



## OUTCOMES-BASED EDUCATION (OBE) COURSE SYLLABUS

Chem 138  
Biochemistry II  
(For BS Biotechnology)

### 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.

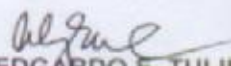
#### 3. VSU Quality Policy Statement

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 of the College of Arts and Sciences

- 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.
- To uplift the economic well-being of the region through relevant R and D and extension programs.
- Enhance regional development of the Visayas for regional competitiveness.

#### 5. Quality Objectives of the Department of Pure and Applied Chemistry

- To produce highly qualified and skilled Chemists and Chemical Technicians for the industry and academia.
- To generate relevant knowledge and technologies through basic and applied multi- and inter-disciplinary researches.
- 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 (COPC No. 142 granted on Nov. 24, 2020)
3. BOR Approval	BOR Resolution No. 76, s. 2006; Revised Curriculum BOR Resolution No. 80, s. 2018

#### 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 Lecture
3. Pre-requisite	Chem 137 - Biochemistry 1 Lec Chem 137.1 – Biochemistry 1 Laboratory
4. Co-requisite	Chem138.1 – Biochemistry II Laboratory
5. Credit	3.0 units
6. Semester Offered	Second Semester



7. Number of hours	3 hrs / 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 the 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 to discuss issues and formulate choices as socially responsible chemists in the national and global communities	I	D	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 / Instructional Workbook / Laboratory Manual</p> <p>Submission of requirements</p> <p>Values Integration: _____</p>	<p>Explain their role in the attainment of VSU's VMGO</p> <p>Get to know each students and instructor</p> <p>Explain the tips in optimizing their learning process, and in getting good grades</p> <p>Discuss the expectations from students and the course</p>	<p>Computer assisted lecture</p> <p><i>Q &amp; A for clarification, setting of expectations, and getting-to-know-each other</i></p> <p><i>Class interaction</i></p> <p><i>Sharing of Ideas</i></p> <p><i>Feedbacks</i></p> <p><b>VSUEE/VC*</b> : Familiarization of the virtual classroom</p>	<p>Role play through a video</p>	<p>Not necessarily graded:</p> <p>Oral recitation/ Quiz</p>
CO1: Explain how living organisms extract energy from the surroundings to perpetuate life.					
1,2	<p><b>Module No. 1</b></p> <p><b>Intermediary Metabolism</b></p> <p><b>Lesson 1</b></p> <p>Phases of metabolism</p> <p>Anabolism</p> <p>Catabolism</p> <p><b>Lesson 2</b></p> <p>Overview of Metabolism</p> <p>Digestive system and digestive juices</p> <p>Hydrolytic enzymes</p> <p>Stages of digestion</p> <p>Salivary digestion</p> <p>Gastric digestion</p> <p>Intestinal digestion</p>	<p>At the end of this unit, the students are expected to</p> <p>✓ appreciate the importance of metabolism</p> <p>✓ give an overview of metabolism</p> <p>✓ trace the pathway of the digestion of the following basic foodstuffs: starch, fats, proteins</p> <p>✓ identify the digestive juices and the</p>	<p>Powerpoint presentation</p> <p>Interactive discussion</p>	<p>Flow diagrams</p>	<p>Worksheet</p> <p>Recitation/ Quiz</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: explain how organisms store and transmit genetic information to grow and to reproduce accurately</b>					
3	<p><b>Module 2 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 <u>Nonhydrolytic cleavage</u></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/ Quiz</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 the 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. Glycolysis</b></p> <p><b>Lesson 1</b> The overall pathway of glycolysis</p> <p><b>Lesson 2</b> Conversion of six-carbon glucose to three-carbon glyceraldehyde-3-phosphate</p> <p><b>Lesson 3</b> Glyceraldehyde-3-phosphate is converted to pyruvate</p> <p><b>Lesson 4</b> Anaerobic metabolism of pyruvate Lactate fermentation Ethanol fermentation</p> <p><b>Lesson 5</b> Energy production in glycolysis (aerobic and anaerobic)</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>Worksheet</p> <p>Recitation/Quiz</p> <p>Exam</p>

