



## Course Syllabus

### MLAB 2401 -Clinical Chemistry

*Revision Date: August 16, 2016*

**Catalog Description:** An introduction to the principles, procedures, physiological basis, and significance of testing performed in Clinical Chemistry. Includes quality control, reference values, and safety.

**Lecture hours = 4, Lab hours = 1**

**Prerequisites:** Enrollment in this course and the Medical Laboratory Technology Program requires department head approval and successful completion of the admissions process. Students must be accepted into the MLT program.

**Semester Credit Hours: 4**

**Lecture Hours per Week: 4**

**Lab Hours per Week: 1**

**Contact Hours per Semester: 128**

**State Approval Code: 5110040000**

**Instructional Goals and Purposes:** The purpose of this course is to provide basic understanding of medical laboratory clinical chemistry from the sophomore level MLT. Students are reintroduced to safety and quality control procedures covered in previous MLAB and PLAB courses.

#### **Learning Outcomes:**

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.

#### **Specific Course Objectives (includes SCANS):**

After studying all materials and resources presented in the course, the student will be able to:

1. **Chapter 1**
  - a. Identify two methods used to produce clinical laboratory-grade water for use in the clinical laboratory. **(1a-i)**
  - b. Identify four types of glassware available for laboratory use. **(1b-iv, v, vi)**
  - c. Define the following terms: to contain (TC) and to deliver (TD) in reference to types of pipettes, molarity, molality, normality, thermocouple, percent solution, and hydrates. **(1b-v. 2c-i, iii.)**
  - d. Complete the mathematical calculations presented in this chapter correctly. **(1a-iii, b-ii, iii, iv, vi. 2a-iii.)**
  - e. Convert results from one unit format to another. **(1a=i, ii, iii. b-l, iii. 2a-l, ii, iii.)**
  - f. Calculate the volumes required to prepare a 1:2, 1:5, and 1:10 dilution. **(1a-iii. b-ii, iii, iv.)**
  - g. Distinguish swinging-bucket, fixed-angle-head, and ultra centrifuges from one another. **(1b-iv, v)**
  - h. Distinguish density, specific gravity, and assay by weight from one another. **(1b-iv, v)**

2. **Chapter 2**
  - a. Identify two physical properties of light. **(1b-ii, iv. 2c-iii, d-i.)**
  - b. Define the following wave parameters: Amplitude, period, frequency. **(1a-i, ii. b-ii, iv, v. 2 c-iii)**
  - c. List four spectrophotometric function checks **(1a-i, ii.)**
  - d. Define the following terms: Diffuse reflections, retention time, Rf, fluorescence, chemiluminescence. **(1b-v. 2c-i, iii.)**
  - e. Identify specific analyte(s) that are measured by each device or instrument. **(1b-ii, iv. 2c-iii, d-i.)**
  - f. Calculate the concentration of a solution given the absorbance values for test and standards. **(1a-iii, b-iii, v. 2c-i)**
  - g. Explain how the absorbance and transmittance of light are related. **(1a-i, ii, v, b-v. 2c-i, iii)**
3. **Chapter 3**
  - a. List four advantages of automated chemical analysis. **(1a-i, ii.)**
  - b. Define the following terms: throughput, test menu, carryover, discrete testing, random access testing, open-reagent analyzer, and closed-reagent analyzer. **(1b-v. 2c-i, iii.)**
  - c. Identify five laboratory tasks associated with the preanalytical stages of laboratory testing. **(1b-ii, iv. 2c-iii, d-i.)**
  - d. List four tasks associated with the analytical stage of laboratory testing. **(1a-i, ii.)**
  - e. Identify three task associated with the post-analytical stage of laboratory testing. **(1b-ii, iv. 2c-iii, d-i.)**
  - f. Distinguish the three stages of laboratory testing from one another. **(1b-iv, v)**
  - g. Explain the principle used for clot detection in automated analyzers. **(1a-i, ii, v, b-v. 2c-i, iii)**
4. **Chapter 4**
  - a. Explain a Gaussian distribution. **(1a-i, ii, v, b-v. 2c-i, iii)**
  - b. Define accuracy and precision. **(1b-v. 2c-i, iii.)**
  - c. Identify three types of errors. **(1b-ii, iv. 2c-iii, d-i.)**
  - d. Interpret the results of selected laboratory statistics. **(1a-i, ii, b-i, ii, v. 2c-i, iii)**
  - e. Explain the characteristics of a Levey-Jennings chart and include x- and y- axis labels. **(1a-i, ii, v, b-v. 2c-i, iii)**
  - f. Interpret a Levey-Jennings quality-control plot. **(1a-i, ii, v, b-v. 2c-i, iii)**
  - g. Explain each Westgard rule violation. **(1a-i, ii, v, b-v. 2c-i, iii)**
  - h. Identify Westgard rule violations and determine a course of action. **(1b-ii, iv. 2c-iii, d-i.)**
  - i. Provide the correct words that correspond to the following abbreviations: OSHA, MSDS, NFPA, JCAHO, HEPA, RACE, PASS, and CFR. **(1a-i, ii, b-i, ii, v. 2c-i, iii)**
  - j. Identify three hazards related to handling biological specimens. **(1b-ii, iv. 2c-iii, d-i.)**
  - k. Identify elements of an exposure-control plan. **(1b-ii, iv. 2c-iii, d-i.)**
  - l. State the two items required to interface computers. **(1a-i, ii, v, b-v. 2c-i, iii)**
5. **Chapter 5**
  - a. Explain the fundamental differences among enzyme immunoassays, fluorescent immunoassays, and chemiluminescent immunoassays. **(1a-i, ii, v, b-v. 2c-i, iii)**
  - b. Identify three advantages of monoclonal antibodies used in immunoassay systems. **(1b-ii, iv. 2c-iii, d-i.)**
  - c. Define the terms antigen, antibody, immunogen, and hapten. **(1b-v. 2c-i, iii.)**
  - d. Explain the differences between competitive immunoassays and noncompetitive (sandwich) immunoassays. **(1a-i, ii, v, b-v. 2c-i, iii)**
  - e. Explain the principles of the reactions for the following immunoassays: EMIT, FPIA, CEDIA, SLFIA, CLIA, LOCI. **(1a-i, ii, v, b-v. 2c-i, iii)**
6. **Chapter 6**
  - a. List and define the major classes of carbohydrates and give examples of each. **(1a-i, ii.)**
  - b. Define the most common terms associated with carbohydrate metabolism. **(1b-v. 2c-i, iii.)**
  - c. Briefly summarize the three major biochemical pathways associated with carbohydrate metabolism. **(1a-i, ii, v, b-v. 2c-i, iii)**
  - d. Compare and contrast the main characteristics of the two major types of diabetes mellitus (DM) (type 1 and type 2). **(1a-i, ii, b-i, ii, v. 2c-i, iii)**
  - e. Review other carbohydrate disorders, including: gestational diabetes, other types of diabetes (secondary diabetes mellitus), and impaired glucose tolerance. **(1a-i, ii, b-i, ii, v. 2c-i, iii)**

