El Paso Community College
Syllabus
Part II
Official Course Description

SUBJECT AREA	**Medical Laboratory Technology**
COURSE RUBRIC AND NUMBER	**MLAB 2401**
COURSE TITLE	**Clinical Chemistry**
COURSE CREDIT HOURS	**4 3 : 4**
	Credits Lec Lab

I. Catalog Description

An introduction to the principles, procedures, physiological basis, and significance of testing performed in clinical chemistry. Includes quality control, reference values, and lab safety. A grade of "C" or better is required in this course to take the next course. **Corequisite: MLAB 2360. (3:4). Lab fee.**

II. Course Objectives

A. Unit I. Lab Operations and Laboratory Safety

Upon satisfactory completion of this unit, the student will be able to:

1. Identify regulations and regulatory agencies governing the clinical laboratory.
2. Discuss legal and ethical concerns pertaining to Patient Informed Consent, Standard of Care, and HIPAA regulations.
3. Explain the importance of actively participating in Quality Assurance, Quality Control and Proficiency Testing protocols incorporating precision, accuracy, Levey Jennings Charts and Westgard Rules.
4. Locate and make use of MSDS (Material Safety Data Sheets)
5. Locate and make use of a lab facility's SOP (Standard Operating Procedures manual).
6. Discuss how OSHA affects safety, health, and compliance policies in the workplace.
7. Demonstrate compliance with government, state, and organizational safety regulations involving Biological, Chemical, Fire, Electrical, Physical and Radioactive Hazards.
8. Discuss nosocomial infections and identify the potential routes of infection and methods for preventing transmission of microorganisms through these routes.
9. Explain the proper techniques for hand washing, gowning, gloving, and masking.
10. Compare and contrast the different blood collection biohazard containers used to dispose of contaminated materials.
11. Differentiate waived, moderate, and high complexity testing.
12. Explain what is mean by CLIA 1988.
13. Discuss pre-analytical, analytical and post analytical variables, accuracy, precision, reproducibility, specificity, and sensitivity with possible effects on chemistry test results.
14. Calculate mean, standard deviation and coefficient of variation.
15. Discuss the acceptance or rejection criteria based on QC rules, including modified Westgard QC rules.
16. Describe the typical specimen collection, transport, and storage requirements for routine clinical chemistry testing to include glucose,electrolytes, enzymes, light and temperature sensitive chemistry tests.
17. Explain the use of a spectrophotometer for chemistry tests, and it how it relates to Beer's Law.
18. List the different types of body fluids that can be analyzed in the chemistry department to include:
    a. Urine
    b. Aminotic fluid

c. CSF
d. Peritoneal fluid
e. Pleural fluid
f. Synovial fluid
g. Serum and plasma

B. Unit II. Carbohydrate Disorders

Upon satisfactory completion of this unit, the student will be able to:

1. Describe the principles of glucose, ketone, and glycated hemoglobin analyses, including commonly encountered sources of analytical interferences and/or blood collection errors.
2. Discuss common diseases associated with carbohydrate metabolism.
3. Analyze the classification, diagnosis, and assessment of diabetes type I and type II based on American Diabetes Association guidelines including FBS, random glucose, Oral glucose tolerance test, 2-hr postprandial blood glucose, Glucose Challenge, and glycosylated hemoglobin.
4. Discuss the stability of specimens when collected as serum specimens versus plasma specimens collected with antiglycolytic additives.
5. Discuss insulin with respect to its site of production and its function.
6. Describe the effect of fat metabolism in diabetes on the following: diabetic acidosis, hypercholesterolemia, arteriosclerosis, kidney disease.
7. Evaluate glucose and ketone results and expected findings and correlate with disease processes.
8. Compare results of carbohydrate and ketone testing with expected and previous findings and correlate results with pathology.
9. Suggest appropriate course of action that is needed when encountering common sources of discrepancies in patient test results.
10. Correlate the blood glucose levels with CSF glucose levels and relate them with disease processes.

C. Unit III. Hemoglobin Production Disorders

Upon satisfactory completion of this unit, the student will be able to:

1. List three (3) physiologic function of iron in the body.
2. Discuss the common methods of analysis, endpoint detection, specimen collection and handling requirements, and sources of error for Iron, TIBC, whole blood lead, and glycated hemoglobin
3. Evaluate serum iron, TIBC, transferrin, and % saturation results compared to reference ranges and correlate with iron-deficiency anemia, anemia of chronic diseases, and hemosiderosis.
4. Describe the effect of lead in heme syntheses.
5. Evaluate whole blood lead level and possible sources of toxicity.
6. Describe the enzyme defects in acute intermittent prophyria and hereditary coproporphyria.
7. Describe the principle, specimen collection and handling requirements, and interferences in the Watson-Swartz test and the prophyrin tests.

