ADVANCED MEDICAL LABORATORY PROCEDURES - CLSC 4382
DEPARTMENT OF LIFE SCIENCES
SPRING 2019

A. COURSE INFORMATION

Course number/section: CLSC_4382_001-101
Class meeting time: TR-2:30-3:20 PM; M-2:30-5:20 PM
Class location: TR-ECDC 219B & M-TBA
Course Website: https://bb9.tamucc.edu/

B. INSTRUCTOR INFORMATION

Instructor: Dr. Felix Omoruyi
Office location: Center for Sciences 130B
Office hours: MW – 12:00 - 2:00 PM; R – 12:00 – 1:00 PM
Telephone: 361-825-2473
e-mail: felix.omoruyi@tamucc.edu
Appointments: N/A

C. COURSE DESCRIPTION

Lecture and laboratory studies of the newest development in laboratory diagnostic medicine. Includes advanced clinical chemistry, immunology, and molecular diagnostic procedures.

D. PREREQUISITES AND COREQUISITES

Prerequisites
CLSC 4325: Clinical Chemistry 1
CHEM 4401: Biochemistry 1
BIMS 4406 or BIOL 4406: Immunology

Corequisites
SMTE 0092: Biomedical Laboratory Safety Seminar

E. REQUIRED TEXTBOOK(S), READINGS AND SUPPLIES

Required Textbook(s)

Optional Textbook(s) or Other References
OR
Supplies
You will also need a scientific calculator.

F. STUDENT LEARNING OUTCOMES AND ASSESSMENT

Assessment is a process used by instructors to help improve learning. Assessment is essential for effective learning because it provides feedback to both students and instructors. A critical step in this process is making clear the course’s student learning outcomes that describe what students are expected to learn to be successful in the course. The student learning outcomes for this course are listed below. By collecting data and sharing it with students on how well they are accomplishing these learning outcomes students can more efficiently and effectively focus their learning efforts. This information can also help instructors identify challenging areas for students and adjust their teaching approach to facilitate learning.

Method Evaluation and Statistics for Method Evaluation
At the completion of the lecture and laboratory, the student should be able to:
1. List aspects to be considered when selecting a method for use in a clinical laboratory
2. Define: random error, constant error, systematic error, total error, delta check
3. Describe experimental methods of evaluating each type of error including design of the experiment, type of specimens, and materials required.
4. Describe statistical evaluation and interpretation of the data obtained.

Electrophoretic Techniques
At the completion of the lecture and laboratory, the student should be able to:
1. Explain the principles of electrophoresis.
2. Discuss the different types of electrophoresis.
3. Describe the charge properties of proteins at acidic, isoelectric, and basic pH.
4. Discuss factors influencing an electrophoretic separation.
5. List the most common support materials and give relevant characteristics of each.
6. Define immunofixation electrophoresis (IFE) and immunoelectrophoresis (IEP) and their role in diagnosis
7. Discuss SDS polyacrylamide gel electrophoresis
8. Discuss Isoelectric Focussing
9. Discuss and define capillary zone electrophoresis (CZE)

Chromatographic Techniques
At the completion of the lecture and laboratory, the student should be able to:
1. State the general principles of chromatography.
2. Describe the different separation processes involved with the following types of chromatography and list the class of molecules that can be separated by each type.
   a. adsorption
   b. partition
   c. ion exchange
   d. gel permeation
3. Explain the principles of gas chromatography, high-performance liquid chromatography, and mass spectrometry.
4. Discuss the clinical applications of GC, GC-MS, and HPLC.
Gammopathies
At the completion of the lecture and laboratory, the student should be able to:
1. Describe the structure of each class of immunoglobulin and list the classes of immunoglobulins in order of relative concentration in plasma.
2. Explain polyclonal and monoclonal gammopathies and para-protein Bence-Jones proteins.
3. Describe diseases associated with abnormalities of the gamma proteins and detection by SPE.
4. Describe the criteria for monoclonal gammopathy on SPE and criteria for benign vs pathological monoclonal gammopathy.

Hemoglobin Electrophoresis
At the completion of the lecture and laboratory, the student should be able to:
1. Describe the basic differences between acid and alkaline electrophoresis for hemoglobin.
2. Discuss the different electrophoretic patterns for pathologic hemoglobin conditions.
3. Explain differentiation of hemoglobins that migrate in similar positions on alkaline electrophoresis.

