MEDT 473 - Clinical Chemistry Practicum

COURSE SYLLABUS

INTRODUCTION

The clinical practicum is the culmination of several years of study. It is an exciting time for students, and offers unique experiences in the clinical laboratory setting. Students will achieve from this experience benefits comparable to the effort they put forth.

STUDENT LEARNING GOALS

Student learning goals for the clinical chemistry practicum focus on active participation in daily laboratory operations and personal performance as a laboratory professional. Thus, the learning goal for the technical portion of the clinical chemistry practicum is to facilitate and enhance the student's application of clinical chemistry theory, laboratory experience, and test data interpretation learned in campus courses to an active clinical laboratory setting. To accomplish this goal, students will apply principles of pre-analytical, analytical, and post-analytical components of laboratory practice in clinical chemistry to the performance of laboratory operations in a contemporary clinical setting. The learning goal for the professional component is for students to attain high level interpersonal performance so as to interact professionally with fellow staff and all consumers of laboratory testing. The ultimate outcome of a successfully completed practicum experience is the ability to perform testing of the highest quality to support the laboratory's role in quality patient care and safety. Student achievement during this practicum course will lay the foundation for success as an entry-level medical laboratory scientist.

GENERAL COURSE OBJECTIVES

Upon the completion of this course, based upon the objectives detailed in this document, the student must achieve a final minimum average of 70% on the assessment tools utilized in this course.

Upon successful completion of the clinical practicum, studying assigned materials, and reviewing materials associated with the course objectives from MEDT 375, 401/411, and 403/413, the student will:

1. Demonstrate correctly proper procedures for the collection, safe handling, and analysis of biological specimens to the satisfaction of the instructor.

2. Utilize correctly scientific principles, principles of methods for quantifying, clinical correlations, and clinical decision making for analytes of interest in clinical chemistry.

3. Perform correctly laboratory testing according to established laboratory protocol.

4. Apply correctly appropriate problem solving steps for determining instrument/methodology problems, utilizing instrument manuals, laboratory procedure manuals, and information contained in package inserts.

5. Operate equipment properly, troubleshoot, and perform preventive and corrective maintenance according to the manufacturer's directions to the satisfaction of the instructor.

6. Utilize proper techniques in the performance of all laboratory testing to the satisfaction of the instructor.

7. Evaluate correctly laboratory test results to determine disease diagnosis.

8. Evaluate correctly acceptability of quality control and test result data.

9. Discuss the impact and apply principles of total quality management on laboratory operations, including relevance to the pre-analytical, analytical, and post-analytical stages of the testing process.

10. Comply with established safety regulations and regulations governing regulatory compliance related to laboratory practice to the satisfaction of the instructor.

11. Assess correctly critical pathways to facilitate diagnosis and to determine additional testing as warranted.

12. Communicate effectively and professionally as a member of the healthcare team to enable consultative and educational interactions with other healthcare personnel, the public, and patients to the satisfaction of the instructor.

13. Demonstrate ethical behavior and professionalism, including maintaining the confidentiality of patient information to the satisfaction of the instructor.

14. Participate in continuing education as opportunities arise for one's own professional career development to the satisfaction of the instructor.

OUTCOME EXPECTATION FOR STUDENTS BASED ON UNIVERSITY, PROGRAM, AND COURSE STUDENT LEARNING GOALS AND OBJECTIVES

The student learning goals and objectives, as stated for MEDT 473 Clinical Chemistry Practicum, provide the foundation for student achievement of the Medical Laboratory Science Program's student learning goals and objectives. Achievement of the Program's combined goals and objectives is necessary for students to gain the knowledge needed to be successful entry-level medical laboratory scientists, as well as successful on passing the Board of Certification national examination. Additionally, the Medical Laboratory Science Program's student learning goals and objectives support student accomplishment of the University's general education goals for undergraduate students. The University's general education goals support a comprehensive understanding of the liberal arts and sciences, fostering student development for success in an increasingly challenging global society. The synergy for this collaborative educational effort is expressed in the table entitled "University and MLS Program Educational Goals and Objectives".

University and MLS Program Educational Goals and Objectives

UNIVERSITY GENERAL EDUCATION GOALS	MLS PROGRAM OBJECTIVES, SUPPORTING GEN ED GOAL(S) GED ED #:	MEDICAL LABORATORY SCIENCE PROGRAM EDUCATION OBJECTIVES	MEDT473 COURSE OBJECTIVE(S) SUPPORTING MLS ED OBJECTIVES COURSE OBJ #
1-Read critically, analyze arguments & information, & engage in constructive ideation.	**5**	**1**-Demonstrate proper procedures for the collection of safe handling & analysis of biological specimens.	**1**
2-Communicate effectively in writing, orally, & through creative expression.	**5**	**2**-Utilize scientific principles (e.g. physiology, immunology, biochemistry, molecular biology, genetics, microbiology, etc.), laboratory principles and methodologies for the clinical setting.	**2**
3-Work collaboratively & independently within & across a variety of cultural contexts and a spectrum of differences.	**5**	**3**-Perform laboratory testing with accuracy.	**3**
4-Critically evaluate the ethical implications of what they say and do.	**1,3**	**4**-Evaluate problems that impact on laboratory services and take corrective action.	**4**
5-Reason quantitatively, computationally, and scientifically.	**1,5**	**5**-Operate equipment properly, troubleshoot, and perform preventive and corrective maintenance.	**5**
	5	**6**-Utilize proper technique in the performance of all laboratory testing.	**6**
	1,5	**7**-Interpret clinical significance, clinical procedures, & laboratory test data accurately.	**2, 7, 11**
	5	**8**-Evaluate laboratory data using statistical analysis.	**8**
	1,5	**9**-Apply principles of continuous assessment to all laboratory services.	**9**
	1,2,5	**10**-Utilize principles of quality assurance and quality improvement for all phase of laboratory services (i.e. pre-analytical, analytical, & post-analytical).	**9**
	2,4	**11**-Comply with established laboratory safety regulations & regulations governing regulatory compliance related to laboratory practice.	**10**
	2,3	**12**-Communicate through oral and written skills effectively & professionally to enable consultative & educational interactions with healthcare personnel, the public, & patients in order to function successfully as a member of the healthcare team.	**12**
	4	**13**-Demonstrate ethical behavior & professionalism, maintain confidentiality of patient information, & participate in continuing education for one's own professional career development.	**13, 14**
	2,3	**14**-Apply principles of educational methodology to educate providers & users of laboratory services.	**N/A**
	1,5	**15**-Evaluate published scientific studies utilizing knowledge of research design.	**N/A**
	1,2,3,5	**16**-Apply principles & concepts of laboratory operations to critical pathways and clinical decision making, performance improvement dynamics of healthcare delivery systems in relationship to laboratory services, human resource management & financial management.	**11**
	1,3	**17**-Demonstrate a commitment to the future of medical laboratory profession through involvement in a national professional society.	**N/A**
	1,2,3	**18**-Demonstrate an understanding of human creativity & of various types of aesthetic & intellectual expression through study of the liberal arts.	**N/A**
	1,3	**19**- Demonstrate an understanding of the significance of cultural diversity as exhibited within the United States through study of the liberal arts including completion of a multicultural course.	**N/A**
	1,3	**20**-Demonstrate an understanding of the impact of globalization on society through study of the liberal arts.	**N/A**

