



## OUTCOMES-BASED EDUCATION (OBE) COURSE SYLLABUS

Course No. Chem 138  
Course Title Biochemistry 2

### I. UNIVERSITY INFORMATION

#### 1. Vision of the University

A globally competitive university for science, technology, and environmental conservation

#### 2. Mission of the University

Development of a highly competitive human resource, cutting-edge scientific knowledge and innovative technologies for sustainable communities and environment.

#### 3. VSU Quality Policy Statement

The Visayas State University (VSU), a globally competitive university of science and technology and environmental conservation, is created by law to develop highly competitive human resource, cutting-edge scientific knowledge and innovative technologies for sustainable communities and environment.

Towards this end, we, at the Visayas State University, commit to:

- Produce highly competent, quality and world-class manpower in science and technology, especially for agriculture, environmental management and industry who are proficient in communication skills, critical thinking and analytical abilities;
- Generate and disseminate relevant knowledge and technologies that lead to improved productivity, profitability and sustainability in agriculture, environment and industry; and
- Satisfy the needs and applicable requirements of the industry, the community and government sectors who are in need of quality graduates and technology ready for commercialization through the establishment, operation, maintenance and continual improvement of a Quality Management System (QMS) which is aligned with the requirements of ISO 9001:2015.

It shall be the policy of the university that the quality policies and procedures are communicated to and understood by all faculty, staff, students and other stakeholders and that the system be continually improved for its relevance and effectiveness.

  
**EDGARDO E. TULIN**  
President  
v0 07-16-2019

#### 4. Quality Goals of the College

1. To produce quality manpower and graduates in biology, biotechnology, chemistry, English, liberal arts and behavioral sciences, mathematics, physics and statistics to serve the development needs of the region
2. To uplift the economic well-being of the region through relevant R and D and extension programs
3. To enhance regional development of the Visayas for global competitiveness

#### 5. Quality Objectives of the Department

1. To produce highly qualified and skilled Chemists and Chemical Technicians for the industry, government agencies and academia
2. To generate relevant knowledge and technologies through basic and applied multi- and inter-disciplinary research
3. To achieve strong linkages and cooperation with domestic and international institutions and agencies involved in the pursuit of sustainable development

## II. PROGRAM INFORMATION

1. Name of the Program	BS in Biotechnology
2. CHED CMO Reference	None
3. BOR Approval	BOR Resolution No. 76, s. 2006

#### 4. Program Educational Objectives and Relationship to Institution Mission

Program Educational Objectives	Mission*		
	a	b	c
1. Provide students with fundamental knowledge and laboratory skills necessary for application to a wide range of biotechnological production processes	√	√	√
2. Engage students in laboratory and coursework and research experience in areas such as plant and animal biotechnology, industrial biotechnology, microbial technology, genetic engineering, biochemical engineering, bioinformatics, environmental biotechnology and the biomedical field	√	√	√
3. Expose students to current biotechnological problems so that they will understand and appreciate the role that molecular biology and biotechnology can play in solving them	√	√	√

\*a - development of a highly competitive human resource, b - cutting-edge scientific knowledge, c - innovative technologies for sustainable communities and environment

## III. COURSE INFORMATION

1. Course Code	Chem 138
2. Course Title	Biochemistry 2
3. Pre-requisite	Biochemistry 1



4. Co-requisite	None
5. Credit	3 units
6. Semester Offered	Second Semester
7. Number of hours	3 hours/week
8. Course Description	Basic chemistry of processes involved in the flow of biological information, the principles of metabolism and the chemistry of the primary metabolic pathways

9. Program Outcomes (POs) in relation to the Program Educational Objectives (PEOs)				
Program Outcomes (POs)		Program Educational Objectives		
		1	2	3
a	produce graduates with excellent laboratory and practical skills in biotechnology necessary for a wide range of biotechnological production processes	√	√	√
b	prepare graduates for advanced study in the life sciences and for positions in biotechnology industry	√	√	√
c	harness the theoretical and analytical skills of students to develop new industrial production systems and novel research ideas based on fundamental principles of biotechnology	√	√	√