	<b>Lesson 6</b> Entry of other carbohydrates into glycolysis Dietary carbohydrates (starch, glycogen, maltose, sucrose, lactose) Fructose, galactose, glycerol	irreversible steps ✓ classify the type of biochemical reaction involved in each step ✓ identify the control points in glycolysis ✓ state the fate of pyruvate during anaerobic metabolism and explain its significance ✓ calculate and compare the ATP production in aerobic and anaerobic glycolysis outline the metabolism of other carbohydrates (i.e. dietary carbohydrates and fructose, galactose and glycerol) by glycolysis			
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### FIRST LONG EXAMINATION ON MODULE NOS. 1-3

**CO3:** Apply the key concepts in biochemistry to explain its practical applications in the field of agriculture, medicine, pharmacy, and allied fields.

**CO4:** Present awareness of major issues at the forefront of biochemistry.

**CO5:** use computers as information and research tools in biochemistry.

6	<b>Module 4.0 The Citric Acid Cycle</b>  <b>Lesson 1</b> The central role of the CAC in metabolism <b>Lesson 2</b> Overall pathway of the CAC <b>Lesson 3</b> Conversion of pyruvate to acetyl Co-A <b>Lesson 4</b> Individual reactions of the CAC <b>Lesson 5</b> Energetics and control of the CAC	✓ define citric acid cycle ✓ identify the role of mitochondria in aerobic metabolism ✓ connect the glycolysis pathway to citric acid cycle ✓ trace the production of	Powerpoint presentation  Interactive discussion	Tracing the CAC and understanding its role in metabolic/genetic diseases  interrelating CAC and glycolysis	Worksheet  Recitation/Quiz  Exam
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**Mission:**

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Page 7 of 18  
TP-IMD-08  
V02 11-14-2022

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	<b>Lesson 6 The glyoxylate cycle: a related pathway</b>	energy and carbon dioxide in the CAC ✓ calculate the net gain of ATP molecules produced in the cycle ✓ identify the end product in the total combustion of glucose and the starting material that enters the CAC ✓ Give the importance of glyoxylate pathway in plants			
<b>CO3:</b> Apply the 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.					
7	<b>Module 5. Electron Transport (ET) and Oxidative Phosphorylation (OP)</b>  <b>Lesson 1</b> The role of ET in metabolism Reduction potentials in the ET Chain Organization of ET complexes The connection between ET and phosphorylation The mechanism of coupling in OP Respiratory inhibitors used to study ET Shuttle mechanisms The ATP yield from complete oxidation of glucose	✓ define ET chain ✓ state the role of ET chain in metabolism ✓ identify the hydrogen acceptors from the metabolite ✓ differentiate the action of the hydrogen acceptors directly from the metabolite ✓ identify the electron acceptors and their action on the electrons along the chain ✓ show the redox reactions occurring in the chain ✓ give the short forms of the	Powerpoint presentation  Interactive discussion  Video clip	Tracing the ET and understanding its role in metabolic/genetic diseases  Interrelating TE to glycolysis and CAC  Writing overall reactions and net reactions  Calculating ATP yield	Worksheet  Recitation/Quiz  Exam



		<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>CO3: Apply the key concepts in biochemistry to explain its practical applications in the field of agriculture, medicine, pharmacy, and allied fields.</p> <p>CO4: Present awareness of major issues at the forefront of biochemistry.</p> <p>CO5: use computers as information and research tools in biochemistry.</p>					
8,9	<p><b>Module 6. 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> Pentose phosphate pathway Hemolytic anemia</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 the glycogenesis, glycogenolysis, gluconeogenesis, pentose phosphate pathway and understanding their role in metabolic/genetic diseases</p>	<p>Worksheet</p> <p>Recitation/ Quiz</p> <p>Exam</p>