- f. Define hypoglycemia and discuss the common causes of drug-induced, reactive, and fasting hypoglycemia. **(1b-v. 2c-i, iii.)**
  - g. Review urine and cerebrospinal fluid glucose clinical significance and methodologies. **(1a-i, ii, b-i, ii, v. 2c-i, iii)**
  - h. Summarize the inborn errors of metabolism affecting carbohydrate metabolism, including glycogen storage diseases and galactosemia. **(1a-i, ii, b-i, ii, v. 2c-i, iii)**
  - i. Interpret laboratory tests used to classify patients as normal, impaired glucose tolerance, or diabetic. **(1a-i, ii, b-i, ii, v. 2c-i, iii)**
  - j. Explain the carious test (e.g. ketons, glycosylated hemoglobin, and microalbumin) and their importance in monitoring DM. **(1a-i, ii, v, b-v. 2c-i, iii)**
- 7. Chapter 7**
- a. Outline and describe classes of clinically significant lipids. **(1b-v. 2c-i, iii.)**
  - b. Define unsaturated and saturated fatty acids. **(1b-v. 2c-i, iii.)**
  - c. List the major components and the percentage composition of the major lipoproteins—for example, apoproteins, cholesterol, and triglycerides. **(1a-i, ii.)**
  - d. Review the four major lipoproteins and their density and function. **(1a-i, ii, b-i, ii, v. 2c-i, iii)**
  - e. Identify causes of hypertriglyceridemia and hypotriglyceridemia. **(1b-ii, iv. 2c-iii, d-i.)**
  - f. Calculate LDL-C using the Friedewald formula. **(1a-ii, iii, b-iii. 2c-i, ii, iii)**
  - g. Identify the risk factors for coronary heart disease. **(1b-ii, iv. 2c-iii, d-i.)**
- 8. Chapter 8**
- a. List the major functions of protein. **(1a-i, ii.)**
  - b. Discuss clinically significant proteins, including function, clinical significance, and protein band in electrophoresis. **(1a-i, ii, v, b-i, ii, v, vi, c-ii, iii, v. 2c-i, ii, iii)**
  - c. Discuss causes of hyperproteinemia and hypoproteinemia. **(1a-i, ii, v, b-i, ii, v, vi, c-ii, iii, v. 2c-i, ii, iii)**
  - d. Describe urinary protein screening, clinical significance, and methodologies. **(1a-i, ii, v, b-v. 2c-i, iii)**
  - e. Describe cerebrospinal fluid protein, clinical significance, and methodologies. **(1a-i, ii, v, b-v. 2c-i, iii)**
  - f. List major functions of albumin. **(1a-i, ii.)**
  - g. Discuss the major components of protein electrophoresis. **(1a-i, ii, v, b-i, ii, v, vi, c-ii, iii, v. 2c-i, ii, iii)**
  - h. List in order the protein electrophoresis bands and approximate percentages of total protein. **(1a-i, ii.)**
  - i. Calculate A/G ratio. **(1a-ii, iii, b-iii. 2c-i, ii, iii)**
- 9. Chapter 9**
- a. Define enzyme and list general functions of enzymes. **(1b-v. 2c-i, iii.)**
  - b. List the six major groups of enzymes and the reactions catalyzed by each group. **(1a-i, ii.)**
  - c. Define cofactor, coenzyme, and metalloenzyme and give examples of each. **(1b-v. 2c-i, iii.)**
  - d. Examine the differences among competitive, noncompetitive, and uncompetitive inhibition. **(1a-i, ii, b-i, ii, v. 2c-i, iii)**
  - e. Review the clinical significance of the three major CK isoenzymes (heart, muscle, and brain), including their dimeric composition and major sources. **(1a-i, ii, b-i, ii, v. 2c-i, iii)**
  - f. Identify a normal CK isoenzyme pattern and the typical pattern following a myocardial infarction (MI). **(1b-ii, iv. 2c-iii, d-i.)**
  - g. Summarize the methodologies, clinical significance, and reference ranges for the following liver enzymes: aspartate aminotransferase (AST), alanine aminotransferase (ALT), and alkaline phosphatases (ALP). **(1a-i, ii, b-i, ii, v. 2c-i, iii)**
  - h. Differentiate the five major LD isoenzymes, including their tetrameric composition and the major tissue(s) involved. **(1b-v. 2c-i, iii.)**
  - i. Relate the methodologies, clinical significance, and reference ranges for the following pancreatic and liver enzymes: amylase (AMY), lipase (LPS), trypsin (TRY), and chymotrypsin (CHY). **(1b-v. 2c-i, iii.)**
  - j. Calculate the CK relative index (RI). **(1a-ii, iii, b-iii. 2c-i, ii, iii)**
- 10. Chapter 10.**
- a. List five roles of tumor markers in the assessment of cancers. **(1a-i, ii.)**