10. Course Outcomes (COs) and Relationship to Program Outcomes (POs)			
After completing this course, the student must be able to perform the following COs:	Program Outcomes Code		
	a	b	c
CO1 explain how living organisms extract energy from the surroundings to perpetuate life	E	D	D
CO2 explain how organisms store and transmit genetic information to grow and to reproduce accurately	E	D	D
CO3 apply key concepts in biochemistry to explain its practical applications in the field of agriculture, medicine, pharmacy and allied fields	D	D	D
CO4 present awareness of major issues at the forefront of biochemistry	D	D	D
CO5 use computers as information and research tools in biochemistry	E	D	D
CO6 list, evaluate and use primary sources of biochemical information	I	E	D
CO7 discuss issues and formulate choices as socially responsible biotechnologists in the national and global communities	E	D	D

Legend: I – Introductory, E – Enabling, D – Demonstrative

Each letter indicates the expected level of competency that each CO should provide for each PO.

11. Course Content and Plan					
Week	Topics	Learning Outcomes	Teaching and Learning Activities		Assessment Tasks
			Teaching Activities	Learning Activities	

Class Orientation					
1	<p>OBE Course Syllabus (including VSU Vision Mission, and Quality Policy Statement)</p> <p>Class Policies</p> <p>Requirements</p> <p>Grading System and Activities</p> <p>Learning Guide</p> <p>Submission of requirements</p> <p>Values Integration:</p>		<p><b>Online Mode:</b> <b>Virtual Meeting/ Viewing of recorded presentation:</b> Q &amp; A for clarification, setting of expectations, and getting-to-know-each other</p> <p>Class interaction</p> <p>Sharing of Ideas</p> <p>Feedbacks</p> <p><b>VSUEE/VC</b> *: Familiarization of the virtual classroom</p>	<b>Online Mode:</b>	
<b>CO1</b> explain how living organisms extract energy from the surroundings to perpetuate life					
1,2	<p><b>Module No. 1 Intermediary Metabolism</b></p> <p><b>Lesson 1</b> Phases of metabolism Anabolism Catabolism</p> <p><b>Lesson 2</b> Overview of Metabolism Digestive system and digestive juices Hydrolytic enzymes Stages of digestion Salivary digestion Gastric digestion Intestinal digestion</p>	<p>At the end of this unit, the students are expected to</p> <ul style="list-style-type: none"> <li>✓ appreciate the importance of metabolism</li> <li>✓ give an overview of metabolism</li> <li>✓ trace the pathway of the digestion of the following basic foodstuffs: starch, fats, proteins</li> <li>✓ identify the digestive juices and the</li> </ul>	<p>Powerpoint presentation</p> <p>Interactive discussion</p>	<p>Flow diagrams</p>	<p>Worksheet</p> <p>Recitation</p> <p>Exam</p>



		<p>enzymes secreted during the digestion of starch, fats and proteins</p> <p>✓ describe the following: action of salivary amylase on starch, action of the proteolytic enzymes in the stomach, effect of free HCl in gastric digestion, action of intestinal enzymes in the completion of digestion, the components of bile and their function in the digestion of fats</p> <p>✓ identify the end products of digestion of starch, fats and proteins</p> <p>state the role of the end products of digestion in metabolism</p>			
<b>CO2</b> explain how organisms store and transmit genetic information to grow and to reproduce accurately					
3	<p><b>Module 2.</b> <b>The Importance of Energy Changes and Electron Transfer in Metabolism</b></p> <p><b>Lesson 1</b> The nature of metabolism The role of oxidation and reduction in metabolism Classification of biochemical reactions</p> <p><b>Lesson 2</b> Oxidation-reduction Group transfer Hydrolysis Nonhydrolytic cleavage</p>	<p>At the end of this unit, the student should be able to</p> <p>✓ define metabolism</p> <p>✓ differentiate anabolism and catabolism</p> <p>✓ relate metabolism with redox reactions</p> <p>✓ give examples of redox reactions occurring in</p>	<p>Powerpoint presentation</p> <p>Interactive discussion</p>	<p>Writing and classifying biochemical reactions</p> <p>Problem solving</p>	<p>Worksheet</p> <p>Recitation</p> <p>Exam</p>

