The University of Jordan

Accreditation & Quality Assurance Center

COURSE Syllabus

1	Course title	Biochemistry II
2	Course number	1203253
3	Credit hours (theory, practical)	3 (theory)
	Contact hours (theory, practical)	48 (theory)
4	Prerequisites/corequisites	Biochemistry I (1203251)
5	Program title	BSc & PharmD
6	Program code	
7	Awarding institution	The University of Jordan
8	Faculty	Pharmacy
9	Department	Biopharmaceutics & Clinical Pharmacy
10	Level of course	undergraduate
11	Year of study and semester (s)	Second semester of the 2nd year
12	Final Qualification	BSc & PharmD
13	Other department (s) involved in teaching the course	NA
14	Language of Instruction	English
15	Date of production/revision	1 September 2015

16. Course Coordinator:

Office numbers, office hours, phone numbers, and email addresses should be listed.
Dr. Violet Kasabri
E-mail: V.Kasabri@ju.edu.jo
Office No.: 135
Office hours to be announced

17. Other instructors:

Dr. Yasser Bustanji
E-mail: bustanji@ju.edu.jo, office No. 218, Office hours to be announced
Dr. Arij Assaf. office No 132, Office hours to be announced
E-mail: areej_assaf@ju.edu.jo

18. Course Description:

This course is the second course in a two-semester sequence in biochemistry. The students are expected to use the knowledge gained in Biochemsitry I to understand the main biochemical concepts regarding the different metabolic pathways of biomolecules; carbohydrate, lipids, proteins and nucleotides. Storage and expression of genetic information topics will be covered in this course.

19. Course aims and outcomes:

Program Competencies Achieved:

2.2 Recognize main physiological and biochemical principles that govern normal body functioning

A- Aims:
This course is the second course in a two-semester sequence in biochemistry. The students are expected to:
1- Use the knowledge gained in Biochemistry I to understand the basic concepts of metabolism
2-Understand the metabolic pathways of the major biomolecules; carbohydrate, lipids, proteins and nucleotides.
3-Understand the main issues regarding the storage and expression of genetic information

B- Course Intended Learning Outcomes (ILOs): Upon successful completion of this course students will be able to …

Successful completion of the course should lead to the following outcomes:

A. Knowledge and Understanding:

Student is expected to develop Intellectual skills (cognitive and analytical) via learning:

A1. DNA, RNA, AND THE FLOW OF GENETIC INFORMATION

A1.1 Nucleotide Biosynthesis

1. Purine Bases Can Be Synthesized de Novo or Recycled by Salvage Pathways
2. Deoxyribonucleotides Synthesized by the Reduction of Ribonucleotides Through a Radical Mechanism
3. Key Steps in Nucleotide Biosynthesis Are Regulated by Feedback Inhibition
4. In de Novo Synthesis, the Pyrimidine Ring Is Assembled from Bicarbonate, Aspartate, and Glutamine
5. Nucleoside Monophosphate Kinases: Catalyzing Phosphoryl Group Exchange between Nucleotides Without Promoting Hydrolysis
6. Disruptions in Nucleotide Metabolism Can Cause Pathological Conditions

A1.2 DNA Structure, Replication, Recombination, and Repair

1. A Nucleic Acid Consists of Four Kinds of Bases Linked to a Sugar-Phosphate Backbone
2. A Pair of Nucleic Acid Chains with Complementary Sequences Can Form a Double-Helical Structure
3. DNA Is Replicated by Polymerases that Take Instructions from Templates
4. DNA Can Assume a Variety of Structural Forms
5. DNA Polymerases Require a Template and a Primer
6. Double-Stranded DNA Can Wrap Around Itself to Form Supercoiled Structures
7. DNA Replication of Both Strands Proceeds Rapidly from Specific Start Sites
8. Double-Stranded DNA Molecules with Similar Sequences Sometimes Recombine