- b. List commonly used tumor markers and state their clinical significant in relation to cancer. **(1a-i, ii.)**
- c. Identify several laboratory tests used to evaluate the following: **(1b-ii, iv. 2c-iii, d-i.)**
  - d. a. Prostate disease
  - e. b. Ovarian cancer
  - f. c. Breast cancer
  - g. d. Bladder cancer
  - h. e. Pancreatic cancer
- i. Calculate diagnostic sensitivity and specificity for a given set of data. **(1a-ii, iii, b-iii. 2c-i, ii, iii)**
- j. Define each of the following examples of clinical applications of tumor markers: screening, diagnosis, monitoring treatment, detection of recurrence, and prognosis (staging). **(1b-v. 2c-i, iii.)**

#### 11. Chapter 11

- a. List and briefly describe the major parts of the urinary system. **(1a-i, ii.)**
- b. Trace the ultrafiltrate (urine) flow through the major parts of the nephron. **(1a-i, ii.)**
- c. Trace the blood flow in the kidney from the renal artery to the renal vein. **(1a-i, ii.)**
- d. Identify the source of blood urea nitrogen (BUN) and the major organ of the urea cycle. **(1b-ii, iv. 2c-iii, d-i.)**
- e. State the reference range for BUN. **(1b-ii, iv. 2c-iii, d-i.)**
- f. Define azotemia and uremia. **(1b-v. 2c-i, iii.)**
- g. Identify causes of a decreased BUN. **(1b-ii, iv. 2c-iii, d-i.)**
- h. Explain the source of creatinine (CR). **(1a-i, ii, v, b-v. 2c-i, iii)**
- i. Calculate the BUN:CR ratio and discuss its clinical significance. **(1a-ii, iii, b-iii. 2c-i, ii, iii)**
- j. Calculate a creatinine clearance given the relevant data. **(1a-ii, iii, b-iii. 2c-i, ii, iii)**
- k. Explain primary hyperuricemia (gout), including causes (precipitating factors) and treatment. **(1a-i, ii, v, b-v. 2c-i, iii)**
- l. Explain dialysis and its role and complications in patients in renal failure. **(1a-i, ii, v, b-v. 2c-i, iii)**

#### 12. Chapter 12

- a. Identify the analytes required to calculate anion gap and osmolality. **(1b-ii, iv. 2c-iii, d-i.)**
- b. Distinguish between serum and plasma. **(1b-v. 2c-i, iii.)**
- c. List five examples of body fluids that are assayed for electrolyte composition. **(1a-i, ii.)**
- d. Select the electrolyte associated with each of the following: **(1b-v. 2c-i, iii.)**
  - a. major intracellular cation
  - b. major extracellular cation
  - c. major extracellular anion
- e. Identify four methods used to measure chloride in sweat. **(1b-ii, iv. 2c-iii, d-i.)**
- f. Discuss the clinical aspects of increased and decreased plasma body fluid electrolyte concentrations. **(1a-i, ii, v, b-v. 2c-i, iii)**
- g. Define anion gap and discuss its clinical significance. Calculate and interpret anion gap results from a given set of data. **(1b-v. 2c-i, iii.)**

#### 13. Chapter 13

- a. State the Henderson–Hasselbalch equation and identify the respiratory and metabolic components. **(1b-ii, iv. 2c-iii, d-i.)**
- b. Identify the four major body buffer systems. **(1b-ii, iv. 2c-iii, d-i.)**
- c. Identify preanalytical sources of errors in blood-gas analysis. **(1b-ii, iv. 2c-iii, d-i.)**
- d. Identify the specimen of choice discuss the proper handling of specimen for blood-gas analysis. **(1b-ii, iv. 2c-iii, d-i.)**
- e. Given a set of arterial blood gases (ABGs) and pH results, determine which acid–base disorder is most appropriate. **(1b-ii, iv. 2c-iii, d-i.)**
- f. Explain how the body attempts to compensate for acid–base disorders; include kidneys, lungs, and body buffers. **(1a-i, ii, v, b-v. 2c-i, iii)**