		<p>including the enzymes involved</p> <p>✓ explain how glycogen metabolism is controlled, and relate it to diabetes mellitus</p> <p>including the enzymes involved</p> <p>✓ explain how glycogen metabolism is controlled, and relate it to diabetes mellitus</p> <p>✓ define gluconeogenesis and describe its role in biological systems</p> <p>✓ identify smaller biomolecules that can be used to synthesize glucose</p> <p>✓ identify the three glycolytic steps bypassed # in gluconeogenesis</p> <p>✓ compare and contrast glycolysis, glycogenesis, glycogenolysis and gluconeogenesis</p> <p>✓ differentiate pentose phosphate pathway (PPP) from other carbohydrate metabolic pathways</p> <p>✓ identify the importance of PPP in biological systems</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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		<ul style="list-style-type: none"> <li>✓ trace the oxidative and non-oxidative reactions in PPP</li> <li>✓ explain how PPP is controlled</li> <li>✓ relate how a defective enzyme in PPP can result in hemolytic anemia</li> </ul>			
<b>10 MIDTERM EXAMINATION</b>					
<p>CO3: Apply the key concepts in biochemistry to explain its practical applications in the field of agriculture, medicine, pharmacy, and allied fields.</p> <p>CO4: Present awareness of major issues at the forefront of biochemistry.</p> <p>CO5: use computers as information and research tools in biochemistry</p> <p>CO7: discuss issues and formulate choices as socially responsible biotechnologies in the national and global communities.</p>					
11	<b>Module 7. Photosynthesis</b>  <b>Lesson 1 Site of Photosynthesis</b>  <b>Lesson 2 Photosystems I and II and the Light Reactions of Photosynthesis</b>  <b>Lesson 3 Photosynthesis and ATP Production</b>  <b>Inhibiting Photosynthesis</b>	<ul style="list-style-type: none"> <li>✓ rationalize how the structure of chloroplast affects photosynthesis</li> <li>✓ compare and contrast chlorophyll, hemoglobin and myoglobin in terms of structure</li> <li>✓ trace the ATP production of photosynthesis</li> <li>✓ relate photosynthesis with ET chain in terms of ATP production</li> </ul> <p>describe how herbicides can inhibit photosynthesis</p>	Powerpoint presentation  Interactive discussion  Video clip	Tracing photosynthesis and understanding its role in plants  Illustrating photosystems I & II  Writing overall reactions of photosynthesis  Calculating ATP yield	Worksheet  Recitation/Quiz  Exam
<p>CO3: Apply the key concepts in biochemistry to explain its practical applications in the field of agriculture, medicine, pharmacy, and allied fields.</p> <p>CO4: Present awareness of major issues at the forefront of biochemistry.</p> <p>CO5: use computers as information and research tools in biochemistry</p>					
12-13	<b>Module 8. Lipid Metabolism</b>  <b>Lesson 1 Catabolism of Lipids</b> $\beta$ -oxidation of fatty acids	<ul style="list-style-type: none"> <li>✓ Trace the digestion and storage of triacylglycerols,</li> </ul>	Powerpoint presentation	Tracing $\beta$ -oxidation, fatty acid	Worksheet Recitation/

	<b>Lesson 2</b> Energy yield from the oxidation of fatty acids  <b>Lesson 3</b> Catabolism of unsaturated fatty acids and odd-carbon fatty acids  <b>Lesson 4</b> Ketone bodies  <b>Lesson 5</b> Fatty acid Biosynthesis  <b>Lesson 6</b> Synthesis of acylglycerol and compound lipids  <b>Lesson 7</b> Cholesterol biosynthesis	and fatty acids, including the role of the different lipoproteins (HDL, LDL, VLDL) ✓ identify the hormones involved in the metabolism of dietary triacylglycerols ✓ calculate the ATP yield in $\beta$ -oxidation ✓ identify the end product of $\beta$ -oxidation ✓ relate $\beta$ -oxidation to CAC and ET chain ✓ relate the production and significance of ketone bodies to $\beta$ -oxidation ✓ trace the biosynthesis of fatty acids, triacylglycerol and cholesterol and identify its control points	Interactive discussion  Video clip	biosynthesis, cholesterol biosynthesis and understanding their role in metabolic/genetic diseases  Interrelating $\beta$ -oxidation to CAC, ET chain and ketone bodies  Writing overall reactions of photosynthesis  Calculating ATP yield	Quiz  Exam
CO3: Apply the key concepts in biochemistry to explain its practical applications in the field of agriculture, medicine, pharmacy, and allied fields. CO4: Present awareness of major issues at the forefront of biochemistry. CO5: use computers as information and research tools in biochemistry					
14-15	<b>Module 9. The Metabolism of Nitrogen</b>  <b>Lesson 1</b> An Overview on the Metabolism of Nitrogen  Lesson 2 Nitrogen fixation  <b>Lesson 2</b> Amino acids Biosynthesis  <b>Lesson 3</b> Amino acids Catabolism Urea cycle  <b>Lesson 4</b> Purine and Pyrimidine Biosynthesis	✓ describe the process of nitrogen fixation ✓ define transamination reaction ✓ trace the biosynthesis of the following families of amino acids: glutamate, aspartate, serine, pyruvate, aromatic, histidine	Powerpoint presentation  Interactive discussion  Video clip	Tracing nitrogen fixation, amino acid biosynthesis and catabolism, purine/pyrimidine biosynthesis and catabolism and	Worksheet  Recitation/Quiz  Exam