A1.3 RNA Synthesis and Splicing

1. Transcription Is Catalyzed by RNA Polymerase
2. Eukaryotic Transcription and Translation Are Separated in Space and Time
3. The Transcription Products of All Three Eukaryotic Polymerases Are further subjected to downstream processing
4. Most Eukaryotic Genes Are Mosaics of Introns and Exons

A1.4 Protein Synthesis

1. Gene Expression Is the Transformation of DNA Information Into Functional Molecules
2. Amino Acids Are Encoded by Groups of Three Bases Starting from a Fixed Point
3. Protein Synthesis Requires the Translation of Nucleotide Sequences Into Amino Acid Sequences
4. Mutations Involve Changes in the Base Sequence of DNA
5. Aminoacyl-Transfer RNA Synthetases Read the Genetic Code

6. A Ribosome Is a Ribonucleoprotein Particle (70S) Made of a Small (30S) and a Large (50S) Subunit
7. Protein Factors Play Key Roles in Protein Synthesis
8. Eukaryotic Protein Synthesis Differs from Prokaryotic Protein Synthesis Primarily in Translation Initiation and subsequent coupling reactions.

A1.5 The Gene Expression Regulation

1. Prokaryotic DNA-Binding Proteins Bind Specifically to Regulatory Sites in Operons
2. The Greater Complexity of Eukaryotic Genomes Requires Elaborate Mechanisms for Gene Regulation
3. Transcriptional Activation and Repression Are Mediated by Protein-Protein Interactions
4. Some Receptors Dimerize in Response to Ligand Binding and Signal by Cross-phosphorylation
5. Gene Expression Can Be Controlled at Posttranscriptional Levels

A1.6 Molecular basis of inherited diseases

1. Restriction Enzymes: Performing Highly Specific DNA-Cleavage Reactions
2. DNA recombinations are helpful in establishing genomic as well as cDNA libraries
3. Antibiotic resistance genes can select for the transfected cloning vector.
4. The utility of Sanger dideoxy method is basically for purified DNA sequencing.
5. Restriction Fragment Length Polymorphism analysis is a direct diagnostic tool of sickle cell disease.
6. Polymerase chain reaction is highly advantageous in detecting/tracing low abundance nucleic acid sequences
7. Microarray technique is quite a handy Analytical means of determinations of the gene expression products.
8. ELISA and Western blots can be Important Techniques to investigate specific proteins.

A2. TRANSDUCING & STORING OF ENERGY
INTERMEDIARY METABOLISM

A2. 1 Glycolysis and Gluconeogenesis

1. Metabolism Is Composed of Many Coupled, Interconnecting Reactions
2. The Oxidation of Carbon Fuels Is an Important Source of Cellular Energy
3. Glycolysis Is an Energy-Conversion Pathway in Many Organisms
4. The Glycolytic Pathway Is Tightly Controlled
5. Glucose Can Be Synthesized from Noncarbohydrate Precursors
6. Gluconeogenesis and Glycolysis Are Reciprocally Regulated

A2. 2 Citric Acid Cycle

1. The Citric Acid Cycle Oxidizes Two-Carbon Units
2. Entry to the Citric Acid Cycle and Metabolism Through It Are Controlled
3. The Citric Acid Cycle Is a Source of Biosynthetic Precursors. Amino Acids Are Made from Intermediates of the Citric Acid Cycle and Other Major Pathways

A2. 3 The Pentose Phosphate Pathway

1. the Pentose Phosphate Pathway Generates NADPH and Synthesizes Five-Carbon Sugars
2. The Metabolism of Glucose 6-Phosphate by the Pentose Phosphate Pathway Is Coordinated with Glycolysis
3. Glucose 6-Phosphate Dehydrogenase Plays a Key Role in Protection Against Reactive Oxygen Species

