COURSE SYLLABUS
for
BITC 2411
(replaces BITC 1401)

BIOTECHNOLOGY LABORATORY INSTRUMENTATION

CATALOGUE DESCRIPTION
Presentation of theory, applications, and operations of various analytical instruments. Practice of separation and identification techniques including electrophoresis, spectrophotometry, chromatography, and centrifugation.

CREDITS
4

PREREQUISITES
Prerequisites: BITC 1402; BIOL 1406; BIOL 2420 or BIOL 2421; CHEM 1405 or 1411; or instructor’s approval; ENGL 0305 or ENGL 0316 AND ENGL 0307 or 0326, OR higher level course (ENGL 1301), OR placement by testing.

ADA STATEMENT
NHMCCCD is dedicated to providing the least restrictive learning environment for all students. The college district promotes equity in academic access through the implementation of reasonable accommodations as required by The Vocational Rehabilitation Act of 1973, Title V, Section 504 and the Americans with Disabilities Act of 1990 (ADA) which will enable students with disabilities to participate in and benefit from all post-secondary educational programs and activities.

Students with disabilities who believe that they need accommodations in this course are encouraged to contact the Disability Services Office at 936-273-7239; located in Building E, Office 103H as soon as possible to better ensure that such accommodations are implemented in a timely fashion. If you require reasonable accommodations because of a physical, mental, or learning disability, please notify the instructor of this course within the first 2 weeks of the term.
COURSE OUTCOMES

1. To demonstrate qualitative and quantitative analytical skills with various common instruments using common biotechnology laboratory protocols.
2. To demonstrate an understanding of the theory, proper operation, maintenance and applications of common analytical laboratory instruments, including equipment for electrophoresis, spectrophotometry, and chromatography.
3. To demonstrate laboratory safety and management techniques in a safe and prudent manner using established guidelines.
4. To demonstrate proper handling of laboratory chemical chemicals and management skills by using these skills in the laboratory.
5. To properly apply scientific mathematical skills to calculations relevant to the laboratory.
6. To maintain an accurate, up-to-date, and complete notebook record of all laboratory activities.
7. To write accurate, timely and complete laboratory reports of all laboratory activities.

THE ADDITIONAL COURSE LEARNING OUTCOMES LISTED BELOW ARE KEY ACTIVITIES FROM THE BIOTECHNOLOGY AND BIOMEDICAL SKILL STANDARDS FOR RESEARCH, DEVELOPMENT, AND MANUFACTURING

1. Students will perform assays and experiments and operate and maintain laboratory equipment.
2. Interpersonal communication between students to ensure quality laboratory work, communicate experimental results, and ensure that production or service meets typical industry requirements will be emphasized.
3. Students will become familiar with safe laboratory practices by participating in safety training, identifying unsafe conditions and taking corrective action, learning proper handling and disposal techniques for hazardous materials, and maintaining security.
4. Students will develop critical thinking skills relevant to biotechnology by performing data analysis, troubleshooting experiments and equipment, and suggesting continuous improvements.
5. Students will learn aspects of the day-to-day running of a biotechnology laboratory, including ordering supplies, the monitoring, maintenance, and troubleshooting of equipment, tools, and workstations, coordination of inventory, the maintenance of equipment logbooks and chemical and biological stock records. They will also send, receive, and distribute biological and chemical materials and participate in the installation, modification, and upgrade of equipment.
6. Students will coordinate experiments and other activities with work teams.
7. Students will develop laboratory-relevant writing skills, including properly maintaining a lab notebook, maintaining training documentation, and creating lab reports and other documents. They will also provide orientation and training for other students.
8. Students will begin to gain laboratory independence by cleaning and preparing items for the lab and preparing biological and/or chemical materials, as well as other items used in experiments.
9. Students will stay current with research and techniques in biotechnology by assisting in method development and investigating new technologies and methodologies.
REQUIRED MATERIALS
Textbooks:
Modern Experimental Biochemistry, 2nd ed., by Boyer, Addison-Wesley.
Basic Laboratory Methods for Biotechnology, by Seidman/Moore, Prentice Hall.