#### 14. Chapter 14

- a. Identify three forms of calcium as they exist in circulation. **(1b-ii, iv. 2c-iii, d-i.)**
- b. Identify two main causes of hypercalcemia. **(1b-ii, iv. 2c-iii, d-i.)**
- c. Indicate the source of parathyroid hormone. **(1b-ii, iv. 2c-iii, d-i.)**

- d. List three functions of vitamin D. **(1a-i, ii.)**
  - e. Identify biochemical markers specific for bone formation and resorption. **(1b-ii, iv. 2c-iii, d-i.)**
  - f. Discuss the clinical usefulness of measuring ionized magnesium. **(1a-i, ii, v, b-v. 2c-i, iii)**
  - g. Identify several bone-related diseases and the appropriate biochemical marker(s) for bone that may be measured to assess a patient. **(1b-ii, iv. 2c-iii, d-i.)**
  - h. Predict the laboratory findings for serum total calcium, phosphorus, and urinary phosphate in patients with primary hyperparathyroidism. **(1b-i, ii, iii, iv, v)**
  - i. Correlate laboratory data for minerals and bone markers with disease. **(1b-i, ii, iii, iv, v)**
- 15. Chapter 15**
- a. Identify three major types of hormones. **(1b-ii, iv. 2c-iii, d-i.)**
  - b. State which of the three classes of hormones characterizes the following compounds: **(1a-i, ii, v, b-v. 2c-i, iii)**
    - a. thyroxine
    - b. cortisol
    - c. parathyroid hormone
    - d. epinephrine
    - e. estrogen
  - c. Define negative feedback. **(1b-v. 2c-i, iii.)**
  - d. List five examples of hormones found in the anterior pituitary gland. **(1a-i, ii.)**
  - e. List two examples of hormones found in the posterior pituitary gland. **(1a-i, ii.)**
  - f. Associate abnormal laboratory results with a disease or syndrome. **(1b-i, ii, iii, iv, v)**
  - g. Know the functions of the hormones presented. **(1a-v)**
  - h. Correlate laboratory data on patients with Addison's disease or Cushing's syndrome. **(1b-i, ii, iii, iv, v)**
  - i. Define the role of the laboratory in the diagnosis and management of some common endocrine disorders. **(1b-v. 2c-i, iii.)**
  - j. Identify laboratory tests that will provide useful information for assessing selected endocrine diseases or syndromes. **(1b-ii, iv. 2c-iii, d-i.)**
- 16. Chapter 16**
- a. Review the gross anatomy of the gastrointestinal (GI) tract from the mouth to the anus. **(1a-i, ii, v, b-v. 2c-i, iii)**
  - b. Identify three examples of GI regulatory peptides. **(1b-ii, iv. 2c-iii, d-i.)**
  - c. Define the following terms: peptic ulcer, gastrinoma, and protein-losing enteropathy. **(1b-v. 2c-i, iii.)**
  - d. Explain the principal pathological condition associated with each of the following GI tract disorders: Zollinger–Ellison's syndrome, peptic ulcer, celiac disease, protein-losing enteropathy, lactase deficiency, and carcinoid tumors. **(1a-i, ii, v, b-v. 2c-i, iii)**
  - e. Identify five nonclinical laboratory diagnostic tests or procedures used to assess patients with disorders of the GI tract. **(1b-ii, iv. 2c-iii, d-i.)**
  - f. Discuss the pathology of GI tract disorders. **(1a-i, ii, v, b-v. 2c-i, iii)**
- 17. Chapter 17**
- a. Review the location and anatomy of the pancreas **(1a-i, ii, v, b-v. 2c-i, iii)**.
  - b. Summarize the endocrine and exocrine functions of the pancreas. **(1a-i, ii, v, b-v. 2c-i, iii)**
  - c. Summarize the most common noninvasive tests for assessing pancreatic exocrine insufficiency: pancreatic elastase-1, pancreatic chymotrypsin, pancreatic serum enzymes, breath test (C-mixed triglyceride test), urinary amylase, fecal fat, phospholipase A2, NBT-PABA, and fecal elastase. **(1a-i, ii, v, b-v. 2c-i, iii)**
  - d. Summarize briefly diabetes mellitus, the major endocrine pancreatic disease. **(1a-i, ii, v, b-v. 2c-i, iii)**
  - e. List the two primary causes of acute pancreatitis. **(1a-i, ii.)**
  - f. Briefly review the etiology and prognosis of chronic pancreatitis. **(1a-i, ii, v, b-v. 2c-i, iii)**
  - g. Summarize the etiology of cystic fibrosis **(1a-i, ii, v, b-v. 2c-i, iii)**
  - h. Briefly explain CA 19-9, the major tumor marker for colorectal and pancreatic cancer.
  - i. Compare and contrast acute and chronic pancreatitis. **(1a-i, ii, v, b-v. 2c-i, iii)**
- 18. Chapter 18**
- a. Explain the inflammatory response associated with atherosclerosis. **(1a-i, ii, v, b-v. 2c-i, iii)**

