Course Title: Clinical Biochemistry

Course Description: This course is designed to the **2th year** undergraduate Thi-Qar medical college students the goal of the Clinical Chemistry department is study the basic science of chemistry and metabolic processes occurring in the human body in order to understand the biochemical basis, correlated symptoms, signs and complication of disease to biochemical events

Course Duration: 90 hours of theory and 30 hours of practice

Course learning Units: 8 units .

Course General Objectives:

Goal of clinical biochemistry: The goal of the Clinical Chemistry is study the metabolic processes occurring in the human body in order to understand the biochemical basis, correlated symptoms, signs and complication of disease to biochemical events.

Teaching methods: Each lecture is accompanied with power point presentation , examines (quiz), and major individual project that takes the form of seminars , Case Studies Presentations , group & class discussion and active Participation by clinical biochemistry research .

Objectives:

The student will be capable of

1-The detailed relationships between basic science, organ physiology and function, pathophysiology, patient outcomes and selected topics of evidence-informed care and management.

2-Investigations for metabolic disorders.

3-Provide additional information regarding the current diagnosis.

Specific objectives :

Explained with in topics description in the attached table.

Teaching strategy (overview):

- Objective – based learning
- Student-centered learning
- Active student interaction

Teaching and Learning Methods:

The course will use the following teaching and learning methods:

- **Theory sessions :**
  - **Lectures:** Knowledge acquisition
  - **Visual aids** (e.g., films , videos, , and illustrations): Knowledge acquisition and skill development.
  - **Group discussion** - critical thickening

Practical part of clinical chemistry

Goals:. The practical part of clinical chemistry goal to the analysis and testing of body fluids and tissues to develop and expand of the information in and clinical reasoning skills by data gathering and interpretation, hypothesis generation , testing, and critical evaluation of diagnostic, monitoring, and prognosis of most disease processes

Blueprint for 2th year medical student in Thi-Qar college of medicine include:

- Three hours Theoretical / Two hours Practical weekly

- The course will be divided into the following topics:

Week NO	Lecture Name	Specific Objective	hours	ILO	Assessment Method						Total Weight (impact X frequency
					Summative			Formative			
					Written	practical	Log book	Quizzes	Group discussion	Project homework	
1.	**Catabolism of Amino Acids**	• The students are learned to understand the Catabolism of amino acids including aminoacids pool and removal of amino group by transamination • Explain diagnostic importance of aminotransferase enzymes • Explain how ammonia transfer to the liver	1	K:1,6,19 S:4,6,15	X		X	X			22
2.	**Urea Cycle**	• Describe the reactions of the Urea Explain the fate of urea after being synthesized • List the sources for ammonia in the body • Describe hyperammonemia, its clinical consequences and its types	1	K:1,2,3,5,10, S:2,3,4,14,15	X			X	X		17
3.	**AMINO ACID CARBON SKELETON**	• Define ketogenic and glucogenic amino acids, and list them as exclusively ketogenic,glucogenic, or both. • Explain the relation between homocysteine and cardiovascular diseases • Describe the role of Folic Acid in Amino Acid Metabolism	1	K:1,3,4,8.18,6,19 S:3,4,15	X		X	X	X		19
4.	**BIOSYNTHESIS OF NONESSENTIAL AMINO ACIDS**	• Define the nonessential a.a and list them • Explain the biochemical reactions of nonessential a.a synthesis		K:2,3,10 S:4	X		X	X	X	X	20
5.	**AMINO ACID METABOLISM DISORDERS**	• Explain the biochemical basis of inborn errors of amino acid metabolism including the deficient enzyme, relation of the deficiency to the buildup of secondary metabolites and the clinical sign and symptoms related to the disease. • The following diseases	1	K:1,6,3,4,8.1,19 S:4,,15	X		X	X	X	X	20

