction kinetics and Michael's constant Km. • Classification of Enzymes. • Denaturation of enzyme. • Enzyme activators and inhibitors. The existence and distribution of enzymes in plant cells	**6**
3	Photosynthesis. • Definition & importance. • Origin of O_2 evolved during photosynthesis. • Structure and functions of chloroplasts as well as photosynthetic pigments. • Photosystems and energy transfer. • Photochemical (light) reaction and electron transport. • Non-cyclic photophosphorylation. • Cyclic photophosphorylation (electron transport). • Biochemical (dark) reaction. • C O_2 – fixation (reduction). • C3 plants (Calvin cycle). • C4 plants (Hatch and Slack pathway). CAM plants (Crassulacean-acid metabolism).	**6**
4	Respiration. • Introduction to respiration. • Dark respiration. -Glycolysis. -Fermentation (absence of O_2). -Krebs (Citric acid) cycle (presence of O_2). • Energy yielded from anaerobic and aerobic respiration. • Respiratory electron-transport and the biosynthesis of energy-rich compound (ATP). • Respiratory rate and quotient. Photorespiration.	**6**
5	Metabolism of 1-ry metabolic products • Introduction to metabolic pathways (anabolism & catabolism) and metabolic products. • Carbohydrate Metabolism -Biosynthesis & biodegradation (monosaccharides – disaccharides - oligosaccharides – polysaccharides). -Relationship between polysaccharides and lipids. • Lipid Metabolism -Biosynthesis & biodegradation of lipids (fatty acids – triglyceride phospholipid). • Synthesis of plant acids. • Protein Metabolism -Classification of amino acids.	**8**

	-Biosynthesis & biodegradation of proteins. -Structure and importance of proteins. -Electrical properties, precipitation and denaturation of proteins. • Nucleic acids metabolism -Introduction to nucleic acids & nucleotides (structure & types). -Biosynthesis & biodegradation of nucleic acids. -Differences between DNA and RNA.	
Total		**28 hrs**

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	After completing this course student should be able to: Know the fundamental concepts, importance of enzymes, plant metabolism and the underlying processes.	• Lectures • Interactive presentations • Scientific discussion • Video Shows (Educational Videos) • Web-based study	• Exams (Oral test - Periodic tests) Group discussions
1.2	Understand the structure, properties, occurrence, nomenclature, mechanism of action, specificity and classification of enzymes as well as enzyme activators and inhibitors, and factors affecting enzyme activity.		
1.3	Understand the relationship between photosynthesis and respiration on one hand, and between anabolism and catabolism of 1-ry plant metabolites (carbohydrates, lipids, proteins & nucleic acids) on the other hand.		
1.4	Differentiate between the structure and functions of metabolic organelles as well as those of the photosynthetic pigments and systems.		
1.5	Give a description of the photosynthetic and respiratory phosphorylation (electron transport).		
1.6	Acquire a comprehensive knowledge and understanding about the machinery of CO2 reduction and glucose oxidation as well as between the underlying mechanisms of each process.		
1.7	Acquire the essential practical skills relevant to the use of instruments in chemical analysis.		
2.0	**Skills**		

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
2.1	After successfully completed the course students should be able to: Compare between metabolic cycles, between C3, C4 and CAM plants, and between glycolysis, fermentation and Krebs cycle.	• Lectures • Scientific discussion. Presentation skills and throw through the activities and duties required to be displayed to the students in seminars	- Laboratory lessons through practical tests to asses research related to the course are viewing on students in the evaluation discussion groups
2.2	Differentiate between the biosynthesis and biodegradation of the 1-ry plant metabolites, and the energy-rich compounds.		
2.3	Calculate the ATP yielded from anaerobic and aerobic respiration		
2.4	Aquire the essential practical skills relevant to the use of instruments in chemical analysis.		
2.5	Carry-out quantitative analysis and determine physiological criteria		
2.6	Analyse physiological experimental data and draw sensible conclusions from such data.		
2.7	Interpret results of oriented problems, whether graphically or algebraically		
3.0	**Competence**		
3.1	- Developing oral presentations.	Oral presentations. Internet search assignments and essays. Incorporating the use and utilization of computer in the course requirements. Students will be asked for delivering a summary regarding certain topics related to the course.	Evaluation of student essays and assignments. Evaluating the laboratory written reports. Marks given to for good reports and presentations Evaluating during the discussion in lecture and reports. Part of the grad is put for student's written participation
3.2	- Communicating personal ideas and thoughts.		
3.3	- Work independently and as part of a team to finish some assignments.		
3.4	- Communicate results of work to others		

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	**Home works, search or presentation**	**4th and 8th weeks**	**10 %**
2	**Midterm "Written Test (1)"**	**8th week**	**30%**
3	**Final Exam "Practical Test"**	**15th week**	**20%**
4	**Final Exam Written Test**		**40%**
5			
6			
7			
8			

***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 scheduled hours (6 hours) during the school week to communicate with the students**

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	Course notes and Laboratory manual authorized by the Council of Department of Biology, Botany Branch. Initially, students are provided with a limited number of references relating to their subject area, but then are expected to search the literature on their own
Essential References Materials	Biochemistry by Donald Voet (Hardcover - Mar 9, 2004). Lehninger Principles of Biochemistry, Fourth Edition by David L. Nelson and Michael M. Cox (Hardcover – April 23, 2004). Fundamentals of Biochemistry: Life at the Molecular Level by Donald J. Voet, Judith G. Voet, and Charlotte W. Pratt (Hardcover - Mar 31, 2005). Biochemistry (Biochemistry (Berg)) by Jeremy M. Berg, John L. Tymoczko, and Lubert Stryer (Hardcover - May 19, 2006). William Plaxton and Michael McManus (2006). Control of Primary Metabolism in Plants. Blackwell, ISBN: 1405130962. Lincoln Taiz and Eduardo Zeiger (2010): Plant Physiology. 5th Edition, Sinauer Associates, Inc., ISBN: 978-0-87893-511-6. Photosynthesis Research Protocols. Series: Methods in Molecular Biology, Vol. 684. Carpentier, Robert (Ed.) 2nd ed., 2011, XIV, 395 p. 71 illus., Hardcove.
Electronic Materials	www.plantphysiol.org/content/152/4/1763.full. www.biology-online.org/.../9_plant_meta... www.ucalgary.ca/plantmetabolism. www.ecomii.com/.../plant-metabolism. www.ufv.br/dbv/pgfvg/.../metabolism/NMR.pdf.
Other Learning Materials	

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	Classrooms, laboratories
Technology Resources (AV, data show, Smart Board, software, etc.)	data show, Smart Board

Item	Resources
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods

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

Council / Committee	
Reference No.	
Date	