- b. Define acute coronary syndrome (ACS). **(1b-v. 2c-i, iii.)**
- c. List five factors that define an ideal cardiac biomarker. **(1a-i, ii.)**
- d. Define hs-CRP relative to cardiac usefulness. **(1b-v. 2c-i, iii.)**
- e. Identify the clinical usefulness of the following cardiac biomarkers: **(1b-ii, iv. 2c-iii, d-i.)**
  - a. Lipoprotein (a)
  - b. Lipoprotein-associated phospholipase A2
  - c. Glycogen phosphorylase isoenzyme BB
  - d. Omega-3 fatty acids
  - e. Matrix metalloproteinases
  - f. Placental growth factor
  - g. Oxidized low-density lipoprotein (LDL)
  - h. Myeloperoxidase
  - i. Cardiac troponin I and T
  - j. Brain-type natriuretic peptide and NT-proBNP
  - k. Ischemia-modified albumin (IMA)
- f. Discuss the advantages of point-of-care testing (POCT) for cardiac biomarkers. **(1a-i, ii, v, b-v. 2c-i, iii)**
- g. Discuss the temporal relationship and concentration of each the following relevant to acute myocardial infarction (AMI): **(1a-i, ii, v, b-v. 2c-i, iii)**
  - a. Myoglobin
  - b. CK-MB
  - c. Cardiac troponin I
- h. Explain the differences between cTnT and cTnI. **(1a-i, ii, v, b-v. 2c-i, iii)**
- i. Identify the limitations of the following biomarkers relative to various disease states: **(1b-ii, iv. 2c-iii, d-i.)**
  - a. CK-MB
  - b. Myoglobin
  - c. Cardiac troponin I and T

#### 19. Chapter 19

- a. Review major liver functions and list examples of each category. **(1a-i, ii, v, b-v. 2c-i, iii).**
- b. Differentiate conjugated and unconjugated bilirubin, including composition and solubility in water and alcohol. **(1b-v. 2c-i, iii.)**
- c. Review the clinical significance of bilirubin, including levels of total, direct, and indirect bilirubin. **(1a-i, ii, v, b-v. 2c-i, iii).**
- d. Define jaundice, and identify and list examples of the three major categories of jaundice. **(1b-v. 2c-i, iii.)**
- e. Identify type of virus, route of transmission, at risk populations, incubation period, and recovery rate for the following types of viral hepatitis: A, B, C, and D. **(1b-ii, iv. 2c-iii, d-i.)**
- f. Briefly examine the progression in alcoholics from alcoholic fatty liver to alcoholic hepatitis to alcoholic cirrhosis. **(1a-i, ii, v, b-v. 2c-i, iii).**
- g. Briefly outline other liver function tests: enzymes, albumin, urinary and fecal urobilinogen, and prothrombin time. **(1a-i, ii, v, b-v. 2c-i, iii).**
- h. Describe three inherited metabolic liver diseases: hereditary hemochromatosis, Wilson disease, and  $\alpha$ 1-antitrypsin deficiency. **(1b-v. 2c-i, iii.)**
- i. Examine the three most common cholestatic liver diseases: primary biliary cirrhosis, primary sclerosing cholangitis, and mechanical obstruction of the bile ducts. **(1a-i, ii, v, b-v. 2c-i, iii).**

#### 20. Chapter 20

- a. Explain how iron is transported in the human body. **(1a-i, ii, v, b-v. 2c-i, iii)**
- b. Outline the metabolism of iron and iron-containing compounds. **(1b-v. 2c-i, iii.)**
- c. Cite examples of specific diseases associated with iron deficiency and iron overload. **(1b-ii, iv. 2c-iii, d-i.)**
- d. Identify methods used to measure iron in serum or plasma. **(1b-ii, iv. 2c-iii, d-i.)**
- e. List the two classes of porphyrias and outline specific porphyrias within each class. **(1a-i, ii.)**
- f. Define the following terms: porphyrins, porphyrias, ferritin, transferrin, heme, hemin, hematin, and hemoglobin. **(1b-v. 2c-i, iii.)**

