COURSE SYLLABUS

**Course Number:** BCH 4033  
**Prerequisite(s):** CHM 2210/2211 with passing grade.  
**Course Title:** Biochemistry I  
**Course Credit:** 3  
**Course Hours:** 3 per week  
**College:** Arts and Sciences  
**Department:** Chemistry  
**Required Text(s):** Biochemistry by Berg, Tymoczko and Stryer. 6th edition, 2001 (W. H. Freeman & Co.).

**Faculty Name:** Dr. Ngozi Ugochukwu  
**Term and Year:** Summer 2010  
**Place and Time:** 101 Dyson Building  
MWF 9:15 - 10:05 pm

**Office Location:** 118 FSH (Science Research Building)  
**Telephone:** 850-412-7124  
**e-mail:** ngozi.ugochukwu@famu.edu

<table>
<thead>
<tr>
<th>Office Hours</th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1:00 – 2:00 pm</td>
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<td>10:00 – 11:00 a.m.</td>
<td>2:00 – 4:00 pm</td>
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**Course Description**

Chemistry of biomolecules: proteins, carbohydrates and lipids. A basic study of membranes, enzymes, enzyme kinetics, vitamins, intermediary metabolism and bioenergetics.

**Course Purpose**

Required course for chemistry and Biology majors. An elective course for students in Animal Science, Chemical Engineering and Biomedical Engineering.

**References**

6. Campbell, Biochemistry
7. Horton et al, Principles of Biochemistry

**Conceptual Framework**

The Conceptual Framework in the Professional Education Unit (PEU) at Florida A&M University is an integrated approach to providing educational experiences that result in exemplary professional educators. The Framework is comprised of six themes with the mission of developing high quality classroom teachers, administrators and support personnel. The term “exemplary” refers to the kind of graduates the PEU strives to produce. The figure below provides a diagram of the Exemplary Professional Conceptual Framework:

**TECHNOLOGY**

- **CF 2**
  - Through this focal area, the FAMU professional education candidate will:

<table>
<thead>
<tr>
<th>CF: 2.1 (S)</th>
<th>Use of available technology and software to support student learning.</th>
<th>F: 4,12</th>
<th>I: 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CF: 2.7 (S)</td>
<td>Facilitate the use of technology by students.</td>
<td>F: 4,12</td>
<td>I: 6</td>
</tr>
</tbody>
</table>

**VALUES**

- **CF 3**
  - Through this focal area, the FAMU professional education candidate will:

<table>
<thead>
<tr>
<th>CF: 3.4(D)</th>
<th>Be committed to individual excellence.</th>
<th>F: 11</th>
<th>I: 5,9</th>
</tr>
</thead>
<tbody>
<tr>
<td>CF: 3.5(D)</td>
<td>Recognize the importance of peer Relationships in establishing a climate for learning.</td>
<td>F: 2, 7</td>
<td>I: 5,10</td>
</tr>
</tbody>
</table>
CRITICAL THINKING

• CF 4
  • Through this focal area, the FAMU professional education candidate will:

| CF: 4.2 (S) | Use a variety of instructional/professional strategies to encourage students’ development of critical thinking and performance. | F: 2, 7 | I: 4 |
| CF: 4.3 (D) | Value critical thinking and self-directed learning as habits of mind. | F: 4 | I: 1, 4 |
| CF: 4.5 (S) | Demonstrate the use of higher order thinking skills. | F: 8 | I: 4 |

PROFESSIONALISM

• CF 5
  • Through this focal area, the FAMU professional education candidate will:

| CF: 5.1 (K) | Know the content | F: 8 | I: 1 |
| CF: 5.6 (S) | Display effective verbal & non-verbal communication techniques to foster valuable interaction in the classroom. | F: 2 | I: 6 |
| CF: 5.7 (S,D) | Display appropriate code of conduct including dress, language, and respective behavior. | F: 11 | I: 5, 9 |

National and State Standards Addressed in the Course

Interstate New Teacher Assessment and Support Consortium (INTASC) Standards

**Standard 1: Subject Matter:** The teacher understands the central concepts, tools of inquiry, and structures of the discipline(s) he or she teaches and can create learning experiences that make these aspects of subject matter meaningful for students.

1.10 Knowledge
1.12 The teacher understands how students’ conceptual frameworks and their misconceptions for an area of knowledge can influence their learning.

1.13 The teacher can relate his/her disciplinary knowledge to other subject areas.

1.20 Dispositions
1.24 The teacher is committed to continuous learning and engages in professional discourse about subject matter knowledge and children’s learning of the discipline.

1.30 Performances
1.35 The teacher develops and uses curricula that encourage students to see, question, and interpret ideas from diverse perspectives.
**Standard 4: Instructional Strategies:** The teacher understands and uses a variety of instructional strategies to encourage students' development of critical thinking, problem solving, and performance skills.

**4.10 Knowledge**

4.11 The teacher understands the cognitive processes associated with various kinds of learning (e.g. critical and creative thinking, problem structuring and problem solving, invention, memorization and recall) and how these processes can be stimulated.