COURSE DETAILS

This is a clinical practicum course, and it will meet at a clinical affiliate to be determined by the University instructor. Students will be notified of this location prior to the commencement of the clinical practicum. **Attendance at all clinical practicums is MANDATORY, and missed time must be rescheduled with the date/time at the discretion of the clinical instructor and the University instructor. See http://sites.udel.edu/mls/clinical-practicum-schedule/for further details about attendance expectations.**

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MODES OF INSTRUCTION

Clinical faculty will utilize various methods of instruction, including but not limited to a combination of:

- Clinical specimens
- Quality control materials
- Chemistry automated analyzers
- Assay of CAP survey samples previously analyzed and stock samples
- Case studies

Students will receive instruction about proper operation of equipment, specimen processing, quality control, use of the LIS, and result interpretation and reporting mechanisms specific to the clinical facility where they are assigned.

METHODS OF ASSESSMENT

Upon the completion of this course, based upon affective, cognitive and psychomotor objectives, the student must achieve a final minimum average of 70% (C-) on the assessment tools utilized in this course.

The clinical instructor will administer written quizzes. In addition, the clinical instructor will assign papers or projects that are relevant to the practicum. This component of the Evaluation comprises **40%** of the practicum grade.

A practical examination is another means of assessment employed by the clinical instructor. The instructions and rubric for the practical examination will be provided to the student prior to commencing the practical examination. The clinical instructor will complete the practical grading rubric and will return it to the University instructor. This component of the Evaluation comprises **40%** of the practicum grade.

Affective assessment is incorporated into the mid- and final-evaluation process. A mid-evaluation will be completed by the clinical instructor and will be discussed with the student. If there are any issues to be addressed, this will also be shared with the University instructor. The final MEDT 473 Clinical Chemistry Practicum Evaluation will be completed by the clinical instructor and discussed with/reviewed by the student. The affective component on the final Evaluation comprises **20%** of the practicum grade.

A written final examination will be administered by the University instructor at the conclusion of the practicum. The University-administered written final examination component of the Evaluation does not affect the practicum grade, but is included on the form.

A sample MEDT 473 Clinical Chemistry Practicum Evaluation can be found at the end of this syllabus.

Additional Requirements

Journals are one of the most frequently prescribed methods of reflecting on lifetime experiences. Each student is required to maintain a journal for each clinical practicum period. The student may record the sequence of daily events, as well as unusual or memorable situations or events that transpired and how he/she reacted to them. Think about what happened. How would you react the next time you encounter a similar situation? Or perhaps provide a commentary about a particular laboratory employee or environment that you encounter. Think about how your day impacted you professionally. Write regularly and record the date of each entry. Adhere to HIPAA and confidentiality guidelines; do not disclose any identifying facts or information. For more information and guidelines for the journal, see: http://sites.udel.edu/mls/clinical-practicum-evaluation/

Paperwork documenting attendance and orientation to the affiliate institution must be submitted to the University instructor at the conclusion of the practicum. Note that the attendance sheet must be signed by the Clinical instructor prior to completion of the practicum.

Site evaluations are a tool used by the Clinical and University instructors to assess the achievement of the clinical practicum experience and the academic preparation for it. Students are required to submit a completed Site Evaluation for each clinical practicum to the University instructor. These will be collated by affiliate institution and discipline, and will be provided in an anonymous format to the Clinical instructors during the summer following completion of the clinical practicums. Comments regarding academic preparation will be shared and discussed with the University instructors, and used to enhance the curriculum as indicated. Please complete these in a professional, constructive manner.

COURSE PREREQUISITES

MEDT 403/413
RESTRICTIONS:
Open to medical laboratory science majors only.

TEXTBOOKS AND OTHER RESOURCES

One of the following review books is required for all clinical practicums senior year and should be taken daily to your clinical practicum sites for review during slower periods:

Ciulla AP, Lehman DL. *Success! In Clinical Laboratory Sciences.* 4th ed. Upper Saddle River, NJ: Pearson Education, Inc.; 2010. ISBN: 978-0-13-512648-6

Tanabe, Patricia A., Holladay, E. Blair., eds. *BOC Study Guide: Clinical Laboratory Certification Examinations*. 5th ed. Chicago, Ill. : American Society For Clinical Pathology, 2014, c2009. Print. ISBN: 978-089189-5879

Students should refer to the textbook and lecture and laboratory course materials from MEDT 375, MEDT 401/411, and MEDT 403/413. Students are expected to review these materials in preparation for this clinical practicum experience. In addition, students are expected to use these materials as resources during this practicum, as well as in preparation for the written final examination.

Students also have access to the reference library at the affiliate institution. This library provides students access to journals and medical-related books.