D. Unit IV. Renal Function Assessment

Upon satisfactory completion of this unit, the student will be able to:

1. Discuss the anatomy and physiology of the renal system.
2. Describe the principle of analysis of urea, creatinine, and uric acid, in terms of key reagents, their role and endpoint detection.
3. Evaluate patient sample collection and handling processes in terms of impact on their renal function and electrolyte analysis**.**
4. Discuss common sources of analytical interference in BUN, creatinine, or other renal function tests.
5. Discuss the principle of analysis of Na, K, Cl, and total CO_2 (HCO_3^-), in terms of electronic components, reagents, and endpoint detection.
6. Discuss the procedure for creatinine clearance test.
7. Calculate Creatinine clearance test and correlate the results with physiological and disease processes.
8. Evaluate appropriate criteria for interpreting renal function and electrolyte laboratory test results.
9. Determine the appropriate course of action needed to resolve discrepancies in patient test results.
10. Explain the use of adult and pediatric nomograms.

11. Evaluate renal function test results and correlate them with physiological and disease processes.
12. Differentiate between a anion and cation.
13. Calculate anion gap.
14. Assess electrolyte values and correlate them with physiological and disease processes.
15. Compare and contrast electrolyte levels in serum and other body fluids such as CSF.

E. Unit V. Liver Function Assessment

Upon satisfactory completion of this unit, the student will be able to:

1. Review basic anatomy and physiology of liver.
2. Explain the role of quality control results in liver enzyme analysis.
3. List the steps and characteristics of bilirubin and its metabolism.
4. Discuss common preanalytical errors resulting from improper specimen collection and handling and commonly encountered sources of interference in ammonia, bilirubin, total serum protein, albumin, alkaline phosphatase, alamine transaminase and other liver enzyme analyses.
5. Describe the principles of alamine and aspartate transaminase, alkaline phosphatase, ammonia, total and direct bilirubin, urobilinogen, total serum protein, and albumin analyses in terms of key reagents and their role.
6. Cite normal values of common liver function test and correlated them to physiological and pathological disorders—TP, albumin, bilirubin, AST, ALT, ALT, GGT, LD, LAP, 5'nucleotidase, ammonia, urobilinogen, fibrinogen levels.
7. Verify calculation of results when a dilution is required.
8. Correlate the effects of urobilinogen levels and hepatobiliary disorders.
9. Evaluate liver function test results and correlate them with physiological and disease processes.
10. Investigate appropriate course of action needed to resolve discrepancies in patient test results.
11. Outline bilirubin assays including principle of procedure, chemical reaction, interfering substances.
12. Discuss the use of tumor markers for liver cancer.

F. Unit VI. Cardiovascular Disorders

Upon satisfactory completion of this unit, the student will be able to:

1. Identify preanalytical factors that can alter accuracy of laboratory testing for cardiac function
2. Describe testing for cardiac function, such as troponin T and I, CK-MB, LD isoenxymes, hs-CRP, and homocysteine.
3. Describe the testing used to assess risk of cardiovascular disease and toxicity to cardioactive medications.
4. Describe the current trends and guidelines for reducing cardiovascular disease.
5. Explain the role of HDL.
6. Compare and contrast AST, ALT, total CK and isoenzymes, total LD and isoenzymes, myoglobin, and troponin levels in normal patients and patients suspected of suffering heart disease
7. Assess the cardiac related clinical laboratory test results for predicting heart disease.
8. Correlate cholesterol levels with coronary artery disease.
9. Discuss and correlate cholesterol values with normal, moderate and high risk of heart disease as designated by the National Institute of Health.
10. Compare and contrast Hyperlipidemia and post-prandial lipemia.
11. Evaluate lipid panel results and correlate them with physiological and disease processes.
12. List possible blood collection errors that may result in the collection of lipemic samples.

G. Unit VII. Respiratory Disorders

Upon satisfactory completion of this unit, the student will be able to:

1. Discuss sample preparation for arterial blood gas analysis and co-oximetry.
2. Calculate H_2CO_3, HCO_3^-, oxygen capacity, and oxygen content.
3. Correlate ABG, oxygenation, and carboxyhemoglobin testing.
4. Discuss sources of discrepancy in terms of preanalytical and analytical errors in arterial blood gases, oxygen, and carboxyhemoglobin testing.
5. Discuss main steps needed for sample collection of arterial and venous samples by laboratory and other appropriate personnel.