Nucleic Acid Chemistry, Structure, and Function
At the completion of the lecture and laboratory, the student should be able to:
1. Describe the basic structure of RNA/DNA.
2. Discuss the function of RNA/DNA.
3. Define and describe the basic types of mutations and briefly explain how they can cause cell dysfunction.

General Principles of Molecular Pathology
At the completion of the lecture and laboratory, the student should be able to:
1. Discuss the structure of DNA and describe how its properties of complementary base pairing and digestion by specific nucleases can be used to identify specific sequences of DNA.
2. Discuss the applications of molecular pathology.
3. Discuss denaturation, reannealing, digestion, synthesis, and ligation of nucleic acid.
4. Discuss the importance of Human Genome Project.

Nucleic Acid Enzymes, Hybridization, Stringency and Probes
At the completion of the lecture and laboratory, the student should be able to:
1. Explain the separation and combination of DNA strands.
2. Discuss nucleic acid modifying enzymes.
3. Describe the methods used in nucleic acid separation.
4. Explain the terms: hybridize, amplify, primer, probe, clone.
5. Briefly describe the principles and different formats of hybridization assays.

Polymerase Chain Reaction
At the completion of the lecture and laboratory, the student should be able to:
1. Discuss the principle of PCR.
2. List the components of PCR.
3. Discuss the cycling parameters.
4. Explain the quality control.
Optimization and Troubleshooting of PCR Reactions
At the completion of the lecture and laboratory, the student should be able to:
1. Discuss the factors that significantly impact PCR sensitivity and specificity, including: oligonucleotide primer design, PCR cycling parameters, the composition of the PCR mixture.
2. Discuss PCR contaminants.
3. Discuss PCR troubleshooting.

Ligase Chain Reaction, Fluorescent In Situ Hybridization (FISH), Restriction Fragment Length Polymorphisms (RFLP)
At the completion of the lecture and laboratory, the student should be able to:
1. Discuss ligase chain reaction.
2. Describe restriction fragment length polymorphisms.
3. Discuss the following: the use of RFLP, Problem associated with RFLP, RFLP & DNA typing.
4. Discuss the applications of FISH.
5. Briefly describe nucleic acid extraction.

RNA Diseases and Viruses
At the completion of the lecture and laboratory, the student should be able to:
1. Discuss the structure of RNA.
2. Discuss the following: RNA viruses, characteristics of retrovirus, HIV testing.
3. Discuss hepatitis C virus and the laboratory testing.

Infectious Diseases
At the completion of the lecture and laboratory, the student should be able to:
1. Discuss HIV and the associated clinical laboratory testing.
2. Describe the differences between genotyping and phenotyping for HIV.
3. Describe the different hepatitis viruses and the associated clinical laboratory testing.
4. Discuss H.pylori infections and the associated clinical laboratory testing.

Pharmacogenetics and Pharmacogenomics
At the completion of the lecture and laboratory, the student should be able to:
1. Define pharmacogenetics and pharmacogenomics.
2. Discuss pharmacogenomics classification.
3. Discuss the applications of pharmacogenomics.
4. Explain the barriers to progress associated with the application of pharmacogenomics.
5. Explain the future of pharmacogenomics.

Genetic Diseases
At the completion of the lecture and laboratory, the student should be able to:
1. Discuss the molecular structure of DNA.
2. Explain modes of inheritance.
3. Discuss the clinical applications of molecular genetic testing.
4. Discuss polygenic disorders.
Molecular Analysis of Hematologic Diseases
At the completion of the lecture and laboratory, the student should be able to:
1. Describe the principles and summarize the procedures for common laboratory tests used in molecular diagnostics.
2. Recall the clotting factors that contribute to the intrinsic, extrinsic and common pathways.
3. Describe and explain the applications of molecular tests in the diagnosis of hematologic disorders.
4. Discuss molecular analysis of hematologic malignancies: CML, APL.

Flow Cytometry
At the completion of the lecture and laboratory, the student should be able to:
1. Discuss the general principles of flow cytometry.
2. Explain the clinical applications of flow cytometry.
3. Discuss immunophenotyping and applications of immunophenotyping.
4. Discuss flow cytometry specimen requirement and preparation.