Through the University of Delaware, students have online access to DELCAT – UD's library online catalog https://library.udel.edu/.

DRESS CODE

All University of Delaware Medical Laboratory Science majors assume responsibility for their own attire while in the clinical setting. Each site has established guidelines for employee/students. In addition to abiding by the guidelines of the site at which the rotation occurs, each student must adhere to the following minimum guidelines of the University of Delaware Medical Laboratory Science Program described below.

- Navy medical scrub uniforms are required. Clothing must be neatly pressed and colors must match. Hose or socks are required when wearing pants. White shoes are recommended; flat shoes are required. Cloth or open-toed shoes, jeans, t-shirts and sweatshirts are not acceptable.

- A clean, pressed white labcoat is required unless otherwise specified by the clinical site. A University of Delaware pin with your name, denoting status as a University of Delaware student, must be worn at all times while at the clinical affiliate sites.

- Hair styles which extend below the shoulder must be tied back.

- For safety reasons, most jewelry is limited. Small post earrings that do not extend below the ears are acceptable, long necklaces or dangling bracelets are not. Facial, ear cartilage and tongue piercings must be removed while at the affiliate institution. Tattoos that are visible must be covered.

- The various clinical sites may have additional dress code requirements. The student must adhere to any additional requirements at that site.

- Safety glasses must be worn at all times while in the clinical laboratory.
- Each student is expected to present a professional appearance and attitude at all times. NO EXCEPTIONS!!

ACADEMIC HONESTY

Honesty is essential in the profession of Medical Laboratory Science. You are encouraged to become familiar with the UD Student Guide to University Policies <http://www.udel.edu/stuguide/current>. The content of the handbook applies to this course. If you have any questions about this policy please consult with the instructor.

ACADEMIC SERVICES

The University of Delaware offers a variety of academic services for students. These services include coordinating tutoring sessions, providing academic skills workshops, and providing assistance for students with ADHD and learning disabilities. Students are encouraged to contact the Academic Enrichment Center at 831-2805 or <http://www.aec.udel.edu> to take advantage of these services.

AFFECTIVE OBJECTIVES

The following objectives have been listed as general affective objectives, since they apply to the overall performance and participation by the student during clinical rotations at the affiliate institutions. Among other qualities, the student is expected to demonstrate dependability, organizational skills, time efficiency and the ability to work with others in accordance with a professional program of study. As a member of the health care team, it is expected that the student will maintain an appropriate professional demeanor at all times.

During the clinical rotations and upon completion of the program of study in Medical Laboratory Science, the student will:

1. Comply with the established dress code policy as outlined in the clinical practicum manual.
2. Report to the laboratory at the scheduled time.
3. Notify the Clinical Coordinator and the University Education Coordinator when unable to report to the clinical practicum.
4. Comply with the attendance policy as outlined in the clinical practicum manual.
5. Comply with instructions given either orally or written.
6. Demonstrate the ability to ask pertinent questions or for assistance if needed.
7. Demonstrate the ability to work independently within student guidelines.
8. Communicate courteously, effectively and professionally with instructors, laboratory staff, other health care personnel, patients and visitors.
9. Demonstrate interest and enthusiasm for the clinical laboratory science profession.
10. Accept evaluation of performance as constructive when offered by instructors and other laboratory personnel, and follow through with suggestions made.
11. Adhere to laboratory safety regulations in each clinical area.
12. Maintain a clean, organized work area.
13. Utilize reagents and supplies judiciously.
14. Replenish supplies required in the laboratory work area.
15. Demonstrate self-confidence in the operation of equipment and in the performance of laboratory procedures.
16. Report patient laboratory results only to authorized personnel.
17. Maintain the confidentiality of all privileged information.
18. Cooperate with other laboratory personnel to create a pleasant and efficient work environment.
19. Demonstrate the ability to concentrate on the laboratory test procedure being performed and the need to avoid distractions.
20. Demonstrate organizational skills through ability to coordinate the quantity of work needed to be done with the time available for its completion.
21. Practice acceptable quality assurance as established for each clinical area.
22. Defend the policy of running quality control samples according to laboratory protocol.
23. Coordinate theory with laboratory analysis to appropriately judge patient data.
24. Offer assistance to other laboratory personnel when scheduled assignment is complete.
25. Recognize technical problems and plan possible corrective action.
26. Maintain composure and work quality under stressful conditions.
27. Demonstrate concern for professional self-image and that of the medical laboratory science profession by practicing ethical behavior, participating in professional activities and attending professional seminars to maintain knowledge base.

COURSE OBJECTIVES RELATED TO SPECIFIC CONTENT AREAS

Upon the completion of this course, based upon the objectives detailed in this document, the student must achieve a final minimum average of 70% on the assessment tools utilized in this course.

*Psychomotor performance in these areas is considered an enhancement or an elective to the basic clinical practicum educational experience. However, students are responsible for the corresponding theoretical content.

I. PROFESSIONALISM

Introduction
The student is expected to conduct himself/herself in a professional manner at all times. The ability to communicate in a respectful manner under all circumstances is an expectation of a professional. The student must remember that all patient information is privileged and as such strict confidentially must be maintained. The student should realize that in some ways his/her education is just beginning, and to remain current during the work years ahead, it is important to participate in continuing education activities on a routine basis. If continuing education activities are available at the affiliate institution during the practicum, it is expected that the student will avail himself/herself of the opportunity. Professional performance is guided by the affective objectives previously listed, and professional behavior is evaluated using the form located at the end of this syllabus.

Objectives
Upon successful completion of the clinical practicum, studying assigned materials, and reviewing materials associated with the course objectives from MEDT 375, 401/411, 403/413, and 461/471, the student will:

1. Communicate effectively and professionally as a member of the healthcare team to enable consultative and educational interactions with other healthcare personnel, the public, and patients to the satisfaction of the instructor.
2. Demonstrate ethical behavior and professionalism to the satisfaction of the instructor.
3. Maintain confidentiality of patient information to the satisfaction of the instructor.
4. Participate in continuing education as opportunities arise for one's own professional career development to the satisfaction of the instructor.