6. Explain the typical causes, signs symptoms, and laboratory indicators of respiratory illnesses, including chronic bronchitis, adult respiratory failure, neonatal respiratory distress, and cystic fibrosis.
7. Evaluate the status of a patient given the results of a series of blood gases including pH, pCO2, HCO3 and O2 saturation levels.

H. Unit VIII. Digestive Function

Upon satisfactory completion of this unit, the student will be able to:

1. Discuss ways in which the laboratory assists the dietitian in the assessment of nutritional disorders and evaluation of nutritional therapy.
2. List four trace metals that the human body uses as enzyme co-factors.
3. Discuss the biochemical markers of nutrition in health and disease.
4. Describe laboratory testing that may be used to assess nutritional and digestive status.
5. Describe common preanalytical errors resulting from improper specimen collection and handling for tests of biomarkers that are used for the assessment of nutrition and digestive function.
6. Discuss commonly encountered sources of interference in biochemical analysis of nutrition and digestive function.
7. Correlate laboratory results of biomarkers with nutritional and digestive disorders.
8. Describe basic testing procedure and explain the clinical significance of the chloride sweat test.
9. List primary sources of amylase and lipase and correlate them to pancreatic function.
10. Evaluate amylase levels, lipase levels, and clinical findings to determine physiological and disease process.

I. Unit IX. Endocrine Disorders

Upon satisfactory completion of this unit, the student will be able to:

1. Discuss the anatomy and physiology of the body's endocrine glands.
2. Describe the chemical makeup of specific hormones as they relate to methods of analysis.
3. Compare advantages and disadvantages of current methodologies for hormone analysis to include principle of analyses, specimen requirements specificity and sources of interferences.
4. Differentiate primary and secondary hormonal disorders in terms of causes and typical laboratory results.
5. Evaluate patient endocrine test results and correlate with clinical symptoms and clinical pathology.
6. Describe communication that may be necessary with appropriate members of the healthcare team to include requesting clarification of unexpected test results, verification of patient preparation or sample collection for suspected discrepancies and reporting test results according to accepted practice for routine, emergency, and critical values.
7. Explain the classification of hormones.
8. Describe the typical findings in hCG levels over a 48-hour period in normal pregnancy, ectopic pregnancy, and threatened spontaneous abortion.
9. Differentiate qualitative and quantitative hCG in terms of principle of method, uses, and where testing s generally performed.
10. Describe the diagnostic value of monitoring LH, FSH, and estradiol levels in women and LH, FSH, and testosterone levels and semen analysis in male fertility testing.
11. Describe the cause of hemolytic disease of the newborn and give an example of the testing methodology that is used to assess this disease.
12. Correlate changes in concentration of phospholipids in the developing fetal lung with testing methodology that is used to assess this disease.
13. Explain the typical specimen collection and handling of amniotic fluid, including special steps needed for preservation of substances to be tested in the laboratory.
14. Discuss the use of tumor markers for Testicular and Ovarian cancer.

J. Unit X. Electrophoresis

Upon satisfactory completion of this unit, the student will be able to:

1. Explain the meaning of the following terms, listing specific examples when applicable: malignancy, tumor cancer, benign, neoplasm, tumor marker, diagnostic sensitivity, diagnostic

specificity, positive predictive value, negative predictive value, (ROC) receiver operating characteristic curve, medical decision limit (cutoff), ad tumor load.
2. Discuss the sequence of protein synthesis including amino acids, peptide bonds, dipeptide and polypeptides.
3. Compare and contrast albumin and globulins including site of production, size and function.
4. Discuss electrical properties of proteins including their amphoteric nature, physiologic charge, and relationship between electrical properties and electrophoresis.
5. Discuss electrophoresis including anode, cathode, pH, rate of migration, effect of charge, size of molecule and molecular weight on speed of migration.
6. Evaluate electrophoretic patterns and correlate them with physiological and disease processes.
7. Cite the normal values for protein, albumin, globulins and A/G ratio.
8. Discuss the most common methods to determine total protein and albumin
9. Compare and contrast serum total protein and album levels and urine protein.
10. Describe the use and clinical significance of sulfosalicylic acid protein determination.
11. Evaluate protein levels in serum and urine and correlate them with physiological and disease processes.

