



# Course Book

## Course Description

This course is an introductory course to Clinical Chemistry that includes the definitions, principles and procedures of multiple medical laboratory tests conducted in Clinical Chemistry.

The course represents the physiological basis, principle and procedure, and clinical significance of test results, including quality control and reference values.

It also includes basic chemical laboratory technique and safety, electrolytes, acid-base balance, proteins, carbohydrates, lipids, enzymes, endocrine function, and toxicology.

### **Clinical Chemistry Tests:**

Common chemical pathology tests include:

#### **Lipid Profile tests;**

Total cholesterol;

Triglycerides;

HDL-C;

LDL-C;

VLDL-C;

#### **-Electrolytes**

Sodium;

Potassium;

Chloride;

Bicarbonate;

#### **-Renal (Kidney) Function Tests**

Creatinine;

Blood urea nitrogen;

#### **-Liver Function Tests**

Total protein (serum);

Albumin;

Globulins;

A/G ratio (albumin/globulin)

Protein electrophoresis

Urine protein

Bilirubin; direct; indirect; total

Aspartate transaminase (AST);

Alanine transaminase (ALT);

Gamma-glutamyl transpeptidase (GGT);

Alkaline phosphatase (ALP);

#### **-Cardiac Markers**

Troponin

Myoglobin

	<p>CK-MB B-type natriuretic peptide (BNP)</p> <p><b>-Minerals</b> Calcium; Magnesium; Phosphate; Potassium;</p> <p><b>-Blood Disorders</b> Iron; Transferrin; TIBC Vitamin B12 Folic acid</p> <p><b>-Miscellaneous</b> Glucose; C-reactive protein; Glycated hemoglobin (HbA1c); Uric acid; Arterial blood gases (); Adrenocorticotrophic hormone (ACTH); Toxicological screening and forensic toxicology (drugs and toxins); Neuron specific enolase (NSE); Fecal occult blood test (FOBT)</p>
<b>Course objectives</b>	The main objective of the course is to make students gain sufficient expertise for working in medical laboratories through teaching them the basics of laboratory work including safety protocols, quality control principles, contemporary knowledge, good attitude, medical ethics and professionalism basics during practice.
<b>Student's obligation</b>	<ul style="list-style-type: none"> <li>-Students must attend weekly theoretical and practical lectures.</li> <li>-Students must take part in marked class discussions.</li> <li>-Students must also attend all exams during the course.</li> <li>-Students must gain sufficient marks (at least 50%) at the end of the course to pass.</li> </ul>
<b>Required Learning Materials</b>	<ul style="list-style-type: none"> <li>- Printouts of weekly lectures taught at the college campus (Theoretical and Practical).</li> <li>- Reviewing of internet</li> <li>- Proper laboratory (Chemistry, Clinical Chemistry, or Biochemistry).</li> <li>- Proper instruments (Spectrophotometers, Chemical analyzers).</li> <li>- Specialized test kits</li> <li>- Laboratory glassware, equipment</li> </ul>

<b>Evaluation</b>	<b>Task</b>		<b>Weight (Marks)</b>	<b>Due Week</b>	<b>Relevant Learning Outcome</b>
	Paper Review				
	<b>Assignments</b>	Homework	5%		Encourages students to search for more detailed knowledge relevant to the topics taught at campus.
		Class Activity	2%		
		Lab. report	10%		Report their weekly laboratory work
		Seminar	10%		Enhances the preparation and presenting skills of the students
		Essay			To make students engage more with their favorite topics
		Project			
	Quiz		8%		To encourage students study every week.
	Lab.				To make students practice obeying the laboratory rules including scientific, safety, attitude, and ethics.
Midterm Exam		25%		To evaluate students and their achievements at the middle of the term.	
Final Exam		40%		Final evaluation and assessment.	
Total		100%			
<b>Specific learning outcome:</b>	<p><b>By the end of this course the student should be able to:</b></p> <ol style="list-style-type: none"> <li>1- Demonstrate sufficient skills in using Clinical Chemistry's lab equipment including spectrophotometer, and other chemical analyzers.</li> <li>2- Demonstrate skills in performing tests and executing various procedures with considerations to standards and maintain quality.</li> <li>3- Exhibit knowledge of body chemistry levels under healthy or abnormal conditions.</li> </ol>				

	<p>4- Properly evaluate the suitability of clinical chemistry specimens.</p> <p>5- Properly prepare chemistry specimens for analysis.</p> <p>6- Accurately record and report results, indicating normal and abnormal values.</p> <p>7- Evaluate quality control results and note trends, shifts and invalid results.</p> <p>8- Discuss recent trends in clinical chemistry.</p> <p>9- Demonstrate speed and accuracy in the analysis of chemistry specimens for the following types of procedures utilizing only necessary supplies and within a predetermined/reasonable amount of time.</p>	
<b>Course References:</b>	<p><b>Books:</b></p> <p>1- Clinical Chemistry (A laboratory perspective) by: Wendy Arneson and Jean Brickell</p> <p>2-Clinical Chemistry (principles, procedures, correlations) by: Michael L. Bishop and Larry Schoef</p> <p>3-Practical Clinical chemistry by: Harold Varley</p> <p>4-Biochemical methods by S. Sadasviam and A. Manickam</p> <p><b>Journals and internet review</b></p>	
<b>Course topics (Theory)</b>	<b>Week</b>	<b>Learning Outcome</b>
Introduction to Clinical Chemistry II, definitions, objectives, importance, and applications	1	To make students familiar with the science and its importance in practice.
Electrolytes, definitions, classifications, functions	2,3	
Non protein nitrogen compounds, definitions, classifications, metabolism.	4	
Disease correlations of blood urea, creatinine, and uric acids	5,6	
Enzymes, definitions, classifications, metabolism	7	
Disease correlations of enzymes, activity measurements Muscle enzymes, Liver enzymes, pancreatic enzymes	8,9	
Hemoglobin, Iron, and Bilirubin	10, 11	
Trace elements and vitamins	12, 13	
Hormones	14, 15	