	<p>Isomerization and rearrangement</p> <p>Bond formation reactions using energy from ATP</p> <p>Coenzymes in biologically important oxidation-reduction reactions</p> <p>Coupling of production and use of energy</p>	<p>biological systems</p> <p>✓ classify biochemical reactions in terms of the six types catalyzed by enzymes and occurring in biological cells</p> <p>explain the concept of free energy change and the role of ATP in transferring energy from exergonic (energy-producing) processes to endergonic (energy-releasing) processes</p>			
<p><b>CO3</b> apply key concepts in biochemistry to explain its practical applications in the field of agriculture, medicine, pharmacy and allied fields</p> <p><b>CO4</b> present awareness of major issues at the forefront of biochemistry</p> <p><b>CO5</b> use computers as information and research tools in biochemistry</p>					
4, 5	<p><b>Module 3</b></p> <p><b>Glycolysis</b></p> <p><b>Lesson 1</b></p> <p>The overall pathway of glycolysis</p> <p><b>Lesson 2</b></p> <p>Conversion of six-carbon glucose to three-carbon glyceraldehyde-3-phosphate</p> <p><b>Lesson 3</b></p> <p>Glyceraldehyde-3-phosphate is converted to pyruvate</p> <p><b>Lesson 4</b></p> <p>Anaerobic metabolism of pyruvate</p> <p>Lactate fermentation</p> <p>Ethanol fermentation</p> <p><b>Lesson 5</b></p> <p>Energy production in glycolysis (aerobic and anaerobic)</p>	<p>At the end of this unit, the student should be able to</p> <p>✓ define glycolysis and show its overall reactions</p> <p>✓ Recall the importance of glucose in biological systems</p> <p>✓ Identify which organelle in the cell glycolysis occurs</p> <p>✓ break down the glycolysis pathway in terms of: ATP-requiring steps, ATP-producing steps, NAD-involving steps,</p>	<p>Powerpoint presentation</p> <p>Interactive discussion</p> <p>Video clip</p>	<p>Tracing glycolysis and understanding its role in metabolic/genetic diseases</p> <p>Writing overall reactions and net reactions</p> <p>Calculating ATP yield</p>	<p>Worksheets</p> <p>Recitation</p> <p>Exam</p>



		<p>reduced and oxidized states of the hydrogen acceptors</p> <ul style="list-style-type: none"> <li>✓ identify the shuttle systems involved in the transport from cytosol to mitochondria</li> <li>✓ describe the mechanism of transport of each shuttle system</li> <li>✓ describe the coupling of oxidation to phosphorylation in ATP production</li> <li>✓ give the number of molecules of ATP formed from each mole of NAD and FAD</li> </ul> <p>identify inhibitors that can block the chain</p>			
<p><b>CO3</b> apply key concepts in biochemistry to explain its practical applications in the field of agriculture, medicine, pharmacy and allied fields</p> <p><b>CO4</b> present awareness of major issues at the forefront of biochemistry</p> <p><b>CO5</b> use computers as information and research tools in biochemistry</p>					
8, 9	<p><b>Module 6</b> <b>Storage Mechanisms and Control in Carbohydrate Metabolism</b></p> <p><b>Lesson 1</b> Synthesis and degradation of glycogen (Glycogenesis and Glycogenolysis) Diabetes mellitus</p> <p><b>Lesson 2</b> Gluconeogenesis</p> <p><b>Lesson 3</b> Control of carbohydrate metabolism</p> <p><b>Lesson 4</b></p>	<p>At the end of this unit, the student should be able to</p> <ul style="list-style-type: none"> <li>✓ differentiate glycogenesis and glycogenolysis in terms of: utilization of glucose, its role in biological systems, energy involved</li> <li>✓ outline how glycogenesis and glycogenolysis take place,</li> </ul>	<p>Powerpoint presentation</p> <p>Interactive discussion</p> <p>Video clip</p>	<p>Tracing glycogenesis, glycogenolysis, gluconeogenesis and pentose phosphate pathway and understanding their roles in metabolic/genetic</p>	<p>Worksheets</p> <p>Recitation</p> <p>Exam</p>