A2. 4 Glycogen, hexoses and disaccharides Metabolism

1. Glycogen Breakdown Requires the Interplay of Several Enzymes
2. Phosphorylase Is Regulated by Allosteric Interactions and Reversible Phosphorylation
3. Epinephrine and Glucagon Signal the Need for Glycogen Breakdown
4. Glycogen Is Synthesized and Degraded by Different Pathways
5. Glycogen Breakdown and Synthesis Are Reciprocally Regulated
6. All hexoses are to be phosphorylated before they are any further metabolized
7. Hexose epimerase can substitute for lacking dietary sources of galactose
8. Lactose synthesis is mainly mediated by galactosyltransferases

A3. LIPID METABOLISM

A3. 1 Fatty Acid Metabolism

1. Triacylglycerols Are Highly Concentrated Energy Stores
2. The Utilization of Fatty Acids as Fuel Requires Three Stages of Processing
3. Certain Fatty Acids Require Additional Steps for Degradation
4. Fatty Acids Are Synthesized and Degraded by Different Pathways
5. Acetyl Coenzyme A Carboxylase Plays a Key Role in Controlling Fatty Acid Metabolism via Carnitinr shuttle modulation
6. Elongation and Unsaturation of Fatty Acids Are Accomplished by Accessory
7. Ketogenesis is strictly hepatic and ketone bodies can be consumed by brain as well as muscle cells

A3. 2 The Biosynthesis of Membrane Lipids and Steroids

1. Phosphatidic acid Is a Common Intermediate in the Synthesis of Phospholipids and Triacylglycerols
2. Cholesterol Is Synthesized from Acetyl Coenzyme A in Three Stages
3. The Complex Regulation of Cholesterol Biosynthesis Takes Place at Several Levels
4. Important Derivatives of Cholesterol Include Bile Salts and Steroid Hormones

A4. PROTEIN TURNOVER AND AMINO ACID CATABOLISM

1. Proteins Are Degraded to Amino Acids
2. Protein Turnover Is Tightly Regulated
3. Many Enzymes Are Activated by Specific Proteolytic Cleavage
4. The First Step in Amino Acid Degradation Is the Removal of Nitrogen
5. Ammonium Ion Is Converted Into Urea in Most Terrestrial Vertebrates
6. Carbon Atoms of Degraded Amino Acids Emerge as Major Metabolic Intermediates
7. Inborn Errors of Metabolism Can Disrupt Amino Acid Degradation
8. Amino Acids Are Precursors of Many Biomolecules

A5. THE INTEGRATION OF METABOLISM

1. Metabolic Pathways Contain Many Recurring Motifs
2. Metabolism Consist of Highly Interconnected Pathway
3. Each Organ Has a Unique Metabolic Profile
4. Food Intake and Starvation Induce Metabolic Changes
5. Ethanol Alters Energy Metabolism in the Liver
6. Peptide hormones, namely insulin and glucagon, are actively involved in reciprocal regulation of metabolism during absorptive and postabsorptive phases

B. Intellectual skills:

1. Integrate metabolic pathways, and analyze the complete integrated metabolic map.
2. Interpret metabolic abnormalities and relate them to possible causes and mechanisms.
3. Relate the biochemical events at the cellular level to the physiological processes occurring in the whole animal.
4. Follow up the flow of genetic information; DNA→RNA→Protein

C. Subject specific skills

D. Transferable Skills: Student is expected to

1. The development of problem solving and critical thinking skills.
2. Use oral communication to effectively transmit ideas and conclusions to a scientific audience.

Teaching Methods

Lectures and Discussions, Video simulations in addition to class problems

20. Topic Outline and Schedule:

Topic	Week	Instructor	Achieved ILOs	Evaluation Methods	Reference
1. Introduction	1	Violet, Yasser & Areej			
2. Storage and expression of genetic information. • Nucleotide metabolism. • DNA structure and replication • RNA structure and synthesis • Protein Synthesis Regulation of gene expression • Molecular basis of inherited disease • Basics of Biotechnology	1-7	Violet, Yasser & Areej	A, B, D	Exams, Quizes	Specified in each lecture. General references provided below
3. Intermediary metabolism. • Glycolysis. • Gluconeogenesis. • Hexose Monophosphate pathway • Citric acid cycle.	7-9	Violet, Yasser & Areej	A, B, D	Exams, Quizes	Specified in each lecture. General references provided below