K. Unit XI. Therapeutic Drug Monitoring

Upon satisfactory completion of this unit, the student will be able to:

1. List common preanalytical error resulting from improper collection and handling of therapeutic drug specimens, alcohol, and drugs of abuse.
2. Discuss commonly encountered sources of analytical interference due to related chemicals, isopropanol, botanicals, and anticoagulants from evaporation.
3. Verify calculation of osmolality and osmolal gap when it is required**.**
4. Evaluate patient sample collection and handling processes in terms of impact on the outcome to include communicating with other members of the health care team.
5. Define toxicology and Therapuetic Drug Monitoring.
6. Discuss situations regarding acetaminophen and drugs of abuse in which it is important to communicate results to health care providers.
7. Identify commonly monitored therapeutic drugs including medical use and clinical findings when out of therapeutic levels.
8. Evaluate TDM test results and correlate with clinical symptoms and adverse effects.
9. Summarize the function of NIDA—National Institute of Drug Abuse

III. THECB Learning Outcomes (WECM)

1. Apply principles of safety, quality assurance and quality control in Clinical Chemistry.
2. Evaluate specimen acceptability for chemical analysis.
3. Compare and contrast human body chemistry levels under normal and abnormal conditions.
4. Explain, perform and evaluate clinical chemistry procedures and correlate test results with patient conditions.

IV. Evaluation

A. **Preassessment**

Students should have successfully completed the Specialized Admissions process to enter the Medical Laboratory Technology Program. Prerequisites and/or Corequisites may be required for MLAB courses.

B. **Postassessment**

1. Quizzes, lecture exams, and a final comprehensive written examination will be used to assess students' competency in didactic objectives.
2. Lab competency exams and lab practical exams are used to assess students' achievement of psychomotor objectives.
3. Lab practical exams require students to demonstrate a particular skill learned in the lab component of the class.

4. Written unit exams will consist of the following question types: multiple-choice, completion, essay, matching, spelling, analysis, and definition or any combination of these.

C. **Final Examination**
A comprehensive Final Exam is scheduled for this course.

D. Evaluation
To evaluate students' achievement of course objectives, student grades are tabulated using a final grade break down sheet. To successfully complete MLAB2401 Clinical Chemistry, the student must achieve at least a 70% in course components. The students overall grade must be no less than a "C," to be allowed to progress to the next program level.

E. **Remediation**
If a student scores less than 70% on any exam, the instructor will encourage the student to conference with the instructor or tutor, to review problem areas. Different learning and studying techniques will be discussed.

F. **Grading**
Grading Scale used in calculating students' final grade for MLAB 2401 (Clinical) Chemistry.

Evaluation Tools	% Value	Grading Scale
Quizzes	10%	A = 90 -100%
Lecture Exam I	20%	B = 80 - 89%
Lecture Exam II	20%	C = 70 -79%
Lecture Exam III	20%	D = 60 - 69%
Comprehensive Final	30%	F = 59% and below

(Chemistry Lab is on a Pass/Fail bases. Laboratories will be graded on a Pass/Fail system based on the competency limits set by the program for each individual procedure. An average of 80% is required to pass the laboratory portion of MLAB 2401 Chemistry.)

Each grade will initially be determined in decimals to the tenths. The final grade however, will only be recorded as a whole number. The guide used will be to round 0.1 through 0.4 to the lower whole number, and 0.5 through 0.9 are raised to next whole number. Example: If at the end of the course a student earns 87.4, the grade will be reflected as 87%. If the student earns 87.6 the grade is rounded to 88%. No decimals will be shown on the final grade scanners.

V. Disability Statement (Americans with/Disabilities Act [ADA])

EPCC offers a variety of services to persons with documented sensory, mental, physical, or temporary disabling conditions to promote success in classes. If you have a disability and believe you may need services, you are encouraged to contact the Center for Students with Disabilities to discuss your needs with a counselor. All discussions and documentation are kept confidential. Offices located: VV Rm C-112 (831-2426); TM Rm 1400 (831-5808); RG Rm B-201 (831-4198); NWC Rm M-54 (831-8815); and MDP Rm A-125 (831-7024).

VI. 6 Drop Rule

Students who began attending Texas public institutions of higher education for the first time during the Fall 2007 semester or later are subject to a 6-Drop limit for all undergraduate classes. Developmental, ESL, Dual Credit and Early College High School classes are exempt from this rule. All students should consult with their instructor before dropping a class. Academic assistance is available. Students are encouraged to see Counseling Services if dropping because exemptions may apply. Refer to the EPCC catalog and website for additional information.

VII. Title IX and Sex Discrimination

Title 9 (20 U.S.C. 1681 & 34 C.F.R. Part 106) states the following "No person in the United States shall, on the basis of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any educational program or activity receiving Federal financial assistance." The Violence Against Women Act (VAWA) prohibits stalking, date violence, sexual violence, and domestic violence for all students, employees and visitors (male and female). If you have any concerns related to discrimination, harassment, or assault (of any type) you can contact the Assistant to the Vice President for Student and Enrollment Services at 915-831-2655. Employees can call the Manager of Employee Relations at 915-831-6458. Reports of sexual assault/violence may also be reported to EPCC Police at 915-831-2200.