	<b>Lesson 5 Purine and Pyrimidine Catabolism</b>	<ul style="list-style-type: none"> <li>✓ explain why glutamate plays a major role in the biosynthesis of amino acids</li> <li>✓ differentiate between glucogenic and ketogenic amino acids and give examples of each</li> <li>✓ describe the urea cycle and state its importance</li> <li>✓ write an equation for the net reaction of the urea cycle</li> <li>✓ Show how urea is linked to the CAC</li> </ul>		<p>understanding their role in metabolic/genetic diseases</p> <p>Interrelating nitrogen metabolism to CAC</p> <p>Writing overall reactions and net reactions</p> <p>Calculating ATP yield</p>	
<b>THIRD LONG EXAMINATION COVERING MODULES 8 &amp; 9</b>					
<p>CO3: Apply the key concepts in biochemistry to explain its practical applications in the field of agriculture, medicine, pharmacy, and allied fields.</p> <p>CO4: Present awareness of major issues at the forefront of biochemistry.</p> <p>CO5: use computers as information and research tools in biochemistry.</p> <p>CO6: list, evaluate and use primary sources of biochemical information.</p> <p>CO7: discuss issues and formulate choices as socially responsible biotechnologies in the national and global communities</p>					
16	<b>Module 10</b> <b>The Central Dogma</b>  <b>Lesson 1</b> Replication of DNA Flow of genetic information in the cell 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	<ul style="list-style-type: none"> <li>✓ describe the molecular basis of replication, transcription and translation processes</li> <li>✓ discuss the flow of genetic information</li> <li>✓ discuss gene regulation</li> <li>✓ describe the occurrences of mutagenesis</li> <li>✓ Identify xenobiotics</li> </ul>	Powerpoint presentation  Interactive discussion  Video clip	Illustrating the central dogma of molecular biology  Tracing protein synthesis  Constructing the genetic code table  Interrelating the flow of	Worksheet  Recitation/Quiz  Exam

				information, gene expression and mutation	
<p><b>CO3:</b> Apply the 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> <p><b>CO6:</b> List, evaluate, and use primary sources of biochemical information</p> <p><b>CO7:</b> discuss issues and formulate choices as socially responsible biotechnologies in the national and global communities</p>					
17	<p><b>Module 11. Nucleic Acid Biotechnology Techniques</b></p> <p><b>Lesson 1 Purification and Detection of Nucleic Acids</b></p> <p><b>Lesson 2 Cloning and Genetic Engineering</b></p> <p><b>Lesson 3 Polymerase Chain Reaction and DNA Fingerprinting</b></p> <p><b>Lesson 4 DNA Sequencing</b></p>	<ul style="list-style-type: none"> <li>✓ Describe the steps involve in the purification and detection of nucleic acids</li> <li>✓ Define restriction endonucleases and state its importance in creating recombinant DNA</li> <li>✓ Acquire basic knowledge in molecular cloning</li> <li>✓ Describe the laboratory procedures for the preparation of recombinant DNA</li> <li>✓ Outline the fundamentals of polymerase chain reaction and summarize its applications</li> <li>✓ Identify and appraise the broad scope of biotechnology applications in the market today</li> </ul>	<p>Powerpoint presentation</p> <p>Interactive discussion</p> <p>Video clip</p>	<p>Flowchart of nucleic acid purification and detection</p> <p>Flowchart of recombinant DNA preparation</p> <p>Flowchart molecular cloning procedure</p> <p>Flowchart of PCR</p>	<p>Worksheet</p> <p>Recitation/ Quiz</p> <p>Exam</p>
<b>18 FINAL EXAMINATION COVERING MODULES 10-11</b>					
* VSUEE/NC – VSU E-Learning Environment/ Virtual Classroom					
<p><b>12. Life-long Learning Opportunities</b></p> <p>The student will be able to explain the role of metabolic pathways in the occurrence of metabolic/genetic diseases and the importance of drug discovery and development for prophylactic/therapeutic purposes.</p>					