Practical Topics	Week	Learning Outcome
Introduction to Clinical Chemistry II lab, lab safety rules and regulations	1	
Urea, Creatinine, Uric acid tests	2,3,4	
Electrolytes Na <sup>+</sup> , K <sup>+</sup> , Cl <sup>-</sup> tests	5,6,7	
Liver function tests: ALT, AST, ALP, TSB	8,9,10	
Serum Iron test	11	
Serum calcium test	12	

### Questions Example Design (theoretical and practical exam):

#### Q1/ What is the role of each of the following "compounds" in their specialized kit reagents or tests? 30 Marks

- 1- Polyvinylpyrrolidone (PVP) in calcium ion test reagent.
- 2- Creatine Kinase enzyme in serum creatinine test reagent.
- 3- Uricase enzyme in serum uric acid test reagent.
- 4- Alkaline medium in blood urea test reagent.
- 5- Ketone bodies and proteinuria in creatinine clearance test.
- 6- NAD<sup>+</sup> in LDH test.

#### Q2/ Fill in the blanks with an appropriate word. 30 Marks

- 1- LDH-1 isoenzyme is higher in ..... and ....., while LDH-5 isoenzyme is present mostly in ..... and .....
- 2- Serum creatinine's normal range is relatively low (0.6-1.3 mg/dL), because its readily .....
- 3- Alkaline phosphatase enzyme catalyzes the ..... of ..... at alkaline pH 9.0, hence the name alkaline phosphatase.
- 4- ..... results from the overproduction of ..... bilirubin in newborn infants, and their limited ability to ..... it or excrete it.
- 5- Reabsorption of Ca<sup>2+</sup> occurs in the proximal tubule linked to ..... while in distal tubule depends on .....
- 6- Very high ..... concentration accompanied by renal failure is called uremia.
- 7- The modern terminology for GPT is .....
- 8- Increased ..... are found in hemolytic disease and in defective liver cell function such as that seen in hepatitis.
- 9- GOT-1 is present in ....., while GOT-2 is in ..... of the cell.
- 10- When tubules secrete substances into the urine, GFR is ..... clearance.
- 11- ..... is synthesized in the kidneys and liver from some amino acids such as ....., ..... and .....
- 12- The only biologically active form of calcium is .....

#### Q3/ Answer the following questions: 40 Marks

- A/ Write causes of abnormal levels of blood urea.
- B/ Classify the types of hyperuricemia according to their origin and differentiate between them.

C/ Define Jaundice, write causes leading to it.

D/ What is clearance? How Creatinine clearance is calculated (tested)?

**Q1/ Choose the most correct answer from the given options (Only 15).**

**30 marks**

1- Calibration of spectrophotometer is needed while .....

- a. Selection of wavelength,                      b. Measurement of unknown conc. solution, c. Blank, d. All of them

2- Urobilinogen is ..... colored.

- a. Yellow,    b. Pink,                      c. Colorless,                      d. Brown

3- Reverse cholesterol transport is the process of up taking and transporting of cholesterol from tissues to the liver by the role of .....

- a. VLDL,    b. HDL,                      c. LDL,                      d. TG

4- Absence of albumin called .....

- a. Bisalbuminemia,                                      b. Albonimia,                      c. Analbonimia,                      d. STP

5- Glucagon increases glucose in blood, so it's a .....

- a. Hyperglycaemic,                                      b. Hypoglycaemic,                      c. During fasting,                      d. During stress

6- The highest in concentration of plasma proteins is .....

- a. Plasma cells,    b. Albumin,                      c. Globulins,                      d. Fibrinogen

7- In Beer-Lambert's law ( $A = \epsilon bc$ ), c is .....

- a. Cuvette's base length, b. Sample concentration,                      c. Constant value,                      d. Std. concentration

8- Creatine Phosphate – ..... = Creatinine

- a. ATP,    b. ADP,                      c. Phosphoric acid,                      d. water

9- 25 mg/dL is ..... 0.25 g/L.

- a. Smaller than,    b. Bigger than,                      c. Equal to,                      d. none of them

10- Some substances when filtered through tubules are not reabsorbed, so they are .....

- a. Partially cleared,                      b. 100% cleared,                      c. GFR,                      d. Inulin

11- Pre renal causes for high levels of blood urea include .....

- a. Kidney stone,    b. Liver disease,                      c. Urinary tract obstruction,                      d. Renal failure

12- In viral hepatitis, immunoglobulin level is .....

- a. Decreased,    b. Increased,                      c. Does not change,                      d. All of them

13- High spgr urine is a symptom for .....

- a. Hyperglycaemia,    b. Hypoglycaemia,                      c. Hyperurecaemia,                      d. Uremic syndrome

14- ..... is the primary hormone responsible for decreasing glucose in the blood.





18	Specimen mislabeled		R	Eliminate or subtract the effects of reagent or specimen colors
19	Immunoglobulins		S	Deamination of amino acids
20	Free bilirubin		T	380 – 750 nm
21	Specimen + precipitant		U	ATP → ADP

**Extra notes:**

**External Evaluator**