REQUIRED SUPPLIES
1. Safety glasses or goggles bookstore or local purchase
2. A lab coat - local purchase (ex. Scrubs etc on I-45 N)
3. Latex gloves - bookstore or local purchase
4. Waterproof fine-point black or blue marker
5. Scientific calculator

INSTRUCTOR
Larry Loomis-Price, Ph.D.
Office
Bldg B Office 210B

Email lloomisprice@nhmccd.edu

Phone
Work 936-273-7060
Metro 936-321-5161, ext. 7060
Fax 936-273-7362

Webpage http://lloomisprice.nhmccd.cc/

SEMESTER / LOCATION / TIME
Fall 2007
Time: MW, 9 – 11:20 a.m., and F 9 – 9:53 a.m.;
Location: Room A-221 (lecture) and A-222 (lab)
ATTENDANCE EXPECTATIONS

• Attendance is mandatory. If you are unable to attend a class occasionally, you are responsible for the material presented during that session as well as any activity. Please be sure to jot down the phone numbers of one or two classmates for assistance in these instances.

• Because of the difficulty of making up complex laboratories spanning multiple class periods, it is very difficult to make up missed laboratories. However, if documentation of extenuating circumstances is present, the student will be responsible for inquiring about alternate arrangements that may be possible.

• Participation in class discussions and activities is crucial since this course emphasizes the development of technical skills, communication skills, the ability to work responsibly in a group, and the honing of critical thinking skills.

• You will be graded for this participation (50 points total). By definition, you must be in class to receive credit. After one warning, an unexcused absence will result in a 50 point penalty. Being late will result in a grade of 0 for the daily activity.

NO LONGER ATTENDING CLASS DOES NOT CONSTITUTE WITHDRAWAL FROM THIS CLASS, NOR DOES A STUDENT’S NOTIFICATION TO THE INSTRUCTOR THAT THE STUDENT WISHES TO BE DROPPED. FAILURE OF A STUDENT TO FILL OUT A “SCHEDULE CHANGE FORM” TO OFFICIALLY DROP THIS CLASS MAY RESULT IN A GRADE OF “F.”

THE LAST DAY TO DROP THIS CLASS AND RECEIVE “W” IS FRIDAY, NOVEMBER 9, 2007, BY 4:00 P.M. AFTER THIS DATE, NO WITHDRAWALS WILL BE ISSUED.

ADDITIONAL NOTES

Professional behavior is required in all lectures and laboratories in this course. This includes observation of safety procedures, courtesy to your peers, respect for the equipment and reagents and cooperation in group projects. Students will be expected to maintain appropriate decorum in the classroom and may be dropped from the class for unruly or disruptive behavior.

LABORATORY SAFETY

• Review the safety procedures described in chapter 2 of the Laboratory Manual (Seidman and Moore). You are responsible for learning and observing safety procedures. You must sign and date a Biotech Laboratory Safety Agreement before you will be allowed to work in the lab. Be sure that you check the MSDS (copy in the lab) before using any chemical.

• All students must wear a lab coat and safety goggles or glasses in the laboratory at all times, unless told to do otherwise. If you fail to bring your lab coat and goggles (glasses), you will be asked to leave the lab. Hooks to hang your lab coats on are available in the lab. You may bring a combination lock to put on one drawer in the lab to store goggles, gloves etc.
THE LABORATORY NOTEBOOK

Our partner companies have emphasized repeatedly how important good notebook skills are for their employees. To help you meet their standards we will follow a specific set of guidelines for keeping lab notebooks.

1) The notebook must be bound, with numbered pages.
2) You will write only in ink. You will not remove pages, erase or deface any entries. You can make changes by using a single strikeout like this and dating the change.
3) Pages 1-3 will be reserved for the Table of Contents.
4) Before you walk into the lab for an experiment, the following must be in your notebook:
   a. Title of the experiment
   b. Description of the experiment (3-5 sentences per day)
   c. HYPOTHESIS for the experiment. You may need to be creative, but you can come up with one!
   d. Flow diagram for the experiment, including anticipated time.
   e. All necessary calculations.
   f. Blanks to fill in data to be acquired.
   g. Do not rewrite the protocol. Refer to the written protocol, as necessary.
   h. NOTE any changes given to you about the laboratory, written or otherwise.
   i. Date
   j. Entry in the Table of Contents.
   k. Answer any questions or perform any calculations given to you with the protocol
   l. YOU WILL BE GRADED IMMEDIATELY ON THESE ENTRIES.
5) Modifications and safety notices from the instructor will be written down in the notebook.
6) All data, all observations, changes, problems etc will be made directly in the notebook. It is not necessary to rewrite the protocol. It's only necessary to describe variations from the protocol. Include details about all reagents, materials and equipment used.
7) If you are observed writing any of this information anywhere but your notebook it will cost you points on the spot.
8) At the end of EVERY LAB PERIOD, you AND the instructor will sign and date every new page of data entry. Missing the signing will cost you credit.
9) Leave one page blank at the end of each experiment. Your lab write-up and answers to assigned questions will be written up SEPARATELY (see below) and turned in for grading. The returned, graded write-up will be incorporated into the notebook by stapling in onto that blank page.