4.12 The teacher understands the principles and techniques, along with advantages and limitations, associated with various instructional strategies (e.g. cooperative learning, direct instruction, discovery learning, whole group discussion, independent study, interdisciplinary instruction).

4.13 The teacher knows how to enhance learning through the use of a wide variety of materials as well as human and technological resources (e.g. computers, audio-visual technologies, videotapes and discs, local experts, primary documents and artifacts, texts, reference books, literature, and other print resources).

**4.20 Dispositions**

4.21 The teacher values the development of students' critical thinking, independent problem solving, and performance capabilities.

4.23 The teacher values the use of educational technology in the teaching and learning process.

**4.30 Performances**

4.31 The teacher carefully evaluates how to achieve learning goals, choosing alternative teaching strategies and materials to achieve different instructional purposes and to meet student needs (e.g. developmental stages, prior knowledge, learning styles, and interests).

4.33 The teacher constantly monitors and adjusts strategies in response to learner feedback.

4.34 The teacher varies his or her role in the instructional process (e.g. instructor, facilitator, coach, audience) in relation to the content and purposes of instruction and the needs of students.

4.36 The teacher uses educational technology to broaden student knowledge about technology, to deliver instruction to students at different levels and paces, and for advanced levels of learning.

**Standard 5, Learning Environment**

The teacher uses an understanding of individual and group motivation and behavior to create a learning environment that encourages positive social interaction, active engagement in learning, and self-motivation.

**5.10 Knowledge**

5.11 The teacher can use knowledge about human motivation and behavior drawn from the foundational sciences of psychology, anthropology, and sociology to develop strategies for organizing and supporting individual and group work.

5.12 The teacher understands how social groups function and influence people, and how people influence groups.

5.13 The teacher knows how to help people work productively and cooperatively with each other in
complex social settings.

5.14 The teacher understands the principles of effective classroom management and can use a range of strategies to promote positive relationships, cooperation, and purposeful learning in the classroom.

5.15 The teacher recognizes factors and situations that are likely to promote or diminish intrinsic motivation, and knows how to help students become self-motivated.

5.20 Dispositions
5.21 The teacher takes responsibility for establishing a positive climate in the classroom and participates in maintaining such a climate in the school as a whole.

5.22 The teacher understands how participation supports commitment, and is committed to the expression and use of democratic values in the classroom.

5.23 The teacher values the role of students in promoting each other's learning and recognizes the importance of peer relationships in establishing a climate of learning.

5.24 The teacher recognizes the values of intrinsic motivation to students' life-long growth and learning.

5.25 The teacher is committed to the continuous development of individual students' abilities and considers how different motivational strategies are likely to encourage this development for each student.

5.30 Performances
5.31 The teacher creates a smoothly functioning learning community in which students assume responsibility for themselves and one another, participate in decision making, work collaboratively and independently, and engage in purposeful learning activities.

5.32 The teacher engages students in individual and group learning activities that help them develop the motivation to achieve, by, for example, relating lessons to students' personal interests, allowing students to have choices in their learning, and leading students to ask questions and pursue problems that are meaningful to them.

5.33 The teacher organizes, allocates, and manages the resources of time, space, activities, and attention to provide active and equitable engagement of students in productive tasks.

5.34 The teacher maximizes the amount of class time spent in learning by creating expectations and processes for communication and behavior along with a physical setting conducive to classroom goals.

5.35 The teacher helps the group to develop shared values and expectations for student interactions, academic discussions, and individual and group responsibility that create a positive classroom climate of openness, mutual respect, support, and inquiry.

5.36 The teacher analyzes the classroom environment and makes decisions and adjustments to enhance social relationships, student motivation and engagement, and productive work.

5.37 The teacher organizes, prepares students for, and monitors independent and group work that allows for full and varied participation of all individuals.

Standard 6, Communication
The teacher uses knowledge of effective verbal, nonverbal, and media communication techniques to foster active inquiry, collaboration, and supportive interaction in the classroom.

6.10 Knowledge
6.11 The teacher understands communication theory, language development, and the role of language in learning.

6.12 The teacher understands how cultural and gender differences can affect communication in the classroom.

6.13 The teacher recognizes the importance of nonverbal as well as verbal communication.

6.14 The teacher knows about and can use effective verbal, nonverbal, and media communication techniques.

6.20 Dispositions
6.21 The teacher recognizes the power of language for fostering self-expression, identity development, and learning.

6.22 The teacher values many ways in which people seek to communicate and encourages many modes of communication in the classroom.

6.23 The teacher is a thoughtful and responsive listener.

6.24 The teacher appreciates the cultural dimensions of communication, responds appropriately, and seeks to foster culturally sensitive communication by and among all students in the class.

6.30 Performance
6.31 The teacher models effective communications strategies in conveying ideas and information and in asking questions (e.g. monitoring the effects of messages, restating ideas and drawing connections, using visual, aural, and kinesthetic cues, being sensitive to nonverbal cues given and received).

6.32 The teacher supports and expands learner expression in speaking, writing, and other media.

6.33 The teacher knows how to ask questions and stimulate discussion in different ways for particular purposes, for example, probing for learner understanding, helping students articulate their ideas and thinking processes, promoting risk-taking and problem-solving, facilitating factual recall, encouraging convergent and divergent thinking, stimulating curiosity, helping stimulate students to question.