4. Carbohydrate metabolism • Glycogen metabolism • Metabolism of monosaccharides and disaccharides	9-10	Violet, Yasser & Areej	A, B, D	Exams, Quizes	Specified in each lecture. General references provided below
5. Lipid metabolism. • Metabolism of dietary lipids • Fatty acid and triacylglycerol metabolism • Phospholipid metabolism • Cholesterol and steroid metabolism.	11-13	Violet, Yasser & Areej	A, B, D	Exams, Quizes	Specified in each lecture. General references provided below
6. Nitrogen metabolism. • Disposal of Nitrogen. • Metabolism of carbon skeleton. • Conversion of amino acids to specialized products	14	Violet, Yasser & Areej	A, B, D	Exams, Quizes	Specified in each lecture. General references provided below
7. Integration of metabolism. • Metabolic effects of insulin and glucagon. • Metabolism in the well-fed state. • Metabolism in starvation and diabetes mellitus	15	Violet, Yasser & Areej	A, B, D	Exams, Quizes	Specified in each lecture. General references provided below
8. **Final Exam**	16th				

21. Teaching Methods and Assignments:

Development of ILOs is promoted through the following teaching and learning methods:

ILO/s	Learning Methods	Evaluation Methods
	Lectures Assignments Discussions AND Video simulations	Exams, Quizzes Quiz in self-study materials

Learning skills:

1. **Critical thinking**
2. **Digital literacy**
3. **Problem-solving skills**
4. **self-study**

22. Evaluation Methods and Course Requirements:

Opportunities to demonstrate achievement of the ILOs are provided through the following assessment methods and requirements:

1. **Exams,**
2. **Quizzes**
3. **Quiz in self-study materials**

23. Course Policies:

A- Attendance policies:

Attendance: Mandatory.

University regulations will be applied

B- Absences from exams and handing in assignments on time:

University regulations will be applied

C- Health and safety procedures:

NA

D- Honesty policy regarding cheating, plagiarism, misbehavior:

The participation, the commitment of cheating will lead to applying all following penalties together

1) Failing the subject he/she cheated at

2) Failing the other subjects taken in the same course

3) Not allowed to register for the next semester. The summer semester is not considered as a semester

E- Grading policy:

Exams and Quizzes.

Mid Exam:	40 points
Quizz:	10 points
Final Exam:	50 points
Total	100 points

F- Available university services that support achievement in the course:

Classrooms, internet classes

24. Required equipment:

Datashow and internet connection

25. References:

ISBN	Title	Author	Year
716712261	BIOCHEMISTRY 4TH EDITION	STRYER, LUBERT	1995C
781769604	BIOCHEMISTRY LIPPINCOTT'S ILLUSTRATED REVIEWS, 4TH EDITTION	CHAMPE, PAMELA; HARVEY, RICHARD; FERRIER, DENISE; COOPER, MICHAEL	2008C
7167743396	LEHNINGER PRINCIPLES OF BIOCHEMISTRY	LEHNINGER, ALBERT	2005C
9780071765763	HARPER'S ILLUSTRATED BIOCHEMISTRY-27ED.	MURRAY, ROBERT K. (ROBERT KINCAID)	2012
0272797138	ESSENTIALS OF HUMAN BIOCHEMISTRY	PATERSON, COLIN RALSTON	1983

26. Additional information:

Name of Course Coordinator: Yasser Bustanji -Signature: ---------- Date: Jan, 31, 2016

Head of curriculum committee/Department: ---------- Signature: ----------

Head of Department: Nailya Bulatova Signature: ----------

Head of curriculum committee/Faculty: ---------- Signature: ----------

Dean: ---------- -Signature: ----------

Copy to:
Head of Department
Assistant Dean for Quality Assurance
Course File