<b>13. Contribution of Course to Meeting the Professional Component (%)</b>
General Education: _____ %
Basic Education ( <i>Foundation</i> ): _____ %
Professional Education ( <i>Major Field</i> ): 100%
<b>14. References and Other Learning Resources</b>
<b>A. Textbooks</b>
Berg, J.M., Tymoczko, J.L., Gatto, GJ and Stryer, L. (2015) Biochemistry 8 <sup>th</sup> ed. W.H. Freeman (or later edition)
Campbell, M.K. and Farrell, S.O. (2014) Biochemistry 8 <sup>th</sup> ed., Brooks Cole (or later edition)
Mathews, C.K., van Helde, K.E., Appling, DR, Anthony-Cahill S.J. (2012) Biochemistry 4 <sup>th</sup> ed. Benjamin Cummings (or later edition)
Nelson, D.L and Cox, M.M. (2012) Lehninger Principles of Biochemistry 6 <sup>th</sup> ed. W.H. Freeman (or later edition)
Pratt, CW and Cornely, K (2013) Essential Biochemistry, 3 <sup>rd</sup> ed. Wiley (or later edition)
Voet, D. and Voet, J.G. (2010) Biochemistry 4 <sup>th</sup> ed. John Wiley & Sons (or later edition)
<b>B. References</b>
Alberts, B., Johnson, A., Lewis, J (2014) Molecular Biology of the Cell 6 <sup>th</sup> ed. Garland Science (or later edition)
Karp, G. (2013) Cell and Molecular Biology: Concepts and Experiments 7 <sup>th</sup> ed. Wiley (or later edition)
Lodish, H., Berk, A., Kaiser, CA, Krieger, M., Bretcher A., Ploegh, H., Amon, A., Scott, MP (2012) Molecular Cell Biology 7 <sup>th</sup> ed. W.H. Freeman (or later edition)
The National Center for Biotechnology Information, National Library of Medicine, National Institute of Health USA <a href="http://www.pubmed.gov">www.pubmed.gov</a> or <a href="http://www.ncbi.nih.gov">www.ncbi.nih.gov</a>
<b>C. Other Learning Resources</b>
Open Educational Resources/Websites:
: <a href="http://serc.carleton.edu/microbelife/research_methods/genomics/replication.html">http://serc.carleton.edu/microbelife/research_methods/genomics/replication.html</a>
Videos:
<a href="https://www.youtube.com/watch?v=rXzN89I4_Yk">https://www.youtube.com/watch?v=rXzN89I4_Yk</a>
<a href="https://www.youtube.com/watch?v=TNKWgcFPHqw">https://www.youtube.com/watch?v=TNKWgcFPHqw</a>
<a href="https://www.youtube.com/watch?v=bKlpDtJdK8Q">https://www.youtube.com/watch?v=bKlpDtJdK8Q</a>
<a href="https://www.youtube.com/watch?v=sX6LncNjTFU">https://www.youtube.com/watch?v=sX6LncNjTFU</a>
<a href="https://www.youtube.com/watch?v=gG7uCsKUrA">https://www.youtube.com/watch?v=gG7uCsKUrA</a>
<a href="https://www.youtube.com/watch?v=kmrUzDYAmEI">https://www.youtube.com/watch?v=kmrUzDYAmEI</a>
<a href="https://www.youtube.com/watch?v=MvuYATh7Y74">https://www.youtube.com/watch?v=MvuYATh7Y74</a>
<a href="https://www.youtube.com/watch?v=rA8MUR4pqNE">https://www.youtube.com/watch?v=rA8MUR4pqNE</a>
<a href="https://www.youtube.com/watch?v=2JUu1WqidC4">https://www.youtube.com/watch?v=2JUu1WqidC4</a>
<a href="https://www.youtube.com/watch?v=ezfwqmKC9Uc">https://www.youtube.com/watch?v=ezfwqmKC9Uc</a>
<a href="https://www.youtube.com/watch?v=uM1t0mWXU30">https://www.youtube.com/watch?v=uM1t0mWXU30</a>
<a href="https://www.youtube.com/watch?v=CHJsaq2INjU">https://www.youtube.com/watch?v=CHJsaq2INjU</a>
<a href="https://www.youtube.com/watch?v=8FqITslU22s">https://www.youtube.com/watch?v=8FqITslU22s</a>
<a href="https://www.youtube.com/watch?v=ulut0oVWCEg">https://www.youtube.com/watch?v=ulut0oVWCEg</a>
<a href="https://www.youtube.com/watch?v=RN81h85V6D4">https://www.youtube.com/watch?v=RN81h85V6D4</a>
<a href="https://www.youtube.com/watch?v=joZ1EsA5_NY">https://www.youtube.com/watch?v=joZ1EsA5_NY</a>
<a href="https://www.youtube.com/watch?v=KfvYQgT2M-k">https://www.youtube.com/watch?v=KfvYQgT2M-k</a>