		were discussed a) Phenylketonuria b) Maple syrup urine disease c) Albinism d) Homocystinuria e) Alkaptouria									
6.	**Conversion of amino acids to specialized products**	• Describe porphyrin and heme synthesis • Definition of porphyria and its types.	2	K:1,6,19 S:4,6	X		X	X	X	X	19
7.	**OTHER NITROGEN-CONTAINING COMPOUNDS**	• Describe types of catecholamine, its biological role ,its synthesis and catabolism • Definition of histamine and its synthesis • Definition of serotonin ,its synthesis and biological function • Definition of creatine. Its synthesis and degradation • Definition of melanin ,its synthesis and biological function	2	K1,2,4,8,18,19 S:3,6,11	X		X	X	X	X	14
8.	**Carbohydrate CHO Metabolism**	• Explain the digestion of dietary CHO and how this is accomplished • Illustrate the overall purpose of glycolysis • Definition and explanation of aerobic and anaerobic glycolysis and citric acid cycle • Definition of glycogen, its sites and role in glucose homeostasis . • Describe the overall purpose of glycogenesis and glycogenolysis and their contribution to blood glucose regulation • explanation of glycogen storage disease and its types. • Describe the overall purpose of gluconeogenesis, its regulation, different precursors and Medical and Biological Importance. • Explain hormonal regulation of blood glucose • Illustrate the Pentose phosphate pathway	12	K:1,2,3,7,10,19 S:4,6,11,12,14,15	X	X	X	X	X	X	25

		• Definition of Glucose 6 Phosphate Dehydrogenase Deficiency (G6PDD) disease • Explain the role of liver and other organs in buffering of blood glucose									
9.	**Digestion and absorption**	• Illustrate how CHO ,lipid, proteins, and minerals are digested and absorbed • Describe the abnormal status or diseases of malabsorption	2	K:1,2 S:12, 14	X		X	X	X		17
10	**Lipid metabolism**	- Brief review about lipids chemistry including fatty acids, Cholesterol, Triglycerides, and Phospholipids - Their sources, function, and plasma levels	1	K:2,3,10 S:12	X	X	X	X	X	X	21
11	**SYNTHESIS OF TRIGLYCERIDES**	The students are learned to understand the Triglycerides metabolism including the following points: -Synthesis of Triglycerides - Source of glycerol -3-Phosphate - Function of TG -Hormonal Regulation of Triglycerides and Degradation in Adipose tissue	1	K:2,4,10 S:12,15	X	X	X	X	X	X	21
12	**FATTY ACIDS**	The students are learned to understand the SYNTHESIS OF THE FATTY ACIDS including the following points: -Transportation of acetyl CoA. -Formation of malonyl CoA. -Fatty acid synthase multienzyme complex Interrelationship between glucose metabolism and palmitate synthesis - Elongation and Desaturation of the fatty acids chain -Regulation of lipogenesis -Illustrate NADPH Sources	2	K:1,2,4,6,9 S:2,11	X		X	X	X	X	19
13	**OXIDATION OF THE FATTY ACIDS**	Explain the OXIDATION OF THE FATTY ACIDS including the following	1	K:1,4,6,9,18,19 S:2,4,12	X		X	X	X	X	17

		points: - Carnitine shuttle and causes of carnitine deficiency - Beta oxidation pathway - Oxidation of the Fatty Acids with Odd Number of C atoms - Oxidation of the unsaturated Fatty Acids									
14	**CHOLESTROL METABOLISM**	Illustrate the Cholesterol Metabolism regarding the following points: - Biosynthesis of Cholesterol and steps of synthesis - Regulation of Cholesterol Biosynthesis - Degradation of cholesterol	1	K:1,4,13,18,19 S:3,12	X	X	X	X	X	X	21
15	**Lipoproteins**	Definition of lipoproteins; their structure, classification, composition, and functions -Explain The functions of apo-protein - Illustrate the Enzymes involved in lipids transport - Explain the Metabolism of Lipoprotein	2	K:1,3 S:12	X	X	X	X	X	X	16
16	**SPHINGOLIPIDS**	The students are learned to understand the Sphingolipids metabolism including the following points: The Types of Sphingolipids -definition of sphingomyelin, its structure ,synthesis and degradation Definition of Glycosphingolipids, its function types and degradation Illustrate the lipid storage diseases. Explain Prostaglandins and Related Compounds	1	K:1,6 S:11	X		X	X	X		16
17	**PHOSPHOLIPIDS**	Definition of phospholipid, its types, synthesis , function, and degradation	1	K:1 S:3	X		X	X	X	X	16
18	**Ketone bodies**	The students are learned to understand the Ketone Bodies Metabolism -definition of Ketogenesis - Illustrate the Utilization of ketone bodies - Describe the Mechanism of Ketosis	1	K1,6,9,18 S:4,11	X	X	X	X	X	X	