Mass Spectrometry
At the completion of the lecture and laboratory, the student should be able to:
1. Define mass spectrometry
2. Describe methods for ionization of molecules and mass analyses
3. Discuss approaches to tandem mass spectrometry
4. Discuss clinical applications of mass spectrometry

Cancer Diagnosis
At the completion of the lecture and laboratory, the student should be able to:
1. List common types of cancer.
2. Define oncogenes and tumor suppressor genes, and describe how they can cause cancers.
3. Differentiate between familial and sporadic cancers.
4. Discuss the roles of tumor markers in the assessment of cancers.
5. List commonly used tumor markers and state their clinical significance in relation to cancer.
6. Describe the laboratory tests used in cancer diagnosis.
7. Discuss the approaches to cancer treatments.

ELISA and Luminex Technology
At the completion of the lecture and laboratory, the student should be able to:
1. Discuss the principles of immunossays.
2. List the components of ELISA.
3. Discuss the principles ELISA.
4. Discuss the types of ELISA and the advantages and disadvantages of each.
5. Describe luminex technology.
By the end of this course, students should be able to:

1. develop an understanding of the general principles of advanced medical laboratory procedures.
2. discuss the basic concepts of nucleic acid biochemistry and genetics relative to the application of molecular diagnostic procedures in the clinical laboratory.
3. develop an understanding of the use of laboratory tests in diagnosis, prognosis, and treatment.
4. acquire skill in the use of molecular diagnostic methods.

G. INSTRUCTIONAL METHODS AND ACTIVITIES

You will be provided with lecture notes. Instructional methods will include lecturing with discussion, problem solving and case studies.

H. MAJOR COURSE REQUIREMENTS AND GRADING

The final course grade will be based on three exams, problem portfolio, journal presentation, lab average, and a final exam according to the following percentages:

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>% of FINAL GRADE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam 1</td>
<td>15</td>
</tr>
<tr>
<td>Exam 2</td>
<td>15</td>
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<tr>
<td>Exam 3</td>
<td>15</td>
</tr>
<tr>
<td>Problem Portfolio</td>
<td>10</td>
</tr>
<tr>
<td>Journal Presentation</td>
<td>10</td>
</tr>
<tr>
<td>Lab Average</td>
<td>15</td>
</tr>
<tr>
<td>Final</td>
<td>20</td>
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</tbody>
</table>

Grades
You are expected to read the material that corresponds to the objectives as they are covered. Mastering course objectives will require that you have read the material. You must score ≥ 70% in both LAB and LEC (Exam & Problem Portfolio) components to earn the final passing grade. Failure to present the journal article you selected will result in an incomplete grade.

The following scale will be used to report grades:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
</tr>
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<tbody>
<tr>
<td>A</td>
<td>90 - 100</td>
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<tr>
<td>B</td>
<td>80 - 89</td>
</tr>
<tr>
<td>C</td>
<td>70 - 79</td>
</tr>
<tr>
<td>D</td>
<td>60 - 69</td>
</tr>
<tr>
<td>F</td>
<td>below 60</td>
</tr>
</tbody>
</table>
I. **COURSE CONTENT/SCHEDULE**

The following schedule is subject to change. It is the student’s responsibility to stay abreast of any changes announced in class.

