

SUBJECT OUTLINE DETAILS

1. Subject: Biochemistry II

- Code: BC462C
- Credits: 3
- Hours: 45 theory and exercise hours.

2. Management Unit:

- Department of Molecular Biotechnology
- Biotechnology Research and Development Institute

3. Prerequisites: Cells and Molecules I (BS110C), Organism and Populations (BS111C), Organic Chemistry I & II (CH251C & CH352C) and Biochemistry I (BC462C).

4. Subject objectives:

This course examine principles of bioenergetics, metabolism and biosynthesis of important biochemical substances. Students will understand about the biochemical reactions which happen in living things. The biochemical reactions are organized into catabolic pathways that produce energy and reducing power and anabolic pathways.

4.1. Knowledge:

After completing this course, the students were expected to gain knowledge about:

- 4.1.1. The principles of bioenergetics.
- 4.1.2. The metabolism, biosynthesis and degradation of small molecules in the living cells.
- 4.1.3. Techniques of isolation and characterization of protein

4.2. Skills:

- 4.2.1. Students will be trained to get advance knowledge, professional skills and competence to practice in biochemical industry.
- 4.2.2. Students can design, implement, analyze and evaluate biochemical experiments.
- 4.2.3. Students will be trained to get these skills: teamwork skills; scientific information search skills; synthesize, analyze and evaluate information skills; writing skills and presentation skills.

4.3. Attitude:

- 4.3.1. Students should understand the important role of of bioenergetics, metabolism, biosynthesis and degradation of small molecules in the living cells.
- 4.3.2. Students should be developed attitudes relevant to the application of biochemical knowledge in practical such as biological processes, biomedical and biotechnology.

4.3.3. Students must have a positively sense in their self-learning.

5. Brief description of subject content:

Biochemistry II is the course of bioenergetics and metabolism of biochemical materials in living things. Principles of bioenergetics will be examined including bioenergetics and thermodynamics, phosphoryl group transfer and ATP and biological oxidation-reduction reactions. The other chapters in this course examine metabolism - all the processes involved

in maintaining a cell. Metabolism has two components: catabolism and anabolism. Catabolism deals with the breaking down of molecules, whereas anabolism deals with the building up of cells. All metabolic processes involve energy: They either absorb energy (endergonic) or produce it (exergonic). Metabolism is a highly coordinated cellular activity in which many multienzyme systems (metabolic pathways) cooperate to (1) obtain chemical energy by capturing solar energy or degrading energy-rich nutrients from the environment; (2) convert nutrient molecules into the cell's own characteristic molecules, including precursors of macromolecules; (3) polymerize monomeric precursors into macromolecules: proteins, nucleic acids, and polysaccharides; and (4) synthesize and degrade biomolecules required for specialized cellular functions, such as membrane lipids, intracellular messengers, and pigments. Techniques of isolation and characterization of protein will be also examined. The basic knowledges for protein extraction and purification will be explained. Some methods for characterization and purification of proteins will be described.

6. Subject content structure:

	Content	Hours	Objectives
Chapter 1.	Principles of bioenergetics 1.1. Bioenergetics and thermodynamics 1.2. Phosphoryl group transfer and ATP 1.3. Biological Oxidation-Reduction reactions	6	4.1.1, 4.2.1, 4.2.2, 4.2.3, 4.3.1, 4.3.2, 4.3.3
Chapter 2.	Metabolism of carbohydrates 2.1. Carbohydrate biosynthesis 2.2. Glycolysis and the catabolism of hexoses 2.3. The citric acid cycle	9	4.1.2, 4.2.1, 4.2.2, 4.2.3, 4.3.1, 4.3.2, 4.3.3
Chapter 3.	Metabolism of lipids 3.1. Lipids and membranes 3.2. Mechanisms of membranes transport 3.3. Lipid biosynthesis: Biosynthesis of fatty acids, triacylglycerols and membranes lipids 3.4. Metabolism of fatty acids 3.5. Beta Oxidation 3.6. Digestion, mobilization, and transport of fatty acid	9	4.1.2,4.2.1, 4.2.2, 4.2.3, 4.3.1, 4.3.2, 4.3.3

Chapter 4. Biosynthesis of amino acids and metabolism of nitrogen-containing compounds 4.1. Amino acid biosynthesis and nitrogen fixation in plants and microorganism 4.2. Amino acid metabolism 4.3. Biosynthesis and degradation of nucleotides 4.4. Metabolism of DNA 4.5. Metabolism of RNA 4.6. Regulation of gene expression	9	4.1.2,4.2.1, 4.2.2, 4.2.3, 4.3.1, 4.3.2, 4.3.3
Chapter 5. Protein metabolism 5.1. The genetic code 5.2. Protein synthesis 5.3. Protein targeting and degradation	6	4.1.2,4.2.1, 4.2.2, 4.2.3, 4.3.1, 4.3.2, 4.3.3
Chapter 6. Techniques of isolation and characterization of protein 6.1. protein 6.2. Functional diversity of proteins 6.3. Basic knowledges for protein extraction and purification Methods for characterization and purification of proteins	6	4.1.3,4.2.1, 4.2.2, 4.2.3, 4.3.1, 4.3.2, 4.3.3

7. Teaching method:

- Teaching theories in class
- Group and individual home assignments
- Discussion in class
- Tests/ quizzes
- Final examination

8. Duties of student:

Students have to do the following duties:

- Attending at least 80 % hours of the course.
- Participating in group and individual assignments.
- Taking the tests/ quizzes.
- Proactively implementing self-study.
- Taking the final examination.