Note: Review affective objectives and affective evaluation form.

II. SPECIMEN MANAGEMENT/SAFETY

Introduction
Thorough knowledge of safety procedures is essential before performing any duties in the clinical laboratory which might be hazardous to personnel. The chemistry department is responsible for monitoring departmental criteria for specimen acceptance, processing of various testing, evaluating and reporting laboratory results. These pre-analytical, analytical, and post-analytical factors are essential for quality assessment in the laboratory. In the chemistry department, a considerable amount of effort is placed on specimen handling and collection, since the final results for any analyte are dependent on these two factors. The following precautions or conditions are essential for quality specimens:

- correct identification of patient
- correct labeling of specimen
- correct identification of the state of the patient – fasting, nonfasting, etc.
- correct time for specimen collection – drug levels, hormones, etc.
- correct specimen type – anticoagulants, preservatives
- correct identification of special handling – ice, prechilled tubes, spin immediately, etc.
- correct storage conditions

Prerequisite
The student will familiarize herself/himself with the overall management of the Chemistry Department.

Objectives
Upon successful completion of the clinical practicum, studying assigned materials, and reviewing materials associated with the course objectives from MEDT 375, 401/411, and 403/413, the student will:

1. Discuss the specimen management system used by the chemistry laboratory.
2. Distribute specimens to workstations appropriately to the satisfaction of the instructor.
3. State the tests performed at each station or instrument in the chemistry laboratory (e.g., Automated Chemistry Instruments, Manual Methods, Special Chemistry, TDM, etc.).
4. Evaluate correctly specimens for acceptance or rejection using laboratory guidelines.
5. Document correctly specimen rejection according to laboratory guidelines.
6. Report correctly all test results according to laboratory protocol.
7. Call test results according to laboratory protocol to the satisfaction of the instructor.
8. Maintain correctly patient records according to laboratory protocol.
9. File correctly patient records according to laboratory protocol.
10. Utilize correctly safe techniques in handling and disposal of infectious materials according to laboratory protocol.
11. Comply with established safety regulations and regulations governing regulatory compliance related to laboratory practice to the satisfaction of the instructor.

III. QUALITY CONTROL / QUALITY ASSESSMENT / TOTAL QUALITY MANAGEMENT

Introduction
Quality is of utmost importance in every laboratory. Today's laboratories have a variety of programs in place to control, assess, and improve their quality.

Prerequisite
The student should read the department's quality control (QC), quality assessment (QA), total quality management (TQM) and/or continuous quality improvement (CQI) policies.

Objectives

Upon successful completion of the clinical practicum, studying assigned materials, and reviewing materials associated with the course objectives from MEDT 375, 401/411, and 403/413, the student will:

1. Compare and contrast quality control, quality assessment, and total quality management.
2. Evaluate correctly laboratory QC data according to laboratory protocol.
3. Demonstrate the ability to identify appropriate corrective action when data falls out of control range to the satisfaction of the instructor.
4. Discuss how QC is monitored and recorded for each procedure in the chemistry laboratory.
5. Record correctly QC data according to laboratory guidelines.
6. Identify QC shifts and trends when given laboratory data to analyze, suggesting corrective action.
7. Discuss the need for departmental quality assessment and/or total quality management programs.
8. Explain the purpose of proficiency testing.
9. Discuss the impact of total quality management on laboratory operations, including relevance to the pre-analytical, analytical, and post-analytical stages of the testing process.
10. Apply correctly principles of total quality management on laboratory operations, including relevance to the pre-analytical, analytical, and post-analytical stages of the testing process.
11. Discuss the role of the medical laboratory scientist in maintaining laboratory quality.

IV. AUTOMATED CHEMISTRY

Introduction
Automated chemistry analyzers are the workhorse of the chemistry laboratory. While instruments vary by manufacturer and type, the following basic objectives remain the same for each analyzer.

Prerequisites
The student should review the Automated Chemistry Analyzer Instrument Manuals for those instruments that will be employed during the practicum period.

Objectives
Upon successful completion of the clinical practicum, studying assigned materials, and reviewing materials associated with the course objectives from MEDT 375, 401/411, and 403/413, the student will:

1. Examine correctly specimen acceptability for analysis based on proper labeling, specimen characteristics (e.g., serum, plasma, hemolysis, lipemia, etc.), sufficiency of volume, and appropriateness of storage method.
2. Identify different types of analyzers, i.e., batch, random access, etc.
3. Identify the basic operating components of the analyzer(s).
4. Explain the function of each component of the analyzer(s).
5. Describe the chemical principles for each test performed on the analyzer(s).
6. List the assays that utilize immunologic techniques.
7. Identify the analytes that utilize immunologic techniques
8. Perform correctly routine daily maintenance on the analyzer(s) according to the manufacturer's directions.
9. Identify correctly periodic (weekly, monthly, etc.) maintenance requirements according to the manufacturer's directions.
10. Prepare correctly reagents for use on the analyzer(s) according to the manufacturer's directions.
11. State how reagents are stored when not in use on the analyzer.
12. Operate the automated chemistry analyzer(s) to quantify controls and specimens according to the manufacturer's directions to the satisfaction of the instructor.
13. Record correctly quality control data according to laboratory protocol.
14. Evaluate correctly quality control data according to laboratory protocol.
15. State the calibration schedule (frequency) for calibrating the analyzer(s).
16. Describe the procedure(s) for calibration of the automated analyzer(s).
17. Perform correctly calibration(s) as required according to the manufacturer's directions.
18. Explain where to find basic troubleshooting information about the analyzer.
19. Participate in troubleshooting the analyzer as appropriate to the satisfaction of the instructor.
20. Apply appropriate problem solving steps for determining instrument/methodology problems, utilizing instrument manuals, laboratory procedure manuals, and information contained in package inserts to the satisfaction of the instructor.