6.34 The teacher communicates in ways that demonstrate a sensitivity to cultural and gender differences (e.g. appropriate use of eye contact, interpretation of body language and verbal statements, acknowledgment of and responsiveness to different modes of communication and participation).

6.35 The teacher knows how to use a variety of media communication tools, including audio-visual aids and computers, including educational technology, to enrich learning opportunities.

Standard 9: Reflection and Professional Development: The teacher is a reflective practitioner who continually evaluates the effects of her/his choices and actions on others (students, parents, and other professionals in the learning community) and who actively seeks out opportunities to grow professionally

9.10 Knowledge
9.11 The teacher understands the historical and philosophical foundations of education.

9.12 The teacher understands methods of inquiry that provide him/her with a variety of self-assessment and problem solving strategies for reflecting on his/her practice, its influences on students' growth and learning, and the complex interactions between them.

9.13 The teacher is aware of major areas of research on teaching and of resources available for professional learning (e.g. professional literature, colleagues, professional associations, professional development activities).

**9.20 Dispositions**

9.21 The teacher values critical thinking and self-directed learning as habits of mind.

9.22 The teacher is committed to reflection, assessment, and learning as an ongoing process.

9.23 The teacher is willing to give and receive help.

9.24 The teacher is committed to seeking out, developing, and continually refining practices that address the individual needs of students.

9.25 The teacher recognizes her/his professional responsibility for engaging in and supporting appropriate professional practices for self and colleagues.

**9.30 Performance**

9.31 The teacher uses classroom observation, information about students, and research as sources for evaluating the outcomes of teaching and learning and as a basis for experimenting with, reflecting on, and revising practice.

9.32 The teacher seeks out professional literature, colleagues, and other resources to support her/his own development as a learner and a teacher.

9.33 The teacher draws upon professional colleagues within the school and other professional arenas as supports for reflection, problem-solving and new ideas, actively sharing experiences and seeking and giving feedback.

**Standard 10: Collaboration, Ethics, and Relationships:** The teacher communicates and interacts with parents/guardians, families, school colleagues, and the community to support students' learning and well-being.

**10.10 Knowledge**

10.11 The teacher understands schools as organizations within the larger community context and understands the operations of the relevant aspects of the system(s) within s/he works.

10.12 The teacher understands how factors in the students' environment outside of school (e.g. family circumstances, community environments, health and economic conditions) may influence students' life and learning.

10.13 The teacher understands and implements laws related to student's rights and teacher responsibilities (e.g. for equal education, appropriate education for students with disabilities, confidentiality, privacy, appropriate treatment of students, reporting in situations related to possible child abuse).

**10.20 Dispositions**
10.21 The teacher values and appreciates the importance of all aspects of a child's experience.

10.22 The teacher is concerned about all aspects of child's well-being (cognitive, emotional, social, and physical), and is alert to signs of difficulties.

10.23 The teacher respects the privacy of students and confidentiality of information.

10.24 The teacher is willing to consult with other adults regarding the education and well-being of her/his students.

10.25 The teacher is willing to work with other professionals to improve the overall learning environment for students.

**10.30 Performances**

10.31 The teacher participates in collegial activities designed to make the entire school a productive learning environment.

10.32 The teacher makes links with the learners' other environments on behalf of students, by consulting with parents, counselors, teachers of other classes and activities within the schools, and professionals in other community agencies.

10.33 The teacher can identify and use community resources to foster student learning.

10.34 The teacher establishes respectful and productive relationships with parents and guardians from diverse home and community situations, and seeks to develop cooperative partnerships in support of student learning and well being.

10.35 The teacher talks with and listens to the student, is sensitive and responsive to clues of distress, investigates situations, and seeks outside help as needed and appropriate to remedy problems.

10.36 The teacher acts as an advocate for students.

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**Florida Educator Accomplished Practices (FEAP)**

**Accomplished Practice #2: COMMUNICATION**

2.1 The preprofessional teacher recognizes the need for effective communication in the classroom and is in the process of acquiring techniques which she/he will use in the classroom.

2.2 STANDARD: Communication -- Uses effective communication techniques with students and all other stakeholders.

2.a Establishes positive interactions in the learning environment that uses incentives and consequences for students.

2.b Establishes positive interactions between the teacher and student that are focused upon learning.

2.c Varies communication (both verbal and nonverbal) according to the nature and needs of individuals.

2.d Encourages students in a positive and supportive manner.

2.e Communicates to all students high expectations for learning.

2.h Practices strategies that support individual and group inquiry.

2.j Identifies communication techniques for use with colleagues, school/community specialists, administrators, and families, including families whose home language is not English.
Accomplished Practice #4: Critical-thinking

4.1 The pre-professional teacher is acquiring performance assessment techniques and strategies that measure higher order thinking skills in students and is building a repertoire of realistic projects and problem-solving activities designed to assist all students in demonstrating their ability to think creatively. (A) Uses appropriate techniques and strategies which promote and enhance critical, creative, and evaluative thinking capabilities of students.