- g. Correlate laboratory results with selected diseases associated with iron disorders. **(1b-v. 2c-i, iii.)**
  - h. Explain the clinical significance of ferritin and transferrin. **(1a-i, ii, v, b-v. 2c-i, iii)**
- 21. Chapter 21**
- a. Identify the factors that influence drug absorption. **(1b-ii, iv. 2c-iii, d-i.)**
  - b. Discuss two mechanisms associated with drug excretion. **(1a-i, ii, v, b-v. 2c-i, iii)**
  - c. List four parameters that affect changes in dosage of drugs. **(1a-i, ii.)**
  - d. List an example of a specific drug from a given therapeutic category. **(1a-i, ii.)**
  - e. Contrast chemical, generic, and trade name nomenclature for drugs. **(1a-i, ii, v, b-v. 2c-i, iii)**
  - f. Identify two factors that significantly affect steady state. **(1b-ii, iv. 2c-iii, d-i.)**
  - g. Distinguish free versus bound drug. **(1a-i, ii, v, b-v. 2c-i, iii)**
  - h. Discuss the significance of sampling time in monitoring therapeutic drug levels. **(1a-i, ii, v, b-v. 2c-i, iii)**
  - i. Identify health conditions associated with toxic levels of selected therapeutic drugs. **(1b-ii, iv. 2c-iii, d-i.)**
- 22. Chapter 22**
- a. List several examples of toxic substances measured in clinical laboratories. **(1a-i, ii.)**
  - b. List six substances that are frequently used as adulterants in urine specimens for drug abuse testing. **(1a-i, ii.)**
  - c. List several examples of classes of drugs that are included in urine-drugs-of-abuse screening procedures. **(1a-i, ii.)**
  - d. Identify several sources of lead that may result in high blood levels of lead. **(1b-ii, iv. 2c-iii, d-i.)**
  - e. Identify the acidic or ketone metabolites of the following compounds: **(1b-ii, iv. 2c-iii, d-i.)**
    - a. Ethanol
    - b. Methanol
    - c. Ethylene glycol
    - d. Isopropyl alcohol
    - e. Salicylate
  - f. Distinguish between drug screening and drug confirmatory methods. **(1a-i, ii, v, b-v. 2c-i, iii)**
  - g. Explain the clinical significance of measuring selected drugs of abuse and toxic substances. **(1a-i, ii, v, b-v. 2c-i, iii)**
- 23. Chapter 23**
- a. Name 10 essential trace elements. **(1a-i, ii.)**
  - b. Cite biological uses of selected trace elements.
  - c. Identify methods used to measure selected trace elements. **(1b-ii, iv. 2c-iii, d-i.)**
  - d. Identify methods used to measure selected trace elements. **(1b-ii, iv. 2c-iii, d-i.)**
  - e. Define the following terms: trace elements, ultra trace elements, chelating agents, and metalloproteins. **(1b-v. 2c-i, iii.)**
  - f. Correlate laboratory results with diseases associated with trace elements. **(1a-i, ii.)**
  - g. Describe symptoms associated with exposure to selected trace elements. **(1a-i, ii, v, b-v. 2c-i, iii)**
- 24. Chapter 24**
- a. List the fat-soluble vitamins. **(1a-i, ii.)**
  - b. Cite biological uses of selected vitamins. **(1a-i, ii.)**
  - c. State food sources of selected vitamins. **(1a-i, ii.)**
  - d. Identify selected vitamins by both their common and trivial chemical names. **(1b-ii, iv. 2c-iii, d-i.)**
  - e. Define the following terms: functional assay, direct assay, hypervitaminosis, and hypovitaminosis. **(1b-v. 2c-i, iii.)**
  - f. Associate selected vitamins with disease. **(1a-i, ii.)**
  - g. Outline the mechanisms of vitamin absorption, metabolism, and excretion. **(1a-i, ii.)**
  - h. Correlate laboratory results with disease(s) associated with selected vitamins. **(1a-i, ii.)**
- 25. Chapter 25**
- a. List the three components of a nucleotide. **(1a-i, ii.)**
  - b. Describe the basic steps of transcription and translation. **(1a-i, ii, v, b-v. 2c-i, iii)**
  - c. Discuss the basic principles of gel electrophoresis of DNA. **(1a-i, ii, v, b-v. 2c-i, iii)**

- d. Compare and contrast the chemical structures of DNA and RNA. **(1b-v. 2c-i, iii.)**
- e. Explain the basic principles of the following techniques: liquid-phase hybridization, in situ hybridization, fluorescent in situ hybridization (FISH), Southern blot, Western blot, traditional polymerase chain reaction (PCR), real-time PCR, and the Sanger method of DNA sequencing. **(1a-i, ii, v, b-v. 2c-i, iii)**

**26. Lab #1**

- a. Define mean, standard deviation, coefficient of variation. **(1b-v. 2c-i, iii.)**
- b. Distinguish between assayed and unassayed controls. **(1b-v. 2c-i, iii.)**
- c. Read Levy-Jennings graphs to determine the analyte and the value of the mean. **(1a-i, b-iii, iv, v.)**
- d. Read Levy-Jennings graphs and be able to determine values outside of 2SD and 3SD. **(1a-i, b-iii, iv, v)**
- e. Define precision and accuracy **(1b-v. 2c-i, iii.)**.
- f. Describe the proper labeling when a reagent or control is opened and/or reconstituted in the lab. **(1a-i, ii, v, b-v. 2c-i, iii)**
- g. Describe why controls are important in the clinical lab. **(1a-i, ii, v, b-v. 2c-i, iii)**

**27. Lab #2**

- a. Explain the purpose of the "blank" in spectrophotometry. **(1a-i, ii, v, b-v. 2c-i, iii)**
- b. Discuss the importance and the reason we are required to run controls. **(1a-i, ii, v, b-v. 2c-i, iii)**
- c. Explain Beer's law as it relates to the activity performed today. (How the intensity of the observed color relates to concentration) **(1a-i, ii, v, b-v. 2c-i, iii)**
- d. Explain the difference in wavelengths used on spectrophotometer. List the wavelength used in today's procedures. **(1a-i, ii, v, b-v. 2c-i, iii)**
- e. Identify all parts of the spectrophotometer we used today (light source, monochromator, cuvette, photodetector, output). **(1b-ii, iv. 2c-iii, d-i.)**
- f. Discuss PHYSICAL factors of the patient that have an effect on the concentration of cholesterol in the blood. **(1a-i, ii, v, b-v. 2c-i, iii)**
- g. Discuss where cholesterol is found in the body. **(1a-i, ii, v, b-v. 2c-i, iii)**
- h. List common mistakes that can be made in spectrophotometry testing. **(1a-i, ii.)**