19	**Disorders of lipid metabolism**	Listing the investigations and most important points in patient history and examination. -illustrate types of hyperlipidemia and explanation of each type -Description of fatty liver and illustrate the effect of alcohol on the lipid metabolism	2	K:1,3,12 S:1,3,4,7	X	X	X	X	X		17
20	PCR types and using in genetics	At the end of the presentation, participants should know: • Definition and short technical overview of PCR • Applications of PCR •Review DNA replication, knowledge of the process, and how it occurs. •What is PCR amplification of RNA • Examples for diagnostics with PCR	2	K:1,3,19 S:12	X		X	X	X	X	19
21	Obesity	• Definition of Obesity • Assessment of obesity by (BMI) • Cause of obesity • The primary metabolic effect of obesity • Obesity and Diseases	2	K:1,2,4,5,8,10 S:1,3,4			X	X	X	X	17
22	Clinical biochemistry at the extreme of age	• the objective of clinical biochemistry at the extremes of age is to provide valuable diagnostic and monitoring tools that cater to the unique healthcare needs of pediatric and geriatric patients, ensuring their well-being and quality of life	2	K:1,2,4,5,8,13			X	X	X	X	16
23	**Introduction to hormones**	• definition of hormones and their general functions • To illustrate the classification of hormones. • To verify the second messengers of hormones. • study the basic principles of hormone action. • Explanation of feedback control mechanism • illustrate the principle of hormone assay .	1	K:1,6,13,19, S:11,12,15	X		X	X	X	X	21
24	**Hypothalamic**	• Describe anatomy and	1	K:1	X		X	X	X	X	17

	Hormones	function of hypothalamic hormones Listing hormones released by the hypothalamic gland and their control of the pituitary gland		S:3							
25	**Pituitary hormones**	To study the control of pituitary hormones secretion. Describe the anterior pituitary hormone secretion regarding chemistry, control, effects and pathophysiology.	2	K:1,4,11,13,18 S:4,12	X		X	X	X		16
26	**Posterior Pituitary**	To study the chemistry, control, effects and pathophysiology of oxytocin secretion. - To study the chemistry, control, effects and pathophysiology of ADH secretion.	1	K:1,2,4, 10, 19 S:5,14	X		X	X	X	X	14
27	**Thyroid gland**	• Describe thyroid hormone secretion regarding chemistry, control, effects and pathophysiology. • explain the role of the different thyroid function tests in the diagnosis of thyroid disease • To illustrate the Hormones that regulate calcium metabolism	2	K:1,6,4, 10, 19 S:4,12,14	X		X	X	X	X	16
28	**The adrenal gland**	• To explain the biosynthesis of hormones that secreted from the adrenal cortex and their function • Define adrenal androgen and their biosynthesis • Illustrate the effect of stress on the pituitary-adrenal axis • Definition of Congenital adrenal hyperplasia (CAH) and the biochemical causes • Explain adrenal hyperfunction ,causes, metabolic changes and investigations • Explain adrenal hypofunction ,Causes and metabolic features • To study the adrenal medulla hormone secretion and biosynthesis • To verify the metabolism and effects of catecholamines and	2	K:1,2 S:4,12,14	X		X	X	X	X	16

		the disorders of their secretion. .									
29	**The Pancreas**	• study the pancreatic islet hormone secretion. • study the control of insulin secretion and effects of insulin. • Illustrate the secretion and effect of glucagon secretion • Definition of Somatostatin ,its effect and disorders that result from abnormal secretion • Explain the pancreatic polypeptide ,its function and the causes of abnormal level	2	K:1,2, ,18,19 S:3,5	X		X	X	X	X	12
30	**Plasma enzymes in diagnosis (clinical enzymology)**	• know the role of plasma enzymes in the diagnosis of different diseases • The following enzymes will be discussed regarding their biochemistry, sites ,causes of abnormal level and their role in diagnosis of different diseases a) Amylase b) b. Lipase c) c. Alkaline phosphatase d) d. Acid phosphatase e) e. Aminotransferase f) f. GD g) g. LDH h) h. CPK • Illustrate the role of cardiac enzymes in the diagnosis of myocardial infarction the time sequence of their changes	4	K:1,2,4, 5,8,13 S:5,12,1 5	X	X	X	X	X	X	20
31	**Liver functions**	• Describe the basic function of the liver related to metabolic , synthetic and excretory function • Illustrate the metabolism of bilirubin and it types • Definition of jaundice and discuss the classification and causes • Discuss the neonatal jaundice , causes and clinical complications	4	K:1,2, 7,10,11, 19, S:3,4,5, 7,12,15	X	X	X	X	X	X	22