<table>
<thead>
<tr>
<th>Month</th>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>January 14</td>
<td>LAB: Introduction</td>
<td></td>
</tr>
<tr>
<td>January 15</td>
<td>Method Evaluation</td>
<td></td>
</tr>
<tr>
<td>January 17</td>
<td>Statistics for Method Evaluation</td>
<td></td>
</tr>
<tr>
<td>January 21</td>
<td>Martin Luther King, Jr. Holiday</td>
<td></td>
</tr>
<tr>
<td>January 22</td>
<td>Electrophoretic Techniques</td>
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<tr>
<td>January 24</td>
<td>Electrophoretic Techniques</td>
<td></td>
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<tr>
<td>January 28</td>
<td>LAB: Evaluation of New Method in Clinical Laboratory</td>
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<tr>
<td>January 29</td>
<td>Chromatographic Techniques</td>
<td></td>
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<tr>
<td>January 31</td>
<td>Chromatographic Techniques</td>
<td></td>
</tr>
<tr>
<td>February 04</td>
<td>LAB: Evaluation of New Method in Clinical Laboratory</td>
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<tr>
<td>February 07</td>
<td>Gammopathies</td>
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<tr>
<td>February 11</td>
<td>LAB: Journal Presentations</td>
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<tr>
<td>February 12</td>
<td>Hemoglobin Electrophoresis</td>
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<tr>
<td>February 14</td>
<td>EXAM 1</td>
<td></td>
</tr>
<tr>
<td>February 18</td>
<td>LAB: SPE and IFE</td>
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<tr>
<td>February 19</td>
<td>Nucleic Acid Chemistry, Structure, and Function</td>
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<tr>
<td>February 21</td>
<td>General Principles of Molecular Pathology</td>
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<tr>
<td>February 25</td>
<td>LAB: Nucleic Acid Isolation</td>
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</tr>
<tr>
<td>February 26</td>
<td>Nucleic Acid Enzymes, Hybridization, Stringency and Probes</td>
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<tr>
<td>February 28</td>
<td>Polymerase Chain Reaction</td>
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<tr>
<td>March 04</td>
<td>LAB: Journal Presentations</td>
<td></td>
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<tr>
<td>March 05</td>
<td>Optimization and Troubleshooting of PCR Reactions</td>
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<tr>
<td>March 07</td>
<td>Ligase Chain Reaction, FISH &amp; Restriction Fragment Length Polymorphisms (RFLP)</td>
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<tr>
<td>March 11-15</td>
<td>Spring Break</td>
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<tr>
<td>March 18</td>
<td>LAB: Precut Lambda DNA and Electrophoresis</td>
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<tr>
<td>March 19</td>
<td>EXAM 2</td>
<td></td>
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<tr>
<td>March 21</td>
<td>RNA Diseases and Viruses</td>
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<tr>
<td>March 25</td>
<td>LAB: Journal Presentations</td>
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<tr>
<td>March 26</td>
<td>Infectious Diseases</td>
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<tr>
<td>March 28</td>
<td>Pharmacogenetics and Pharmacogenomics</td>
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<tr>
<td>April 01</td>
<td>LAB: Restriction Digestion and Electrophoresis</td>
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<tr>
<td>April 02</td>
<td>Genetic Diseases</td>
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<tr>
<td>April 04</td>
<td>Molecular Analysis of Hematologic Diseases</td>
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<tr>
<td>April 08</td>
<td>LAB: DNA Fingerprinting</td>
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<tr>
<td>April 09</td>
<td>Flow Cytometry</td>
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<tr>
<td>April 11</td>
<td>EXAM 3</td>
<td></td>
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<tr>
<td>April 15</td>
<td>LAB: Journal Presentations</td>
<td></td>
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<tr>
<td>April 16</td>
<td>Cancer diagnosis</td>
<td></td>
</tr>
<tr>
<td>April 18</td>
<td>Cancer diagnosis</td>
<td></td>
</tr>
<tr>
<td>April 22</td>
<td>LAB: ELISA Testing</td>
<td></td>
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<tr>
<td>April 23</td>
<td>ELISA and Luminex technology</td>
<td></td>
</tr>
<tr>
<td>April 25</td>
<td>ELISA and Luminex technology</td>
<td></td>
</tr>
</tbody>
</table>
29 LAB: Journal Presentations
30 Review
May 07 FINAL 1:45 - 4:15 PM

Note: Changes in this course schedule may be necessary and will be announced to the class by the Instructor. The assignments and exams shown are directly related to the Student Learning Outcomes described in Section F.

J. COURSE POLICIES

Attendance/Tardiness
Students are expected to attend all lectures. If you know in advance that you will miss an exam due to official University business, you must provide the Professor with official documentation of the absence at least fourteen days prior to missing. It is the student’s responsibility to obtain official documentation in timely fashion. Once the documentation has been verified, the Professor will decide how to handle the absence. In the overwhelming majority of cases, assignments and exams will be turned in or completed prior to the planned, official absence. Exams given outside regularly scheduled times may vary in format and content at the discretion of the faculty member. Absolutely nothing may be turned in late by anyone for any reason.

Late Work and Make-up Exams
There is no provision for making up late work and missed exams.

Extra Credit
There is no provision for extra credit

Cell Phone Use
No use of cell phone during lectures/exams

Laptop Use
Only for assessing lecture notes posted on blackboard

Food in Class
No eating in class

Missed Exam
Unexcused absence during exams will result in a zero for that exam. It is the student’s responsibility to contact me in cases of extreme emergency. The only excused absences are personal illness, immediate family medical emergency, or attending funeral of immediate family.

K. COLLEGE AND UNIVERSITY POLICIES

- Academic Integrity (University)
  University students are expected to conduct themselves in accordance with the highest standards of academic honesty. Academic misconduct for which a student is subject
to penalty includes all forms of cheating, such as illicit possession of examinations or examination materials, falsification, forgery, complicity or plagiarism. (Plagiarism is the presentation of the work of another as one’s own work.) In this class, academic misconduct or complicity in an act of academic misconduct on an assignment or test will result in a failing grade.