Typical grading scheme for a lab:
Protocol/flow diagram: 10 pts  Notebook grade: 10 pts  Lab reports: 40 pts
LAB REPORTS

Lab reports are separate from your lab notebook. Lab reports are due one week after the lab has been completed.

Lab reports must be produced using a word-processing program such as Microsoft Word. All graphs should be produced using Microsoft Excel and pasted into the Word document or otherwise incorporated into your report. Proofread your lab report before you turn it in. Make the necessary corrections. Well-written reports will get better grades than poorly written ones. If you have trouble writing scientific English for any reason, consult with me early in the semester and we will arrange for appropriate help.

Microsoft Word and Microsoft Excel are generally available programs. They are loaded onto the computers in the biotech lab, on those in the ELC and those in B210A (next to my office).

Lab reports need to include some dialog so the reader can follow the events. Lab reports should follow this format:

Lab Report Format:

Introduction: Describe the problem and what the lab report is about in one to two pages. Give some background -- one sentence is not enough. You will be expected to include one or more references. Include a copy of your hypothesis (from your notebook) with every lab.

Materials and Methods: Refer to the protocol that you have followed, but it is not necessary to include the protocol. If you did not follow the protocol, then describe what you did differently.

Results: This is an important section. Raw data does NOT go here. Try to use your data to tell a story. Use a computer to make all graphs. Be sure that each figure has an explanatory legend. Use complete sentences.

Conclusions: This is the place for your interpretations and your conclusions. Please do not summarize your experiment here. Describe the results and account for accuracy, precision, errors and mistakes. State whether your hypothesis was proven or not.

Raw Data and Calculations: Put these at the end. Normally these would not be part of a lab report, but they will allow me to help you trap errors if there are any in your write-up. Put the data into useful tables.
**Computer Labs:** some days we will use a computer laboratory to analyze data. For the HPLC portion of this course, we will depend somewhat on the use of a computer simulation program, *DryLab*, to help you learn about HPLC. *DryLab* is loaded on the computers in the biotech lab and specific computers in A222 and B210A. I will notify you which computers can be used for *DryLab* when we get to that part of the course.

**Off-site Laboratory:** This year, for the first time ever, we have the opportunity to perform an experimental protocol at a local laboratory. Rigaku Inc. will allow us to use their X-ray diffractometer to solve the crystal structure of a small molecule. For a one week period, our class will meet at Rigaku to perform this work. The data analysis will be performed in the computer laboratory on campus. See the schedule for the exact dates.

**INSTRUMENT CARE**

Every student will be assigned an instrument (such as the HPLC) or group of instruments (such as the pH meters or spectrophotometers). The student will be required to write an SOP (Standard Operating Procedure) and maintain an instrument logbook for that instrument. This will help ensure that all students use the instruments properly and that the instruments are well maintained over the course. This activity will be graded equivalently with one major lab (50 points).

**EVALUATION**

<table>
<thead>
<tr>
<th>Component</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Three Lecture Tests:</td>
<td>100</td>
</tr>
<tr>
<td>Comprehensive Final:</td>
<td>200</td>
</tr>
<tr>
<td>Ten Lab Grades:</td>
<td>40-60</td>
</tr>
<tr>
<td>Instrument care</td>
<td>50</td>
</tr>
<tr>
<td>10 Participation Grades</td>
<td>5</td>
</tr>
<tr>
<td>Skills</td>
<td>100</td>
</tr>
<tr>
<td><strong>Approximate Total</strong></td>
<td>~1200</td>
</tr>
</tbody>
</table>

**EVALUATION (CONT)**

Letter grade:

- A – 100-90%
- B – 89-80%
- C – 79-70%
- D – 69-60%
- F – Below 60%

Note that a grade of “C” or higher is required in BITC courses in order to obtain the AAS degree or ATC certificate.

MAKE-UP EXAMS WILL BE GIVEN ONLY FOR AUTHORIZED ABSENCES; WRITTEN PROOF (FROM A DOCTOR, FOR EXAMPLE) WILL BE REQUIRED. THERE WILL BE NO MAKE-UP LABS.