**28. Lab #3**

- a. Explain the concept of electrophoresis. **(1a-i, ii, v, b-v. 2c-i, iii)**
- b. Describe the results of an electrophoresis gel, including what each "band" represents. **(1a-i, ii, v, b-v. 2c-i, iii)**
- c. State the function of the buffer in an electrophoresis system. **(1a-i, ii.)**
- d. List the different Hemoglobin fractions found in humans. **(1a-i, ii.)**
- e. Describe the purpose of staining electrophoresis gels. **(1a-i, ii, v, b-v. 2c-i, iii)**
- f. Explain tests that can be done using electrophoresis. **(1a-i, ii, v, b-v. 2c-i, iii)**
- g. Outline the symptoms of Sickle Cell Anemia. **(1a-i, ii.)**
- h. Interpret a completed electrophoresis gel. **(1a-i, ii, v, b-v. 2c-i, iii)**

**Course Content:**

A general description of lecture/discussion topics included in this course are listed in the Learning Objectives / Specific Course Objectives sections of this syllabus.

Students in all sections of this course will be required to do the following:

1. Chapter 1-25 Assignments
2. Chapter 1-25 Quizzes
3. Lab 1-3 pre and post quizzes
4. Lab 1-3 assignments

**Methods of Instruction/Course Format/Delivery:**

This is a mainly online course so it will require a lot of outside proactive work by the student. The instructor will provide guidance as needed. The student will be evaluated by assignments, quizzes, cases, and exams as assigned by the instructor outside of the classroom. The student will be required to come to a Panola College testing Center to take all major examinations. Laboratories will take place on three pre-determined Saturdays during the semester and will be mandatory. During the laboratories the



students will be evaluated by case studies, in-lab assignments, and lab practicals as assigned by the instructor.

### **Major Assignments / Assessments:**

The following items will be assigned and assessed during the semester and used to calculate the student's final grade.

#### **Assignments**

1. Chapters 1-7
2. Chapters 8-16
3. Chapters 17-25
4. Lab #1 in lab assignment
5. Lab #2 in lab assignment
6. Lab #3 in lab assignment

#### **Assessment(s):**

1. Chapter 1-25 quizzes
2. Lab 1-3 pre and post quizzes
3. 3 proctor exams

### **Course Grade:**

The grading scale for this course is as follows:

**Lecture Grade = 2/3 of grade**

**Lab Grade = 1/3 of grade**

#### **Lecture**

- Major Exams 50%
- Quizzes 15%
- Homework Assignments 20%
- Final Exam 15%

#### **Laboratory**

- Pre-Lab Quizzes 10%
- Case Assignments 20%
- In-Lab Assignments 20%
- Practicals 50%

### **Texts, Materials, and Supplies:**

- *textbook*
- other materials

### **Required Readings:**

- Sunheimer, Robert. (2011). *Clinical Laboratory Chemistry*. Pearson 11<sup>th</sup> edition. ISBN9780131721715.
- Additional information given on Canvas

### **Recommended Readings:**

- Medical Dictionary

### **Other:**

- For current texts and materials, use the following link to access bookstore listings: <http://www.panolacollegestore.com>
- For testing services, use the following link: <http://www.panola.edu/elearning/testing.html>

- If any student in this class has special classroom or testing needs because of a physical learning or emotional condition, please contact the ADA Student Coordinator in Support Services located in the Administration Building or go to <http://www.panola.edu/student-success/disability-support-services/> for more information.
- Withdrawing from a course is the student's responsibility. Students who do not attend class and who do not withdraw will receive the grade earned for the course.
- Student Handbook, *The Pathfinder*: <http://www.panola.edu/student-success/documents/pathfinder.pdf>

### **More Information:**

#### **Medical Technologies Student Handbook**

Medical Technologies students are subject to all rules and regulations outlined in the Panola College Medical Technologies Student Handbook.

#### **Laboratory Dress Code**

The student will be expected to attend class clean and neatly dressed in long pants or scrubs and wear **closed-toe shoes**. A laboratory coat will must be worn snapped or buttoned up during all laboratory sessions. Hair that is shoulder length or longer **must** be worn up or securely tied back. Gloves must be worn when handling biological materials.

#### **Behavioral Conduct**

While a student is representing Panola College as a Medical Laboratory Technology student, they will be expected to conduct themselves in such a manner as to reflect favorably on themselves and on the Program. If a student acts in such a manner as to reflect immature judgment or disrespect for others, the student will be called before the MLT Department Chair for determination of their status in the Program. Inappropriate conduct is grounds discipline and may be cause for immediate probation or dismissal from the Program.

#### **Academic Dishonesty**

Under no circumstances shall a student submit work that is not their own. Copying answers for study questions, cheating on exams and/or submitting laboratory results which are not your own are expressly prohibited.