- **Classroom/Professional Behavior**
  Texas A&M University-Corpus Christi, as an academic community, requires that each individual respect the needs of others to study and learn in a peaceful atmosphere. Under Article III of the Student Code of Conduct, classroom behavior that interferes with either (a) the instructor’s ability to conduct the class or (b) the ability of other students to profit from the instructional program may be considered a breach of the peace and is subject to disciplinary sanction outlined in article VII of the Student Code of Conduct. Students engaging in unacceptable behavior may be instructed to leave the classroom. This prohibition applies to all instructional forums, including classrooms, electronic classrooms, labs, discussion groups, field trips, etc.

- **Statement of Civility**
  Texas A&M University-Corpus Christi has a diverse student population that represents the population of the state. Our goal is to provide you with a high quality educational experience that is free from repression. You are responsible for following the rules of the University, city, state and federal government. We expect that you will behave in a manner that is dignified, respectful and courteous to all people, regardless of sex, ethnic/racial origin, religious background, sexual orientation or disability. Behaviors that infringe on the rights of another individual will not be tolerated.

- **Deadline for Dropping a Course with a Grade of W (University)**
  I hope that you never find it necessary to drop this or any other class. However, events can sometimes occur that make dropping a course necessary or wise. **Please consult with your academic advisor, the Financial Aid Office, and me, before you decide to drop this course.** Should dropping the course be the best course of action, you must initiate the process to drop the course by going to the Student Services Center and filling out a course drop form. Just stopping attendance and participation WILL NOT automatically result in your being dropped from the class. Please consult the Academic Calendar ([http://www.tamucc.edu/academics/calendar/](http://www.tamucc.edu/academics/calendar/)) for the last day to drop a course.

- **Grade Appeals (College of Science and Engineering)**
  As stated in University Procedure 13.02.99.C2.01, Student Grade Appeal Procedures, a student who believes that he or she has not been held to appropriate academic standards as outlined in the class syllabus, equitable evaluation procedures, or appropriate grading, may appeal the final grade given in the course. The burden of proof is upon the student to demonstrate the appropriateness of the appeal. A student with a complaint about a grade is encouraged to first discuss the matter with the instructor. For complete details, including the responsibilities of the parties involved in the process and the number of
days allowed for completing the steps in the process, see University Procedure 13.02.99.C2.01, Student Grade Appeal Procedures. These documents are accessible through the University Rules website at [http://www.tamucc.edu/provost/university_rules/index.html](http://www.tamucc.edu/provost/university_rules/index.html), and the College of Science and Engineering Grade Appeals webpage at [http://sci.tamucc.edu/students/GradeAppeal.html](http://sci.tamucc.edu/students/GradeAppeal.html). For assistance and/or guidance in the grade appeal process, students may contact the chair or director of the appropriate department or school, the Office of the College of Science and Engineering Dean, or the Office of the Provost.

- **Disability Services**
  The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please call (361) 825-5816 or visit Disability Services in Corpus Christi Hall 116.

  If you are a returning veteran and are experiencing cognitive and/or physical access issues in the classroom or on campus, please contact the Disability Services office for assistance at (361) 825-5816.

  [http://disabilityservices.tamucc.edu/](http://disabilityservices.tamucc.edu/)

- **Statement of Academic Continuity**
  In the event of an unforeseen adverse event, such as a major hurricane and classes could not be held on the campus of Texas A&M University–Corpus Christi; this course would continue through the use of Blackboard and/or email. In addition, the syllabus and class activities may be modified to allow continuation of the course. Ideally, University facilities (i.e., emails, web sites, and Blackboard) will be operational within two days of the closing of the physical campus. However, students need to make certain that the course instructor has a primary and a secondary means of contacting each student.

L. **OTHER INFORMATION**

- **Academic Advising**
  The College of Science & Engineering requires that students meet with an Academic Advisor as soon as they are ready to declare a major. The Academic Advisor will set up a degree plan, which must be signed by the student, a faculty mentor, and the department chair. Meetings are by appointment only; advisors do not take walk-ins. Please call or stop by the Advising Center to check availability and schedule an appointment. The College’s Academic Advising Center is located in Center for Instruction 350 or can be reached at (361) 825-3928.
GENERAL DISCLAIMER

I reserve the right to modify the information, schedule, assignments, deadlines, and course policies in this syllabus if and when necessary. I will announce such changes in a timely manner during regularly scheduled lecture periods.