Late assignments will lose 10% credit per class day late. After one week, a late assignment may be turned in only with permission of the instructor for 1/2 credit.

Test Corrections: For the hour-exams (but not the Final exam), an opportunity to make test corrections will be given for partial credit. Details will be given in class.

**Extra credit:** No other extra credit will be offered or allowed.
PROFESSIONAL ETHICS

I regard high professional standards as one of the most important lessons you can take from this class. My expectation for this class is that each of you will act in a responsible and ethical manner. Please take a look at the sections in our course catalog on Academic Integrity and Appeals (p.51) for details on your responsibilities as a student.

You as individuals are responsible for completing all assignments in this course. You may consult with other members of the class on homework, laboratories, projects and exam corrections (NOT the exams themselves), but I expect each of you to do your own work. If you work with another student, please note whom you worked with on the assignment.

The laboratory reports are the responsibility of each individual student. The background, in particular, requires that you do background research. Such research must be reported IN YOUR OWN WORDS and REFERENCED APPROPRIATELY. Inappropriate use of other work or citation will result in a grade of “0” for the exercise. There will be no warnings.

If you have any questions about my expectations, please ask me. If you need help in writing your laboratory reports, please consult me or a reference librarian. If there is reason to believe you are not meeting those standards, you may expect appropriate disciplinary actions to be taken, as described in the catalog.
NAME:       SEMESTER: FALL 2007

SKILLS CHECKLIST – SECTION 1 (SPECTROPHOTOMETRY) – 40 POINTS

**GENERAL**

<table>
<thead>
<tr>
<th>Task</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Follows all safety precautions at all times</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Completes work in normal time allotted</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Effectively sets up and cleans up</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Demonstrates proper precautions in use of reagents</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Interacts appropriately with colleagues and staff</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Records data directly into the laboratory notebook</td>
<td>yes</td>
<td>no</td>
</tr>
</tbody>
</table>

**SPECIFIC**

<table>
<thead>
<tr>
<th>Task</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uses micropipette accurately</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Uses the spec 20 spectrophotometer appropriately</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Reads the spectrum of a household substance</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Uses Excel to graph raw data</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Handles biological materials safely</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Makes up a laboratory solution properly</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Successfully performs dilutions from standard stocks</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Uses the Ultrospec spectrophotometer appropriately</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Uses a standard curve to obtain unknown values</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Calculates $\lambda_{(\text{max})}$ and $\varepsilon$ for a protein using spectral data</td>
<td>yes</td>
<td>no</td>
</tr>
</tbody>
</table>
SKILLS CHECKLIST – SECTION 2 (ELECTROPHORESIS) – 30 POINTS

GENERAL

Follows all safety precautions at all times   yes   no
Completes work in normal time allotted    yes   no
Effectively sets up and cleans up         yes   no
Demonstrates proper precautions in use of reagents yes   no
Interacts appropriately with colleagues and staff yes   no
Records data directly into the laboratory notebook yes   no

SPECIFIC

Uses micropipette accurately   yes   no
Prepares laboratory solutions appropriately yes   no
Prepares a polyacrylamide gel from component materials yes   no
Uses a polyacrylamide gel to separate proteins yes   no
Stains a polyacrylamide gel   yes   no
Uses a protein gel to calculate MW of unknown proteins yes   no
Uses a 2-D gel to separate proteins yes   no
Transfers proteins using a transblotting system yes   no
Successfully stains a protein immunoblot yes   no
Understands the various aspects of GMP production of a material yes   no
Performs as part of a GMP team yes   no
Successfully prepares solutions for use by another student yes   no
Performs QC on a solution prepared by another student yes   no
NAME:  SEMESTER:  FALL 2007

SKILLS CHECKLIST – SECTION 3 (CHROMATOGRAPHY) – 30 POINTS

GENERAL

Follows all safety precautions at all times       yes no
Completes work in normal time allotted       yes no
Effectively sets up and cleans up      yes no
Demonstrates proper precautions in use of reagents   yes no
Interacts appropriately with colleagues and staff    yes no
Records data directly into the laboratory notebook   yes no

SPECIFIC

Prepares buffers for HPLC      yes no
Prepares samples for HPLC       yes no
Runs an HPLC according to SOP      yes no
Collects data from an HPLC to make a standard curve   yes no
Uses a standard curve to calculate concentration of an unknown yes no
Uses DryLab to model HPLC data       yes no
Performs X-Ray Diffractometry on a small molecule   yes no
Performs computer analysis to solve a crystal structure   yes no