1. Uses assessment strategies (traditional and alternate) to assist the continuous development of the learner. ASSESSMENT

4.2. Uses appropriate techniques and strategies which promote and enhance critical, creative, and evaluative thinking capabilities of students.

4.a Provides opportunities for students to learn higher-order thinking skills.

4.b Identifies strategies, materials, and technologies that she/he will use to expand students’ thinking abilities.

4.g Demonstrates and models the use of higher-order thinking abilities.

Accomplished Practice #7: HUMAN DEVELOPMENT AND LEARNING

7.1 Drawing upon well established human development/learning theories and concepts and a variety of information about students, the preprofessional teacher plans instructional activities.

7.a Recognizes developmental levels of students and identifies differences within a group of students.

7.d Communicates with students effectively by taking into account their developmental levels, linguistic development, cultural heritage, experiential background, and interests.

7.e Varies activities to accommodate different student learning needs, developmental levels, experiential backgrounds, linguistic development, and cultural heritage.

7.h Develops short-term personal and professional goals relating to human development and learning.

Accomplished Practice #8: KNOWLEDGE OF SUBJECT MATTER

8.2 Demonstrates knowledge and understanding of the subject matter.

8.b Increases subject matter knowledge in order to integrate the learning activities.

8.f Develops short- and long-term personal and professional goals relating to knowledge of subject matter.

Accomplished Practice #11: ROLE OF THE TEACHER

11.1 The preprofessional teacher communicates and works cooperatively with families and colleagues to improve the educational experiences at the school.

11.2 STANDARD: Role of the Teacher -- Works with various education professionals, parents, and other stakeholders in the continuous improvement of the educational experiences of students.

11.b Provides meaningful feedback on student progress to students and families and seeks assistance for self and families.

Accomplished Practice #12: TECHNOLOGY

12.b Uses technology tools on a personal basis.

12.c Demonstrates awareness of and models acceptable use policies and copyright issues.

12.d Identifies and uses standard references in electronic media.

12.i Selects and utilizes educational software tools for instructional purposes based upon reviews and recommendations of other professionals.

12.j Uses digital information obtained through intranets and/or the Internet (e.g., e-mail and research).

12.k Uses technology to collaborate with others.

12.l Develops professional goals relating to technology integration.
National Science Teachers Association Standards (NSTA)

Standard 1: Content

Teachers of science understand and can articulate the knowledge and practices of contemporary science. They can interrelate and interpret important concepts, ideas, and applications in their fields of licensure; and can conduct scientific investigations. To show that they are prepared in content, teachers of science must demonstrate that they:

a. Understand and can successfully convey to students the major concepts, principles, theories, laws, and interrelationships of their fields of licensure and supporting fields as recommended by the National Science Teachers Association.
b. Understand and can successfully convey to students the unifying concepts of science delineated by the National Science Education Standards.
c. Understand and can successfully convey to students important personal and technological applications of science in their fields of licensure.
d. Understand research and can successfully design, conduct, report and evaluate investigations in science.
e. Understand and can successfully use mathematics to process and report data, and solve problems, in their field(s) of licensure.

B.4. To create interdisciplinary perspectives and to help students understand why science is important to them, elementary/middle level science specialists should have all of the competencies described for the elementary generalist, but also should be prepared to lead students to understand:

33. Use of technological tools in science, including calculators and computers.

C.3.a. Core Competencies. All teachers of chemistry should be prepared lead students to understand the unifying concepts required of all teachers of science, and should in addition be prepared to lead students to understand:

1. Fundamental structures of atoms and molecules.

C.3.b. Advanced Competencies. In addition to the core competencies, teachers of chemistry as a primary field should also be prepared to effectively lead students to understand:

19. Major biological compounds and natural products.
20. Solvent system concepts including non-aqueous solvents.

Standard 10: Professional Growth

Teachers of science strive continuously to grow and change, personally and professionally, to meet the diverse needs of their students, school, community, and profession. They have a desire and disposition for growth and betterment. To show their disposition for growth, teachers of science must demonstrate that they:

a. Engage actively and continuously in opportunities for professional learning and leadership that reach beyond minimum job requirements.
b. Reflect constantly upon their teaching and identify ways and means through which they may grow professionally.
c. Use information from students, supervisors, colleagues and others to improve their teaching and facilitate their professional growth.

**Professional Organization/Learned Society Standards**

National Society of Science Teachers Association  
Florida Teacher Certification Examination (FTCE) Subject Area Examination (SAE) Competencies and Skills

**Professional Society / National and State Standards Addressed in the Course**

**American Chemical Society (ACS) Expected Outcomes:**

This course should ensure that students know basic chemical concepts such as stoichiometry, states of matter, atomic structure, molecular structure and bonding, thermodynamics, equilibria, and kinetics. Students need to be competent in basic laboratory skills such as safe practices, keeping a notebook, use of electronic balances and volumetric glassware, preparation of solutions, chemical measurements using pH electrodes and spectrophotometers, data analysis, and report writing.