21. Justify the importance of documenting maintenance, quality control, and troubleshooting.
22. Correlate correctly patient results with clinical significance (e.g., impact on diagnosis or treatment of associated disease) and clinical decision making.
23. Assess critical pathways to facilitate diagnosis and to determine additional testing as warranted to the satisfaction of the instructor.
24. Evaluate inaccurate analyzer results to the satisfaction of the instructor.
25. Report correctly all test results according to laboratory protocol.
26. Calculate new reference ranges when needed according to manufacturer protocol.

V. ARTERIAL BLOOD GASES*

Introduction
Arterial blood gases are used to assess acid-base balance and blood oxygen levels. The parameters generally measured are pH, PCO_2, and PO_2. Depending upon the protocol established by a particular hospital, these analyses may be performed either by the laboratory or the respiratory therapy department.

Prerequisites
The student should:
1. Read the Instrument Manual for the Blood-Gas Analyzer.
2. Review acid-base balance.

Objectives
Upon successful completion of the clinical practicum, studying assigned materials, and reviewing materials associated with the course objectives from MEDT 375, 401/411, and 403/413, the student will:

1. Examine correctly specimen acceptability for analysis based on proper labeling, specimen characteristics (e.g., anticoagulant, etc.), sufficiency of volume, and appropriateness of transport/handling method.
2. Operate correctly the blood-gas analyzer according to the manufacturer's directions.
    - Perform correctly instrument calibration.
    - Assay correctly controls and specimens.
3. Evaluate correctly quality control results according to laboratory protocol.
4. Record correctly the gas calibration values, quality control values, patient results and maintenance for each operation according to laboratory protocol.
5. Describe the procedure for changing electrodes.
6. Explain the one and two point calibration procedures.
7. Explain the function of the buffers and flush solutions.
8. Explain the principles of operation for the PO_2, PCO_2, and pH electrodes.
9. Compare and contrast the following acid-base/blood-gas imbalances:
    - Metabolic acidosis
    - Metabolic alkalosis
    - Respiratory acidosis
    - Respiratory alkalosis
10. Correlate patient results with the clinical significance of test noting any abnormal result.
11. Maintain correctly patient records according to established laboratory protocol.

VI. IONTOPHORESIS*

Introduction
The technique of iontophoresis aids in the diagnosis of cystic fibrosis. After the iontophoretic procedure, the chloride concentration of the sweat is measured using an acceptable method. One clinical feature of cystic fibrosis individuals is an increased chloride concentration in the sweat.

Prerequisites
The student should read the Instrument Manual for the Iontophoresis system.

Objectives
Upon successful completion of the clinical practicum, studying assigned materials, and reviewing materials associated with the course objectives from MEDT 375, 401/411, and 403/413, the student will:

1. Explain the principles of iontophoresis and coulometry.
2. Weigh correctly pre- and post-sweat test vials on the analytical balance.
3. Perform correctly iontophoresis following established laboratory protocol. (Under no circumstances should the student perform analysis without the guidance of an instructor and adherence to established protocol as explained in procedure manual.)
4. Perform correctly chloride analysis on obtained sweat according to laboratory protocol.
5. Calculate correctly the chloride level in obtained sweat.
6. Correlate chloride levels in sweat with clinical significance of testing procedure.
7. List possible sources of chloride contamination in the collection and in analysis of the sweat.
8. Describe the effects of incorrect specimen collection/handling on test results.
9. Explain the significance of sweat testing in children and adults.
10. Explain the diagnostic value of the following laboratory tests and clinical features in relation to cystic fibrosis:
    - d-Xylose absorption
    - Patient history
    - Physical symptoms

VII. OSMOMETRY

Introduction
Osmolality is a measure of the total number of dissolved particles in solution and is independent of the molecular weight of the particles. Osmolality measurements are made in the clinical laboratory using either a freezing-point depression or vapor-pressure osmometer.

Prerequisite
The student should read the Instrument Manual for the Osmometer.

Objectives
Upon successful completion of the clinical practicum, studying assigned materials, and reviewing materials associated with the course objectives from MEDT 375, 401/411, and 403/413, the student will:

1. Examine correctly specimen acceptability for analysis based on proper labeling, specimen characteristics (e.g., urine, serum, plasma, etc.), sufficiency of volume, and appropriateness of storage method.
2. Explain the principles of osmometry and osmolality measurement by freezing-point depression or vapor pressure.
3. Operate correctly the osmometer according to the manufacturer's directions.
    - Perform correctly instrument calibration.
    - Assay correctly controls and specimens.
4. Evaluate correctly quality control results according to laboratory protocol.
5. Correlate patient results with clinical significance of test.
6. Report correctly osmolality test results according to laboratory protocol.
7. Perform correctly required maintenance according to the manufacturer's directions.
8. Record correctly patient results, quality control and maintenance according to laboratory protocol.
9. List the major serum osmotic constituents that affect osmolality.
10. Calculate correctly the serum osmolality from the measured concentrations of osmotic constituents using a recommended formula.
11. List the significance of the Urine/Serum osmolality ratio as an important tool in evaluating H_2O balance and renal function.
12. Explain the relationship between urine specific gravity and osmolality as an indication of renal concentration ability and how they might be used to establish criteria for hemodialysis.

VIII. PROTEINS AND ELECTROPHORESIS*

Introduction
Proteins are composed of amino acids linked by peptide bonds in a sequence and configuration characteristic for each specific protein. There are over one hundred proteins present in plasma serving numerous physiological functions. The ability to vary the charge on a protein molecule by changing the pH of its matrix can be used to purify and characterize proteins by electrophoresis and ion exchange chromatography.

Electrophoresis is the movement of charged particles through an electrical field. In order for electrophoresis to occur, there must be an electrical field, a medium for absorbing and holding the analyte and charged particles. The electrical field is supplied by providing a tank through which current may pass. The charged particles are supplied by using an appropriate buffer for ionizing the molecule. After migration, the proteins are stained, and protein bands are identified and quantified. Electrophoresis is useful as a diagnostic technique for the separation of proteins in serum, urine and CSF, for the separation of hemoglobins, and for the separation of serum isoenzymes.