#### **Time Commitment**

According to "Hints on How to Succeed in College Classes"

<http://astrosociety.org/edu/resources/success.html> you should budget your time per week for this four-hour credit course as follows:

1. Reading assigned text 2 to 3 hours
2. Homework assignments 3 to 6 hours
3. Time for review and test preparation 3 hours
4. Total study time per week 10 to 15 hours **PER WEEK**

## SCANS CRITERIA

- 1) **Foundation skills are defined in three areas: basic skills, thinking skills, and personal qualities.**
  - a) **Basic Skills:** A worker must read, write, perform arithmetic and mathematical operations, listen, and speak effectively. These skills include:
    - i) Reading: locate, understand, and interpret written information in prose and in documents such as manuals, graphs, and schedules.
    - ii) Writing: communicate thoughts, ideas, information, and messages in writing, and create documents such as letters, directions, manuals, reports, graphs, and flow charts.
    - iii) Arithmetic and Mathematical Operations: perform basic computations and approach practical problems by choosing appropriately from a variety of mathematical techniques.
    - iv) Listening: receive, attend to, interpret, and respond to verbal messages and other cues.
    - v) Speaking: Organize ideas and communicate orally.
  - b) **Thinking Skills:** A worker must think creatively, make decisions, solve problems, visualize, know how to learn, and reason effectively. These skills include:
    - i) Creative Thinking: generate new ideas.
    - ii) Decision Making: specify goals and constraints, generate alternatives, consider risks, and evaluate and choose the best alternative.
    - iii) Problem Solving: recognize problems and devise and implement plan of action.
    - iv) Visualize ("Seeing Things in the Mind's Eye"): organize and process symbols, pictures, graphs, objects, and other information.
    - v) Knowing How to Learn: use efficient learning techniques to acquire and apply new knowledge and skills.
    - vi) Reasoning: discover a rule or principle underlying the relationship between two or more objects and apply it when solving a problem.
  - c) **Personal Qualities:** A worker must display responsibility, self-esteem, sociability, self-management, integrity, and honesty.
    - i) Responsibility: exert a high level of effort and persevere toward goal attainment.
    - ii) Self-Esteem: believe in one's own self-worth and maintain a positive view of oneself.
    - iii) Sociability: demonstrate understanding, friendliness, adaptability, empathy, and politeness in group settings.
    - iv) Self-Management: assess oneself accurately, set personal goals, monitor progress, and exhibit self-control.
    - v) Integrity and Honesty: choose ethical courses of action.
- 2) **Workplace competencies are defined in five areas: resources, interpersonal skills, information, systems, and technology.**
  - a) **Resources:** A worker must identify, organize, plan, and allocate resources effectively.
    - i) Time: select goal-relevant activities, rank them, allocate time, and prepare and follow schedules.
    - ii) Money: Use or prepare budgets, make forecasts, keep records, and make adjustments to meet objectives.
    - iii) Material and Facilities: Acquire, store, allocate, and use materials or space efficiently. Examples: construct a decision time line chart; use computer software to plan a project; prepare a budget; conduct a cost/benefits analysis; design an RFP process; write a job description; develop a staffing plan.
  - b) **Interpersonal Skills:** A worker must work with others effectively.
    - i) Participate as a Member of a Team: contribute to group effort.
    - ii) Teach Others New Skills.
    - iii) Serve Clients/Customers: work to satisfy customer's expectations.

- iv) **Exercise Leadership:** communicate ideas to justify position, persuade and convince others, responsibly challenge existing procedures and policies.
- v) **Negotiate:** work toward agreements involving exchange of resources, resolve divergent interests.
- vi) **Work with Diversity:** work well with men and women from diverse backgrounds.

Examples: collaborate with a group member to solve a problem; work through a group conflict situation, train a colleague; deal with a dissatisfied customer in person; select and use appropriate leadership styles; use effective delegation techniques; conduct an individual or team negotiation; demonstrate an understanding of how people from different cultural backgrounds might behave in various situations.

- c) **Information:** A worker must be able to acquire and use information.

- i) **Acquire and Evaluate Information.**
- ii) **Organize and Maintain Information.**
- iii) **Interpret and Communicate Information.**
- iv) **Use Computers to Process Information.**

Examples: research and collect data from various sources; develop a form to collect data; develop an inventory record-keeping system; produce a report using graphics; make an oral presentation using various media; use on-line computer data bases to research a report; use a computer spreadsheet to develop a budget.

- d) **Systems:** A worker must understand complex interrelationships.

- i) **Understand Systems:** know how social, organizational, and technological systems work and operate effectively with them.
- ii) **Monitor and Correct Performance:** distinguish trends, predict impacts on system operations, diagnose deviations in systems' performance and correct malfunctions.
- iii) **Improve or Design Systems:** suggest modifications to existing systems and develop new or alternative systems to improve performance.

Examples: draw and interpret an organizational chart; develop a monitoring process; choose a situation needing improvement, break it down, examine it, propose an improvement, and implement it.

- e) **Technology:** A worker must be able to work with a variety of technologies.

- i) **Select Technology:** choose procedures, tools or equipment including computers and related technologies.
- ii) **Apply Technologies to Task:** understand overall intent and proper procedures for setup and operation of equipment.
- iii) **Maintain and Troubleshoot Equipment:** Prevent, identify, or solve problems with equipment, including computers and other technologies.

Examples: read equipment descriptions and technical specifications to select equipment to meet needs; set up and assemble appropriate equipment from instructions; read and follow directions for troubleshooting and repairing equipment.