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Behavioral Objectives</th>
<th>INTASC Standards</th>
<th>FTCE SAE</th>
<th>FEAPS</th>
<th>NSTA</th>
<th>PEU Conceptual Framework</th>
</tr>
</thead>
</table>
| Homework: Selected biochemistry problems from the textbook and additional instructor addendums Each homework assignment will address course content and is aimed at development of problem solving skills. | Students will 1. Demonstrate knowledge of the lecture material, and 2. Develop and enhance the skill of analytical analysis and problem solving | 1, 4, 5, 6, 9, 10 | 1.8  
  
  4.8, 6.3,  
  6.4, 6.5,  
  6.6, 6.7,  
  6.8, 7.3,  
  7.4, 7.5,  
  7.6  
  4.19, 4.20,  
  7.2, 7.7 | 2, 4, 7, 8, 11, 12 | 1; 1.B.4.33;  
  1.C.3.a.1, 3;  
  1.C.3.b.19,  
  20; 10.a,  
  10.b, 10.c. | 2.1, 2.7, 3.4, 3.5,  
  4.2, 4.3, 4.5, 5.1,  
  5.6, 5.7 |
| Quizzes Selected biochemistry problems from the textbook and additional instructor addendums Each homework assignment will address course content and is aimed at development of critical thinking and written communication skills | Develop critical thinking and written communication skills | 1, 4, 5, 6, 9, 10 | 1.8  
  
  4.8, 6.3,  
  6.4, 6.5,  
  6.6, 6.7,  
  6.8, 7.3,  
  7.4, 7.5,  
  7.6  
  4.19, 4.20,  
  7.2, 7.7 | 2, 4, 7, 8, 11, 12 | 1; 1.B.4.33;  
  1.C.3.a.1, 3;  
  1.C.3.b.19,  
  20; 10.a,  
  10.b, 10.c. | 2.1, 2.7, 3.4, 3.5,  
  4.2, 4.3, 4.5, 5.1,  
  5.6, 5.7 |
Develop critical thinking and written communication skills

<table>
<thead>
<tr>
<th>Exams: Four one-hour tests, each test covering specific chapters. Final exam is comprehensive and will cover the material of Chapters 1-21.</th>
<th>Overall Goals of the Course</th>
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<tbody>
<tr>
<td></td>
<td>This Course will introduce students to the basic principles of Biochemistry. This will involve: i) Knowledge of the cell, the structure, function and interactions of biological molecules in synthetic and degradative biochemical pathways. ii) Application of biochemical principles in an inquiry-based understanding of their clinical correlations in humans iii) Analysis of the emerging and recent developments in biochemistry for insight and application to clinical conditions in humans.</td>
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<tr>
<td>1, 4, 5, 6, 9, 10</td>
<td>Specific Behavioral Objectives</td>
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<tr>
<td>1.8 4.8, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 7.3, 7.4, 7.5, 7.6 4.19, 4.20, 7.2, 7.7</td>
<td>Learning Objectives</td>
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<tr>
<td></td>
<td>Chapter 1: Biochemistry: An evolving science</td>
</tr>
<tr>
<td>2.4, 7, 8, 11, 12</td>
<td>1. Know the structure of cells, structure of DNA and chemical bonding. (FTCE 4.14, 4.20, 6.1, 6.2; ACS) 2. Understand the laws of thermodynamics and its application in Biochemistry. (FTCE 4.19, 4.20, 6.13, 7.2, 7.3, 7.5, 7.6, 7.7; ACS)</td>
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<tr>
<td></td>
<td>2.1, 2.7, 3.4, 3.5, 4.2, 4.3, 4.5, 5.1, 5.6, 5.7</td>
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<tr>
<td>2, 4, 7, 8, 11, 12</td>
<td>Chapter 2: Protein composition and structure</td>
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<tr>
<td>2.1, 2.7, 3.4, 3.5, 4.2, 4.3, 4.5, 5.1, 5.6, 5.7</td>
<td>3. Identify and distinguish the primary, secondary, tertiary and quaternary structures of proteins. (FTCE 3.1, 3.16; ACS)</td>
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<td>Chapter 3: Exploring proteins and proteomes</td>
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<td>4. Discuss purification, characterization and structure/function relationship of proteins. (FTCE 1.8; ACS) 5. Understand amino acid sequencing of proteins, and the immunological and spectroscopic methods of studying proteins. (FTCE 1.8, 6.10, 6.12; ACS)</td>
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<td>Chapter 5: Exploring genes and genomes</td>
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<td>6. Demonstrate the flow of genetic information from DNA to RNA to protein synthesis</td>
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and the processes involved. (FTCE 3.1, 3.16; ACS)

Chapter 7: Hemoglobin: portrait of a protein in action
7. The structure of Hemoglobin; the mechanisms involved in its binding and release of oxygen. (FTCE 5.5; ACS)

Chapter 8: Enzymes: basic concepts and kinetics
8. Understand basic concepts and kinetics of enzymes, their specificity and the role of vitamins as co-enzymes. (FTCE 4.8, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9, 7.3, 7.4, 7.5, 7.6; ACS)

Chapter 9: Catalytic strategies
9. Describe with examples the basic catalytic strategies that enzymes utilize in the formation and stabilization of the transition state. (FTCE 2.10; ACS)