Prerequisites
The student should read the Instrumentation Manual for the Electrophoresis system.

Objectives
Upon successful completion of the clinical practicum, studying assigned materials, and reviewing materials associated with the course objectives from MEDT 375, 401/411, and 403/413, the student will:

1. Examine correctly specimen acceptability for analysis based on proper labeling, specimen characteristics (e.g., serum, plasma, whole blood, hemolysis, etc.), sufficiency of volume, and appropriateness of storage method.
2. Explain the basic principle of electrophoresis.
3. Describe factors influencing the mobility and resolution of proteins.
4. Perform correctly the following procedures according to the manufacturer's directions:
    - Serum and urine protein electrophoresis
    - Hemoglobin electrophoresis
5. Explain the principles for the specific electrophoretic tests in objective 4.
6. Use correctly sample concentrators for electrophoresis specimen preparation.
7. Describe the principle of operation of the sample concentrators.
8. Identify the protein fractions visualized on cellulose acetate/agarose electrophoresis for:
    - Serum and urine protein
    - Hemoglobin
9. Interpret protein electrophoresis data in relation to pathological conditions.
10. Perform correctly quality control checks on the densitometer according to laboratory protocol.
11. Record correctly quality control checks on the densitometer according to laboratory protocol.
12. Operate correctly the densitometer according to manufacturer's directions.
13. Prepare correctly patient report forms according to laboratory protocol.
14. Record correctly patient results according to laboratory protocol.
15. Perform troubleshooting when necessary according to the manufacturer's directions to the satisfaction of the instructor.
16. Discuss the following conditions in relation to structural changes in the hemoglobin molecule:
    - Thalassemia
    - Sickle Cell Disease
    - Sickle/Thalassemia
    - Lepore
17. Evaluate the percent of hemoglobins A_1, S, A_2 and F of the total hemoglobin as they relate to the conditions listed in objective 16.
18. Discuss the quantitative methods for differentiating and determining hemoglobins A_2, S and C.
19. List a confirmatory test for Hgb C.
20. Explain the structures of the following hemoglobins:
    - A_1
    - A_2
    - S
    - F

IX. THERAPEUTIC DRUG MONITORING AND DRUGS OF ABUSE

Introduction
Therapeutic drug monitoring (TDM) is a process by which the quantity of a drug is determined to assist the physician in determining whether a drug dosage should be maintained or altered. Methods used to quantify drugs include sophisticated instrumentation that is capable of performing such assays as Enzyme Immunoassay (EIA), Fluorescence Polarization Immunoassay (FPIA), etc.

Prerequisite
The student should review the Instrument Manual for the Therapeutic Drug Monitoring Analyzer.

Objectives
Upon successful completion of the clinical practicum, studying assigned materials, and reviewing materials associated with the course objectives from MEDT 375, 401/411, and 403/413, the student will:

1. Examine correctly specimen acceptability for analysis based on proper labeling, time of collection, specimen characteristics (e.g., serum, plasma, hemolysis, lipemia, etc.), sufficiency of volume, and appropriateness of storage method.
2. Explain the significance of the following selected classes of therapeutic drugs:
    - Cardioactive
    - Antiepileptic
    - Bronchodilator
    - Antibiotic
    - Antipsychotic
    - Antineoplastic
3. For each class of drugs noted in objective 2, list the generic name of drugs that are commonly ordered.
4. Explain the significance of performing therapeutic drug monitoring.
5. Define the following terminology:
    - Therapeutic level
    - Toxic level
    - Steady-state, peak, and trough concentrations
    - Half-life
6. Discuss the significance of peak and trough levels in therapeutic drug monitoring.
7. Differentiate between half-life and steady-state.
8. Explain the principle of enzyme immunoassay.
9. Explain the principle of fluorescence polarization immunoassay.
10. Perform correctly TDM and drugs of abuse assays employing proper analytical techniques according to the manufacturer's directions.
11. Perform correctly all functions related to automated analyzers as stated in the "Automated Chemistry" objectives, including but not limited to daily maintenance, calibration, operation, QC, etc.
12. Assess correctly drug test results for therapeutic management.
13. Discuss the applications of urine drug screens and the importance of confirming positive drug screens.
14. List the type of analytical systems that may be employed for confirmation purposes.
15. Explain the principle of the confirmatory analytical systems.
16. Classify the most common drugs of abuse into the following categories noting the drug groups and the generic names: depressant (sedative-hypnotic), depressant (tranquilizer), narcotic, hallucinogen, stimulant, analgesic, and antidepressant.
17. Identify correctly abnormal and/or erroneous results according to laboratory protocol.
18. Troubleshoot correctly erroneous drug results according to laboratory protocol.
19. Correlate patient results with clinical significance (e.g., impact on treatment of associated disease or impact on drug abuse assessment) and clinical decision making.

20. Assess critical pathways to facilitate diagnosis and to determine additional testing as warranted to the satisfaction of the instructor.
21. Report correctly all drug results according to laboratory protocol.
22. Record correctly patient drug results, quality control and maintenance according to laboratory protocol.

X. URINE AND OTHER BODY FLUID CHEMISTRIES

Introduction
This section deals with urine chemistries and those body fluid chemistries that require manual manipulation or testing.

Objectives
Upon successful completion of the clinical practicum, studying assigned materials, and reviewing materials associated with the course objectives from MEDT 375, 401/411, and 403/413, the student will:

1. Prepare correctly 24-hour urine containers according to laboratory protocol.
2. Explain correctly 24-hour urine collection procedures to patients according to laboratory protocol.
3. Perform correctly the 24-hour urine collection assay according to laboratory protocol.
4. Calculate correctly 24-hour urine results according to laboratory protocol for:
    - Protein
    - Creatinine
    - Creatinine clearance
    - Electrolytes
    - Calcium
    - Phosphorus
    - Urea
5. Perform correctly the 2-hour urine amylase assay according to laboratory protocol.
6. Calculate correctly a 2-hour urine amylase result according to laboratory protocol.
7. Calculate correctly the microalbumin-to-creatinine ratio after performing the urine albumin and creatinine assays according to laboratory protocol.
8. Interpret the microalbumin-to-creatinine ratio correctly for being normal or pathological.
9. Discuss procedures to evaluate other body fluids (CSF, pleural, amniotic, etc.).
10. Perform correctly chemical testing (protein, glucose, etc.) on such body fluids as CSF, pleural, etc. according to laboratory protocol.
11. Perform correctly urine and serum pregnancy tests according to laboratory protocol.
12. Correlate patient results with clinical significance.
13. Report correctly all test results according to laboratory protocol.
14. Record correctly patient results and quality control according to laboratory protocol.