	<p>Pentose phosphate pathway</p> <p>Hemolytic anemia</p>	<p>including the enzymes involved</p> <ul style="list-style-type: none"> <li>✓ explain how glycogen metabolism is controlled, and relate it to diabetes mellitus</li> <li>✓ define gluconeogenesis and describe its role in biological systems</li> <li>✓ identify smaller biomolecules that can be used to synthesize glucose</li> <li>✓ identify the three glycolytic steps bypassed in gluconeogenesis</li> <li>✓ compare and contrast glycolysis, glycogenesis, glycogenolysis and gluconeogenesis</li> <li>✓ differentiate pentose phosphate pathway (PPP) from other carbohydrate metabolic pathways</li> <li>✓ identify the importance of PPP in biological systems</li> <li>✓ trace the oxidative and non-oxidative reactions in PPP</li> </ul>		<p>diseases</p> <p>Interrelating the metabolic pathways of carbohydrate metabolism</p> <p>Writing overall reactions and net reactions</p> <p>Calculating ATP yield</p>	
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	<b>Lesson 5</b> Urea cycle <b>Lesson 6</b> Purine biosynthesis and catabolism Pyrimidine biosynthesis and catabolism	✓ trace the biosynthesis of the following families of amino acids: glutamate, aspartate, serine, pyruvate, aromatic, histidine ✓ explain why glutamate plays a major role in the biosynthesis of amino acids ✓ differentiate between glucogenic and ketogenic amino acids and give examples of each ✓ describe the urea cycle and state its importance ✓ write an equation for the net reaction of the urea cycle show how urea cycle is linked to the CAC		esis and catabolism and understanding their roles in metabolic/genetic diseases Interrelating urea cycle to CAC Writing overall reactions and net reactions	
<b>CO3</b> apply key concepts in biochemistry to explain its practical applications in the field of agriculture, medicine, pharmacy and allied fields <b>CO4</b> present awareness of major issues at the forefront of biochemistry <b>CO5</b> use computers as information and research tools in biochemistry <b>CO6</b> list, evaluate and use primary sources of biochemical information <b>CO7</b> discuss issues and formulate choices as socially responsible biotechnologists in the national and global communities					
16	<b>Module 10</b> <b>The Central Dogma</b>  <b>Lesson 1</b> Replication of DNA Flow of genetic information in the cell	At the end of this unit, the student should be able to	Powerpoint presentation  Interactive discussion	Illustrating the central dogma of molecules	Worksheets Recitation Exam

	Denaturation of DNA <b>Lesson 2</b> Transcription of RNA <b>Lesson 3</b> Translation (synthesis of proteins) Genetic code Post-translation Modification <b>Lesson 4</b> Xenobiotics <b>Lesson 5</b> Types of mutation	✓ describe the molecular basis of replication, transcription and translation processes ✓ discuss the flow of genetic information ✓ discuss gene regulation ✓ describe the occurrences of mutagenesis  identify xenobiotics	Video clip	ar biology  Tracing protein synthesis  Constructing the genetic code table  Interrelating the flow of genetic information, gene regulation and mutation	
<b>CO3</b> apply key concepts in biochemistry to explain its practical applications in the field of agriculture, medicine, pharmacy and allied fields <b>CO4</b> present awareness of major issues at the forefront of biochemistry <b>CO5</b> use computers as information and research tools in biochemistry <b>CO6</b> list, evaluate and use primary sources of biochemical information <b>CO7</b> discuss issues and formulate choices as socially responsible biotechnologists in the national and global communities					
17	<b>Module 11</b> <b>Nucleic Acid Biotechnology Techniques</b>  <b>Lesson 1</b> Purification and detection of nucleic acids <b>Lesson 2</b> Cloning and genetic Engineering <b>Lesson 3</b> Polymerase chain reaction and DNA fingerprinting <b>Lesson 4</b> DNA sequencing	At the end of this unit, the student should be able to  ✓ describe the steps involved in the purification and detection of nucleic acids ✓ define restriction endonucleases and state its importance in creating recombinant DNA ✓ acquire basic knowledge of the process of	Powerpoint presentation  Interactive discussion  Video clip	Flowchart of nucleic acid purification and detection  Flowchart of recombinant DNA preparation  Flowchart of molecular cloning procedure  Flowchart of PCR	Worksheets  Recitation  Exam