Chapter 10: Regulatory strategies
10. Summarize the four principal ways in which the biological activities of proteins are Regulated (FTCE 4.8; ACS)

Chapter 11: Carbohydrates
11. Understand major classes of carbohydrates and their extensive roles in all forms of life. (FTCE 3.1, 3.16; ACS)

Chapter 12: Lipids and cell membranes
12. List the different classes of lipids and discuss how they are integrated with proteins in membranes. (FTCE 3.1, 3.16, 7.1; ACS)
13. Relate content of proteins to their functions in membranes. (FTCE 13.16; ACS)

Chapter 13: Membrane channels and pumps
14. Distinguish between membrane channels and pumps and understand the role of ATP in membrane pumps. (FTCE 2.10; ACS)

Chapter 14: Signal-transduction pathways
15. An overview of how cells receive, process, and respond to information from the environment. (FTCE 3.16; ACS)

Chapter 15: Metabolism: basic concepts and design
16. Summarize the basic concepts of intermediary metabolism. (FTCE 2.10; 4.19: ACS)

Chapter 16: Glycolysis and gluconeogenesis
17. Identify the different steps in glycolysis (with emphasis on phosphorylation) and gluconeogenesis, the different enzymes involved in the pathway and the simultaneous regulation of the two pathways (FTCE 2.10; ACS)

Chapter 17: The citric acid cycle
18. Understand the various steps and enzymes involved in the citric acid cycle (FTCE 3.16; ACS)
19. Be familiar with the TCA cycle as a source of biosynthetic precursors and the anaplerotic reactions that replenish the cycle intermediates when depleted. (FTCE 3.16; ACS)
20. Distinguish between glycolysis and the citric acid cycle. (FTCE 3.16; ACS)

Chapter 18: Oxidative phosphorylation
21. Understand how oxidative phosphorylation is dependent on electron transfer and is regulated by the need for ATP. (FTCE 7.2; ACS)

Chapter 20: Pentose phosphate pathway
22. Understand the importance and the reactions of the pentose phosphate pathway (FTCE 3.16; ACS)

Chapter 21: Glycogen metabolism
23. Describe glycogen breakdown, its synthesis and regulation of the two pathway (FTCE 3.16; ACS).

National and State Standards Addressed in the Course

Professional Organization/Learned Society Standards

American Chemical Society (ACS) Expected Outcomes:
This course should ensure that students know basic chemical concepts such as stoichiometry, states of matter, atomic structure, molecular structure and bonding, thermodynamics, equilibria and kinetics. Students need to be competent in the role of pH in biochemical reactions, structure and function of biological molecules, nucleic acids and flow of genetic information, enzymes and catalysis, signal transduction, chemical energy, biochemical pathways and their regulation.

Florida Teacher Certification Examination (FTCE) Subject Area Examination (SAE) Competencies and Skills
1. Knowledge of the nature of matter.
   8. Differentiate chemical methods for separating the components of mixtures.
2. Knowledge of energy and its interaction with matter.
   10. Analyze energy transformations in physical and biological systems.
   1. Identify the basic theory and applications of spectroscopy.
   16. Differentiate between the structures of common biochemical compounds, such as lipids, amino acids, carbohydrates and nucleic acids.
4. Knowledge of chemical reactions and stoichiometry.
   8. Analyze the effects of concentration, temperature, pressure, surface area, and the presence or absence of catalysts on the rates of reaction.
   14. Evaluate the properties of buffer systems.
   19. Identify the characteristics of biochemical and fossil fuel combustion reactions.
   20. Solve problems related to pH of strong acids or bases.
5. Knowledge of atomic theory and structure.
   5. Relate chemical activity to electron configuration.
6. Knowledge of the nature of science.
1. Identify the characteristics and components of scientific enquiry.
2. Identify how the characteristics of scientific research differ from those of other areas of learning.
3. Identify the variables in a given experimental design.
4. Identify bias in an experimental design.
5. Evaluate, interpret, and predict from empirical data.
6. Interpret graphical data.
7. Analyze the relationship between experimental observations and underlying assumptions, hypotheses, conclusions, laws, or theories.
8. Relate experimental evidence to models.
9. Differentiate between the uses of qualitative and quantitative data.
10. Analyze the relationship between basic scientific research and applied research, technology, the economy, or the public good.
11. Identify evidence of the progressive development of science.
12. Identify the relationship between experimental observations and underlying assumptions, hypotheses, conclusions, laws, or theories.

7. Knowledge of measurement.
   1. Convert between dimensional units for 1, 2, and 3 dimensional measurements.
   2. Analyze the dimensional units of a mathematical formula.
   3. Identify prefixes used in scientific measurements.
   4. Distinguish between accuracy and precision and between systematic and random error.
   5. Apply the correct number of significant figures in measurements or calculations.
   6. Relate the Celsius, Fahrenheit, and Kelvin temperature scales as they pertain to the physical properties of water.
   7. Convert between different units of energy.

**Academic Learning Compact (ALC) / Expected Outcome**

The ALC is located at the home page of the University ([http://www.famu.edu](http://www.famu.edu)) under ‘Academics’. Upon completion of this course students should be able to:

1. **Communication**
   - Effectively communicate concepts and principles of biochemistry both orally and in writing.