XI. GLYCATED HEMOGLOBIN

Introduction
Glycated hemoglobins, Hb A_{1a}, Hb A_{1b}, and Hb A_{1c}, are modifications of Hb A and are formed by the condensation between glucose and the *N*-terminal valine amino acid of each beta-chain. The level of glycated hemoglobin depends on the time-averaged glucose concentration during the preceding 6 to 8 weeks before measurement.

Objectives
Upon successful completion of the clinical practicum, studying assigned materials, and reviewing materials associated with the course objectives from MEDT 375, 401/411, and 403/413, the student will:

1. Examine correctly specimen acceptability for analysis based on proper labeling, specimen characteristics, sufficiency of volume, and appropriateness of storage method.
2. Explain the principle of the glycated hemoglobin method.
3. Describe why glycated hemoglobin is a better indicator than a random or a fasting blood glucose for evaluating long-term glucose control.

4. Perform correctly the glycated hemoglobin assay using specimens, controls and standards according to laboratory protocol.
5. Evaluate correctly quality control results according to laboratory protocol.
6. Correlate patient results with clinical significance.
7. Record correctly patient results and quality control according to laboratory protocol.
8. Report correctly all test results according to laboratory protocol.

ASSESSMENT TOOLS

See below for:
Clinical Practicum Student Affective Evaluation Grading Scale
Clinical Practicum Practical Evaluation Instructions
Clinical Practicum Practical Evaluation Grading Rubric
Clinical Practicum Student Evaluation

Clinical Practicum Student Affective Evaluation Grading Scale:

Instructions: For items #1 through #15: Rate on 1 - 5 point scale below. Record rating in the column provided.

Space is provided with each evaluation item for narrative appraisal. Any unsatisfactory evaluation **must** be documented. Please indicate strong points exhibited. **The completed evaluation form must be discussed with the student at mid-point and end of the clinical practicum.**

Performance Level	Rating Value	Performance Indicators
Outstanding	5	Contribution **far exceeds** what is normally expected of a student. Personal commitment to a high level of performance and professionalism is clear.
Exceeds Expectations	4	Seizes initiative in development and implementation of challenging projects. Accomplishments **exceed** requirements. Requires minimal direction
Fully Satisfactory	**3**	**Performance is what is expected in senior clinical practicum. Does not require significant improvement. Errors are minimal and seldom repeated. Requires only normal supervision and follow-up.**
Less Than Satisfactory	2	Performance generally does not meet minimum requirements for senior clinical practicum. Errors are significant and frequently repeated. Requires close surveillance and guidance.
Unacceptable Performance	1	Has had sufficient exposure to have shown better performance. Does not grasp basic concepts no matter how many times they have been explained. Does not demonstrate commitment to this aspect of professional development.

Practical Evaluation Instructions **Student:** _____

Eval by: _____ **Date:** _____

Clinical Chemistry Instrumentation Practical

Clinical Instructors – please describe chemistry instrumentation practical below; feel free to make additional copies if practicals administered on multiple analyzers.

INSTRUMENT _____

As detailed in the practical evaluation rubric, perform the following functions:

1. Perform daily maintenance procedures according to protocol.
2. Calibrate instrument as needed or required.
3. Run controls as needed or required and evaluate their acceptability before running patient samples.
4. Run patient samples.
5. Interpret patient results.
6. Conditions - The following conditions apply to this practical (all that are marked with a √):

____ Time limit = _____

____ Use of Instrument Operating Manuals is permitted

____ Use of course manuals is permitted

____ Other: Please describe _____

_____

_____

_____

Clinical Urinalysis Practical Evaluation Grading **Student:** _____

Eval by: _____ **Date:** _____

	TOTAL POINTS POSSIBLE:	TOTAL POINTS EARNED:	COMMENTS:
Instrument startup completed accurately and efficiently, all necessary documentation recorded accurately and legibly	10		
Reagents and supplies utilized efficiently, no unnecessary waste of materials	5		
Temperatures of reagent refrigerators, incubators, etc. documented accurately and legibly	5		
Calibrations performed as needed, accurately evaluated, and documentation recorded accurately and legibly	15		
Appropriate QC processed, accurately evaluated, and documentation recorded accurately and legibly on instrument or LIS	15		
Troubleshooting error messages, delta checks, or other instrument “needs” as applicable	5		
Unknown samples processed and accurately evaluated and reported	25		
Critical results noted and reported appropriately, all necessary documentation recorded accurately and legibly	15		
If applicable, verify calculations	5		
Other			
TOTALS:			
PRACTICAL GRADE:			

UNIVERSITY OF DELAWARE

DEPARTMENT OF MEDICAL LABORATORY SCIENCES

MEDT473 CLINICAL LABORATORY PRACTICUM - STUDENT EVALUATION

Student's Name: _____

Affiliate Site: _____

Discipline: **CHEMISTRY**

Signature of Evaluator(s): _____

Date of Mid Evaluation: _____
(due at the end of the first two weeks of the clinical practicum period)

Date of Final Evaluation: _____
(due at the completion of the clinical practicum period, please mail completed evaluation to UD coordinator)

Affective Evaluation

5 = Outstanding *Far exceeds expectations*
4 = Exceeds expectations *Seizes initiative*
3 = Fully satisfactory *Meets expectations*
2 = Below expectations *No self-motivation*
1 = Unacceptable performance *No commitment*

Please circle score below and add comments for all scores below/above "3":

1. Dress Code: (Obj. #1) Complies with the established dress code policy as outlined in the clinical practicum guidelines; gives evidence of good grooming.