### 15. Course Assessment and Evaluation

The performance of students will be assessed and evaluated based on the following:

$$50\% \text{ Midterm} + 50\% \text{ Final Term} = 100\% \text{ (Overall Final)}$$

Item No.	Assessment Tasks	Percentage Contribution (1)	No. of Times in the Semester (2)	Individual Task % Contribution (1/2)
1	Worksheets/Learning Tasks	20	11	1.82%
2	Recitation/Quiz	10	32	0.31%
3	Chapter exams	30	4	7.50%
4	Term exams	30	2	15.00%
5	Video clip	10	1	10.00%

COs	Assessment Tasks	Weight in Percent	Minimum Average for Satisfactory Rating	Target and Standards
COs 1-7	Worksheets/Learning Tasks	20	60%	At least 70% of the students have at least 60% score
	Recitation/Quiz	10		
	Chapter Exams	30		
	Term Exams	30		
	Video Clip	10		
TOTAL		100%		

### Grading System (% Passing: 60%)

Range	Grade	Range	Grade
97-100	1.00	65-69	2.75
93-96	1.25	60-64	3.00
89-92	1.50	59 below	5.00
85-88	1.75		
80-84	2.00		
75-79	2.25		
70-74	2.50		

### 16. Course Policies

- 1) The students should participate in the discussion.
- 2) Quizzes are given real time either announced or unannounced and will open every after a topic has been discussed.
- 3) Worksheets will be done individually.
- 4) Submission of worksheets will be done thru the VSUEE/VSU email account or to the office.
- 5) Chapter exams, midterm exam and final exam will be given face to face.
- 6) A video clip depicting metabolism of biomolecules will be submitted during the last week of classes.



17. Course Materials and Facilities Available				
1.	Powerpoint presentations			
2.	Handouts			
3.	Video clips			
4.	Laptop			
5.	Google meet account			

18. Revision History				
Revision number	Date of Revision	Date of Implementation	Highlights of Revision	Revised by
1	February 7, 2022	February 15, 2022	Use of the most recent OBE syllabus template;	Dr. Ma. Theresa P. Loreto
2	February 17, 2023	February 20, 2023	Updated course information, assessment task, other learning resources, and course policies for face to face learning modality	Dr. Elizabeth S Quevedo

19. Preparation			
Prepared by	Name	Signature	Date Signed
	Elizabeth S. Quevedo	<i>Elizabeth S. Quevedo</i>	02/17/2023

#### IV. INSTRUCTOR/PROFESSOR INFORMATION

1. Name of Instructor/Professor	ELIZABETH S. QUEVEDO
2. Office and Department	Department of Pure and Applied Chemistry
3. Telephone/Mobile Numbers	09178905658
4. Email Address	elizabeth.quevedo@vsu.edu.ph
5. Consultation Time	TBA

#### 20. Department Instructional Materials Review Committee:

Committee	Name	Signature	Date Signed
Member:	MARIA ROBELYN A. INSIK	<i>Maria Robelyn A. Insik</i>	2/17/2023
Member:	VIVIAN P. LINA	<i>Vivian P. Lina</i>	2/17/2023
Chairperson:	Dr. FELIX M. SALAS	<i>Dr. Felix M. Salas</i>	2/21/2023