2. **Content knowledge**
   - Exhibit knowledge of biochemical principles and other biochemical information gained through the aforementioned ‘Learning objectives’.

3. **Quantitative Reasoning**
   - Analyze and solve biochemical problems using basic biochemical principles.

4. **Critical Thinking**
   - Demonstrate critical thinking skills as measured by the ability to
     i) analyze and solve biochemical problems
     ii) comprehend, analyze, evaluate and interpret numerical and general biochemical information.

5. **Information Resources**
   - Demonstrate effective use of information resources and technology in biochemical
applications and analyses.

### Topical Outline

<table>
<thead>
<tr>
<th>Topic</th>
<th>Chapter</th>
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<tr>
<td>Biochemistry overview</td>
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<tr>
<td>Protein composition and structure</td>
<td>2</td>
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<tr>
<td>Exploring proteins and proteomes</td>
<td>3</td>
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<tr>
<td>DNA, RNA, and the flow of genetic information</td>
<td>4</td>
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<tr>
<td>Hemoglobin structure and function</td>
<td>7</td>
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<tr>
<td>Enzymes: basic concepts and kinetics</td>
<td>8</td>
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<tr>
<td>Catalytic strategies</td>
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<td>Regulatory strategies</td>
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<td>Carbohydrates</td>
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<td>Lipids and cell membranes</td>
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<td>Membrane channels and pumps</td>
<td>13</td>
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<td>Signal-transduction pathways</td>
<td>14</td>
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<tr>
<td>Metabolism</td>
<td>15</td>
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<tr>
<td>Glycolysis and gluconeogenesis</td>
<td>16</td>
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<tr>
<td>The citric acid cycle</td>
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<td>Oxidative phosphorylation</td>
<td>18</td>
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<td>Pentose phosphate pathway</td>
<td>20</td>
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<tr>
<td>Glycogen metabolism</td>
<td>21</td>
</tr>
</tbody>
</table>

### Teaching Methodology

Lecture Style, Use of Overheads.

### Course Calendar

<table>
<thead>
<tr>
<th>Week</th>
<th>Lecture No.</th>
<th>Topic</th>
<th>Chapter</th>
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<tbody>
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</tbody>
</table>

Assignments
| 1 | 1-3 | 1. Introduction of class  
2. Cell Structure  
3. Biochemical unity in biological diversity  
4. Biomolecules  
5. Macromolecules  
6. Bonding  
7. Thermodynamics  
8. Acid – Base reaction  
9. Protein Structure: Structure of amino acids | 1, 2 | 1. Homework  
a. Diagrams of a plant cell and an animal cell |
|---|---|---|---|
| 2 | 4-6 | Protein Structure:  
1. Primary structure  
2. Secondary structure  
3. Tertiary structure  
4. Quaternary structure  
5. pH and pKa  
6. Protein folding | 2 | 1. Homework  
Problems:  
a. pH and pKa  
b. Structure of amino acids |
| 3 | 7-8 | *Monday, Sep. 7th – Labor Day, Holiday*  
1. Protein modification  
2. Proteome  
3. Purification of proteins | 2,3 | Class quiz |
| 4 | 9-11 | 1. Amino acid sequencing  
2. Immunological techniques  
3. Other techniques  
4. Synthesis of peptides  
5. Constituents of nucleic acids  
6. DNA structure  
7. Physical characteristics | 3, 4 | Class quiz |
| 5 | 12-14 | 1. Heme proteins  
2. Structure  
3. Oxygen binding  
4. Mutation and Disease | 7 | Exam #1 On Monday Sep. 21 (Ch. 1,2,3 &4)  
Class Quiz. |
| 6 | 15-17 | 1. Enzyme  
2. Cofactors  
3. Classes of enzymes | 8,9 | Homework on plotting of graph (1/S vs. 1/V) and |
<table>
<thead>
<tr>
<th>Week</th>
<th>Dates</th>
<th>Topics</th>
<th>Homework/Exam</th>
</tr>
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</table>
| 7    | 18-20 | 1. Regulation of protein activity  
2. Regulatory strategies of specific enzymes  
3. Models for allosteric control  
4. Regulation of hemoglobin activity  
5. Isozymes  
6. Reversible covalent modification  
7. Zymogen activation by proteolytic cleavage  
8. Blood clotting  
9. Functions of carbohydrate  
10. Classification  
| 10,11 | Homework on mechanism of action of enzymes  
| Class Quiz |
| 8    | 21-23 | 1. Functions of carbohydrate  
2. Classification Stereochemistry  
3. Reactions of carbohydrates  
4. Disaccharides  
5. Oligosaccharides and glycoproteins  
6. Lectins  
7. Carbohydrate receptors  
8. Membranes  
9. Lipids: Fatty Acids  
10. Membrane lipids  
11. Membrane proteins  
12. Membrane structure  
13. Membrane fluidity  
| 11,12 | Class Quiz |
| 9    | 24-26 | 1. Transport across membrane  
2. Active transport  
3. Secondary transporters of carbohydrates  
4. Channels  
5. Gap junctions  
6. Membrane receptors  
7. G-Proteins  
8. Activation of target proteins  
9. Phosphoinositide pathway  
| 13,14 | Exam # 2 on Monday Oct.19 (Ch. 7,8,9,10,11 &12)  
| Class Quiz |
| 10   | 27-29 | 1. Calcium ion  
2. Dimerization  
<p>| 14,15 | Class Quiz |</p>
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</table>
|   | 3. RAS pathway  
4. Defects in signaling pathway  
5. Basic concepts  
6. Metabolism  
7. Thermodynamics  
8. Metabolic pathways  
9. Types of chemical reactions  
10. Regulation of metabolic processes | Homework |
| 11 | 30-32 | 1. Glycolysis  
2. Entry of other sugars  
3. Fate of pyruvate  
4. Gluconeogenesis  
5. Regulation of glycolysis and gluconeogenesis  
6. Glucose transporters  
7. Cori Cycle | 16  
Class Quiz |
|   |   |   |   |
| 12 | 33-34 | Nov. 11 Veteran’s Day  
Holiday  
1. Conversion of pyruvate to Acetyl CoA  
2. TCA cycle  
3. Regulation of TCA cycle  
4. Anaplerotic reactions | 17  
Exam #3 on Monday Nov. 9  
(Ch. 13,14,15 &16)  
Class Quiz |
|   |   |   |   |
| 13 | 35-37 | 1. Glyoxylate cycle  
2. Structure of mitochondria  
3. Redox potential  
4. Electron transport chain  
5. ATP synthesis  
6. Movement across mitochondrial membrane  
6. Inhibitors  
7. Thermogenesis  
8. Regulation of electron transport chain  
9. Energetics of glucose metabolism  
10. Pentose phosphate pathway  
11. Protective role of G-6-PDH | 18,20  
Class Quiz |
|   |   |   |   |
| 14 | 38-39 | 1. Glycogen metabolism  
1. Glycogen synthesis  
2. Regulation of glycogen metabolism  
3. Glycogen storage diseases  
Nov. 26–27: Thanksgiving | 21 |
### Course Evaluation