	MID					FINAL			
5	**4**	**3**	**2**	**1**	**5**	**4**	**3**	**2**	**1**

Comments: _____

2. Punctuality & Attendance: (Obj. #2, 3, 4) Arrives in the laboratory with adequate time to start as scheduled. Returns from breaks as scheduled. Complies with attendance policy; notifies appropriate personnel at affiliate and University in a timely fashion.

	MID					FINAL			
5	**4**	**3**	**2**	**1**	**5**	**4**	**3**	**2**	**1**

Comments: _____

3. Safety: (Obj. #11) Adheres to laboratory safety regulations; works in an orderly and safe manner.

	MID					FINAL			
5	**4**	**3**	**2**	**1**	**5**	**4**	**3**	**2**	**1**

Comments: _____

4. Attention: (Obj. #5, 6, 19) Follows both verbal and written instructions. Asks pertinent questions when necessary. Neither distracts others nor allows distractions to affect the completion of assignment.

	MID					FINAL			
5	**4**	**3**	**2**	**1**	**5**	**4**	**3**	**2**	**1**

Comments: _____

5. Independence: (Obj. #7) Demonstrates the ability to work independently within student guidelines. Student draws on previously gained knowledge to solve problems. Student seeks activities to expand knowledge, ability and performance.

	MID					FINAL			
5	**4**	**3**	**2**	**1**	**5**	**4**	**3**	**2**	**1**

Comments: _____

6. Interpersonal Skills: (Obj. #8, 18) Communicates in a professional, tactful manner with instructors, staff, other health care personnel, patients and visitors. Consistently shows common courtesy and contributes toward achieving an environment conducive to work and learning for self and others.

	MID					FINAL			
5	**4**	**3**	**2**	**1**	**5**	**4**	**3**	**2**	**1**

Comments: _____

7. Self-Confidence: (Obj. #15) Demonstrates self confidence in the operation of instrumentation and in the performance of laboratory procedures.

		MID						FINAL		
5	4	3	2	1		5	4	3	2	1

Comments: _____

8. Organization: (Obj. #20) Demonstrates organizational skills through ability to coordinate the quantity of work needed to be done with the time available for its completion. Able to perform multiple tasks without jeopardizing accuracy and precision.

		MID						FINAL		
5	4	3	2	1		5	4	3	2	1

Comments: _____

9. Management & Economy: (Obj. #12, 13, 14) Conserves reagents and supplies; replenishes supplies required in the laboratory work area.

		MID						FINAL		
5	4	3	2	1		5	4	3	2	1

Comments: _____

10. Composure: (Obj. #10, 26) Maintains composure and work quality under stressful conditions and adapts quickly to new situations. Accepts evaluation of performance as constructive and follows through with suggestions made.

		MID						FINAL		
5	4	3	2	1		5	4	3	2	1

Comments: _____

11. Initiative: (Obj. #24) Offers assistance to other laboratory personnel when scheduled assignment is complete. Identifies tasks in the lab that need to be done and does them without being asked.

		MID						FINAL		
5	4	3	2	1		5	4	3	2	1

Comments: _____

12. Enthusiasm: (Obj. #9) Shows interest and enthusiasm in clinical laboratory work and the medical laboratory science profession.

		MID						FINAL		
5	4	3	2	1		5	4	3	2	1

Comments: _____

13. Professionalism and Integrity: (Obj. #16, 17, 27) Accepts accountability for work performed. Readily admits errors, follows procedures as written, and maintains patient confidentiality. Attends continuing education sessions when given the opportunity.

		MID						FINAL		
5	4	3	2	1		5	4	3	2	1

Comments: _____

14. Decision Making & Problem Solving: (Obj. #23, 25) Demonstrates the ability to solve problems and seeks corrective action. Coordinates theory with lab analysis as it applies patient data.

		MID						FINAL		
5	4	3	2	1		5	4	3	2	1

Comments: _____

15. Quality Assurance: (Obj. #21, 22) Practices acceptable quality assurance as established in specific clinical area. Runs quality control samples according to laboratory protocol. Demonstrates the importance of proper recordkeeping.

		MID						FINAL		
5	4	3	2	1		5	4	3	2	1

Comments: _____

FINAL CLINICAL PRACTICUM GRADE REPORT

Please provide scores and a description for the written assessments and practical below – the UD Clinical Education Coordinator will calculate the final grade based upon these scores and the affective score. Thank you.

Written Assessment(s) – please include brief description below	**QUIZ grades**	**TEST grades**	**PROJECT grades**
Practical – please include brief description of practical below	**Practical Score achieved _____**		

Description of Written Assessment Tools and Practical:

Additional Instructor Comments: _____

_____

_____

Mid Evaluation

Signature of student _____ **Date** _____

Final Evaluation

Signature of student _____ **Date** _____

Student Comments: _____

_____

STOP – Grade will be calculated by the UD Education Coordinator. Thank you ☺

Student Affective Evaluation 20%

Average Points: $\frac{\text{total points}}{15}$ = ___ =

Look up grade below: _____X 20% = _____

Example: 52/15 = 3.47 = B- (**80** x 20%) = **16**

Average points = grade:	Average points = grade:
5.00 – 4.50 = A = 95	**2.49 – 2.00 = C- = 70**
4.49 – 4.00 = A- = 90	**1.99 – 1.50 = D = 65**
3.99 – 3.50 = B = 85	**1.49 – 1.00 = D- = 60**
3.49 – 3.00 = B- = 80	**<1.00 = F = 55**
3.00 – 2.50 = C = 75	

Written Assessment Ave. Score ____ X .40 = _____

Practical Score ____ X .40 = _____

Affective Score ____ X .20 = _____

Grade for Practicum = _____

PASS or FAIL

UD end-of-rotation exam grade _____