	Name	Signature	Date Signed
Verified by:	MA. THERESA P. LORETO College Dean		
Validated by:	NANCY D. ABUNDA Head, IMD		

**Note:**

- 1) The number of POs will depend on each degree program offered
- 2) COs and Relationship to POs
  - a. (I) - **Introductory** – an Introductory Course to an outcome
  - b. (E) - **Enabling** – an Enabling Course or a course that strengthens the outcome
  - c. (D) - **Demonstrated** – a Demonstrative Course or a course demonstrating an outcome.

**REMINDER:**

1. *The author should not be part of the DIMRC.*
2. *\*If the author is the Department Head, he/she will be replaced by another chairperson from among the senior faculty members.*
3. *\*\*If the author is the College Dean, the Head of Instructional Materials Development will approve.*
4. *Follow the next higher supervisor, no same person*
5. *For the component campuses, if the author is the College Dean, the Director for Academic Affairs will approve.*
6. *If the author is the Department Head and at the same time the College Dean, the Director for Academic Affairs will be the Chairperson of the DIMRC, and the Chancellor will approve it.*

*(3) Distribution of copies: OHIMD, Department, Faculty*





## EVALUATION OF OUTCOMES-BASED EDUCATION (OBE) COURSE SYLLABUS

Chem 138 – Biochemistry II  
2<sup>nd</sup> Sem Semester and A.Y. 2022 - 2023

Name of faculty : ELIZABETH S. QUEVEDO  
Department/Institute : Dept of Pure and Applied Chemistry  
College : Arts and Sciences

CRITERIA	Complied	Partially Complied	Not Complied	Remarks
<b>FORMAT</b>				
1) The OBE course syllabus follows the university-prescribed format	/			
2) The course syllabus covers the required number of weeks in one academic term	/			
3) Course policies and grading system are clearly defined	/			
4) The syllabus is designed to align with the CMO-prescribed curriculum in relation to:				
a. Program Educational Objectives to VSU Vision, Mission, and Quality Policy Statement	/			
b. Program Outcomes to Program Educational Objectives	/			
c. Course Outcomes to Program Outcomes	/			
<b>CONTENT</b>				
1) Learning outcomes are clearly articulated ( <i>Specific, Measurable, Attainable, Realistic, Time-bounded (SMART) and anchored on Bloom's Taxonomy of Objectives</i> )	/			
2) Course coverage completely follows the course description	/			
3) Topics/lessons are arranged in a logical – sequence	/			
4) Gender-sensitivity and values education are integrated in the syllabus whenever applicable	/			
5) References are relevant, varied and updated. Contains at least five book titles copyrighted within the last 5 years as prescribed by CHED		/		
<b>TEACHING-LEARNING</b>				



1) Teaching-learning activities are:				
a. varied and relevant	/			
b. outcomes-based	/			
c. encourage active learning	/			
d. develop the students' critical – thinking skills and reflective judgment	/			

#### LEARNING ASSESSMENT

1) Learning outcomes and methods of assessment are aligned	/			
2) Assessment methods used are varied and relevant	/			
3) Schedule and frequency of assessment, and expected outputs are clearly defined	/			

**General Recommendation (Pls. check):**

<input checked="" type="checkbox"/>	APPROVED for use
<input type="checkbox"/>	Needs to be REVISED (please see comments)

**Department Instructional Materials Review Committee:**

Committee	Name	Signature	Date Signed
Member:	VIVIAN P. LINA	<i>[Signature]</i>	2/17/2023
Member:	MARIA ROBLEYN A. INSIK	<i>[Signature]</i>	2/19/2023
Chairperson	FELIX M. SALAS	<i>[Signature]</i>	2/21/2023

	Name	Signature	Date Signed
Verified by <sup>1/</sup> :	MA. THERESA P. LORETO College Dean		
Validated by <sup>2/</sup> :	NANCY D. ABUNDA Head, IMD		

<sup>1/</sup> Means of Verification: Ratings on Individual evaluation sheets of the DIMRC members

<sup>2/</sup> Means of Validation: Final action of the College Dean

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