9. Assessment of student learning outcomes:

9.1. Assessment

No.	Point components	Rules and Requirement	Weights	Objectives
1	Overall attendance	- Attend at least 80 % hours of the total hours in the classes	5%	4.3.2, 4.3.3
2	Group/individual assignments/ Discussion in class	- Report of the group/individual - Discuss in group or in class	10%	4.1, 4.2, 4.3.3
3	Tests/ quizzes	- Taking the quick tests/ quizzes	15%	4.1
4	Final examination	- Taking the final examination (90 minutes)	70%	4.1

9.2. Grading

- Grading components and final test scores will be marked on a scale of 10 (0 to 10), rounded to one decimal place.
- Subject score is the sum of all the components of the evaluation multiplied by the corresponding weight. The subject score is marked on a scale of 10 and rounded to one decimal place then is converted to A-B-C-D-F score and score on a scale of 4 under the academic provisions of Cantho University.

10. Materials:

Materials information	Code number
[1] Hand-out	Students are received hand-out in class
[2] Geoffrey L. Zubay, William W. Parson and Dennis E. Vance. 1995. Principles of biochemistry Dubuque, Iowa: WCB.	572.3/ Z93
[3] Mary K. Campbell. 1999. Biochemistry. Orlando, Florida: Harcourt Brace.	572/ C189
[4] ERIC E CONN ... [et al.]. 1987. Outlines of biochemistry. Singapore: John Wiley and Sons.	572/ O.93
[5] Hames B. D. and Hooper N. M. 2000. Instant notes: Biochemistry. BIOS Scientific Publishers Limited.	Library of biochemistry lab, Personal Bookshelf

11. Self-study Guide:

Week	Content	Theory (hours)	Practice (hours)	Students' duties
1	Chapter 1. Principles of bioenergetics 1.1. Bioenergetics and thermodynamics 1.2. Phosphoryl group transfer and ATP	3	0	- Previous research and reference: +References/materials: Chapter 1, [1], [2], [3]. - Review the contents of the modules studied in class
2	1.3. Biological Oxidation-Reduction reactions	3	0	- Previous research and reference: +References/materials: Chapter 1, [1], [2], [3]. - Review the contents of the modules studied in class
3	Chapter 2. Metabolism of carbohydrates 2.1. Carbohydrate biosynthesis	3	0	Previous research and reference: +References/materials: Chapter 2, [1], [2], [3], [4], [5]. - Review the contents of the

				modules studied in class - Make homework assignments
4	2.2. Glycolysis and the catabolism of hexoses	3	0	Previous research and reference: +References/materials: Chapter 2, [1], [2], [3], [4], [5]. - Review the contents of the modules studied in class - Tests/ quizzes
5	2.3. The citric acid cycle	3	0	Previous research and reference: +References/materials: Chapter 2, [1], [2], [3], [4], [5]. - Review the contents of the modules studied in class - Make homework assignments
6	Chapter 3. Metabolism of lipids 3.1. Lipids and membranes 3.2. Mechanisms of membranes transport	3	0	Previous research and reference: +References/materials: Chapter 3, [1], [2], [3], [4], [5]. - Review the contents of the modules studied in class
7	3.3. Lipid biosynthesis: Biosynthesis of fatty acids, triacylglycerols and membranes lipids 3.4. Metabolism of fatty acids	3	0	Previous research and reference: +References/materials: Chapter 3, [1], [2], [3], [4], [5]. - Review the contents of the modules studied in class - Group exercise, discussion
8	3.5. Beta Oxidation 3.6. Digestion, mobilization, and transport of fatty acid	3	0	Previous research and reference: +References/materials: Chapter 3, [1], [2], [3], [4], [5]. - Review the contents of the modules studied in class
9	Chapter 4. Biosynthesis of amino acids and metabolism of nitrogen-containing compounds 4.1. Amino acid biosynthesis and nitrogen fixation in plants and microorganism 4.2. Amino acid metabolism	3	0	Previous research and reference: +References/materials: Chapter 4, [1], [2], [3], [4], [5]. - Review the contents of the modules studied in class
10	4.3. Biosynthesis and degradation of nucleotides 4.4. Metabolism of DNA	3	0	Previous research and reference: +References/materials: Chapter 4, [1], [2], [3], [4], [5]. - Review the contents of the modules studied in class - Group exercise, discussion

11	4.5. Metabolism of RNA 4.6. Regulation of gene expression	3	0	Previous research and reference: +References/materials: Chapter 4, [1], [2], [3], [4], [5]. - Review the contents of the modules studied in class - Tests/ quizzes
12	Chapter 5. Protein metabolism 5.1. The genetic code 5.2. Protein synthesis	3	0	Previous research and reference: +References/materials: Chapter 5, [1], [2], [3], [4], [5]. - Review the contents of the modules studied in class
13	5.3. Protein targeting and degradation	3	0	Previous research and reference: +References/materials: Chapter 5, [1], [2], [3], [4], [5]. - Review the contents of the modules studied in class - Group exercise, discussion
14	Chapter 6. Techniques of isolation and characterization of protein 6.1. Functional diversity of proteins 6.2. Basic knowledges for protein extraction and purification	3	0	Previous research and reference: +References/materials: Chapter 6, [1], [5]. - Review the contents of the modules studied in class - Tests/ quizzes
15	6.3. Methods for characterization and purification of proteins	3	0	Previous research and reference: [1], [5]. - Review the contents of the modules studied in class - Review for final examination.

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**ON BEHALF OF RECTOR
DEAN/ DIRECTOR**

HEAD OF DEPARTMENT