Written quizzes, homework and Exams.

### Grading

The course grade will be calculated on the basis of 500 points, distributed as follows:

- All quizzes and Homework: 100 points
- Four one-hour exams, 100 points each: 400 points
- Final: 100 points
- Total: 600 points

**Grading Scale**

- A: 85 - 100%
- B: 75 - 84%
- C: 65 - 74%
- D: 55 - 64%
- F: 0 - 54%

### Course Policies

**Attendance:**

Students are expected to be punctual and to maintain a quiet atmosphere conducive to learning in the class. Attendance will be taken during each class meeting. A student should be present for the entire class period in order to be marked present. If a student is absent from a class, an official excuse should be obtained from the Dean’s office and submitted within one week of returning to class. As per the University Catalog, only three unexcused absences are allowed for this course. Subsequent absences will entail a grade of F in the course. It is absolutely the responsibility of the student to keep track of the dates of the absences and to submit the official excuses on time.

**Exams:**

There will be unannounced quizzes and four one-hour exams on the dates indicated in the schedule. If a student is absent from a quiz or an exam, the student will earn zero points for that quiz/exam. **No make-up quiz or exam will be given.** Note their scheduled dates and plan accordingly. The Final examination covers all topics in the course.

**Academic Honor Policy:**

It is expected that each student will be honest and truthful in carrying out his/her responsibilities in the course. It is your responsibility to know the University’s policy on academic/intellectual dishonesty (Section 6C3-2.012(10)(s) of the FAMU Student Handbook. Any student caught cheating in any manner will receive the grade of F. No warnings will be given. All persons collaborating in cheating will receive the grade of ‘F’.

**ADA Compliance:**

<table>
<thead>
<tr>
<th>15</th>
<th>40-42</th>
<th>Review Dec. 4th: Last day of classes.</th>
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<tbody>
<tr>
<td>16</td>
<td></td>
<td>Dec. 7–11: Final Exams.</td>
</tr>
<tr>
<td></td>
<td>FINALS</td>
<td>Comprehensive</td>
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</table>

Exam #4 on Monday Nov. 30 (Ch. 17, 18, 20 & 21)
To comply with the provisions of the Americans with Disabilities Act (ADA), please advise instructor of accommodations required to insure participation in this course. Documentation of disability is required and should be submitted to the Learning Development and Evaluation Center (LDEC). For additional information please contact the LDEC at (850) 599-3180.

**Policy Statement on Non-Discrimination:**

It is the policy of Florida Agricultural and Mechanical University to assure that each student of the University community be permitted to attend classes in an environment free from any form of discrimination including race, religion, color, age, disability, sex, marital status, national origin, veteran status and sexual harassment as prohibited by state and federal statutes.

**Procedure for resolving faculty -student conflicts:**
- Student first attempts to resolve issue with instructor.
- Student submits written notification of problem to chair.
- Chair forwards student letter to instructor.
- Instructor responds in writing to chair.
- Chair meets with instructor and/or student if necessary.
- Chair forwards response/recommendation to Dean’s office.
- Dean decides what further course of action is available to the student.