		• Explain inherited causes of hyperbilirubinemia • Listing the parameters of liver function test and illustrate the role of each parameter in the diagnosis of liver diseases • Describe the various types of hepatitis, their pathology and investigations that asses in diagnosis									
32	**Minerals metabolism**	At the end of this subject the student will understand minerals metabolism regarding the following points: • Calcium metabolism and factors that affect calcium intake and loss • Concept of corrected or adjusted calcium • Hormonal regulation of calcium metabolism • Disorders of calcium metabolism • Effect of potassium • Transport mechanism of potassium between EC and IC compartment • Relationship between hydrogen and potassium ions • Disorders of potassium metabolism	6	K:1,7, 10,12, 19, S:,4,5,12,15	X	X	X	X	X	X	21
33	**CANCER BIOCHEMISTRY**	• Define Cancer and its causes • Explain classification of tumor markers. • Understand the ideal tumor markers. • Elaborate major tumors with its associated tumor markers. • Metabolic aspect of malignant disease	2	K:1,2,4, 5,8,10 S:1,3,4	X		X	X			12
34	**NUTRITION**	• describe the science of nutrition. • Illustrate important facts regarding nutrition. • describe the dietary reference intakes	2	K:1,3 S:5,11	X		X	X			12
35	**Metabolic response to trauma**	• Describe conditions trigger metabolic response. • illustrate hormonal	2	K:1,4,3, 8,9,11 S:5,3,12	X		X	X			12

		changes during the metabolic response to trauma • study the extent of metabolic response to trauma. • study the factors modifying metabolic response to trauma. • Explain physiological changed during catabolic phase. • illustrate consequences of prolonged catabolic state. • To verify changes during the anabolic phase									
36	**Nucleic acids**	Upon completion of this lecture, the student will have the ability to understand the following • DNA directs the development and Cell division. • Expression of genetic information and protein synthesis • DNA Organization, Replication, & Repair • RNA Synthesis, Processing, & Modification • Protein Synthesis & the Genetic Code • Regulation of Gene Expression • Molecular Genetics, Recombinant DNA, & Genomic Technology	5	K:1 S:4,5	X		X	X	X	X	22
37	**Purine and pyrimidine metabolism**	• Name the major purine and pyrimidine bases • Integrate the terminology and defining structural features that distinguish different classes of nucleotide metabolites • Describe the biosynthesis of the purine and pyrimidine. • Explain the salvage pathways for purine and pyrimidine and their relevance to pharmacotherapy • Connect the pentose phosphate pathway to PRPP synthesis	2	K:1,6 S:5			X	X	X		19

		• identify inborn errors of purine metabolism									
38	**Kidney functions**	• Definition of renal glomerular test and explanation of how to determine GFR • Definition of clearance tests and mention the common types • Definition of tubular function and illustrate the Isosmotic transport and Ion exchange processes • Illustrate the role of Plasma measurement of urea, creatinine and electrolytes in the assessment of the glomerular functions • Definition of acute kidney injury ,its causes and investigation • Definition of Chronic kidney disease ,its causes and biochemical changes • Explain the role of Renal tubular function tests in the diagnosis of renal tubular damage • Definition of Renal proteinuria and types	7	K:1,2, 7,10,11, 19, S:3,4,5, 7,12,15	X	X	X	X	X	X	21
39	**Cerebrospinal fluid**	• Definition of CSF and its biological function • Explain how CSF is collected, indications and contraindications to lumber puncture • Illustrate the physical and biochemical analysis of CSF and their parameters • Explain the normal and abnormal status of biochemical components of CSF	2	K:1,2,4, 7,8,18, 19 S:3,5,15	X		X	X			12
40	**BIOLOGICAL OXIDATION**	• Define respiration • Understand the principle of oxidation / reduction • Define oxidative phosphorylation • Understand its parts, Components and Site	2	K:1,19 S:5	X		X	X	X		12

Assessment Methods:

The course will use the following assessment methods:

1.Written exams (short essay questions ,long essay) to assess the students' knowledge and understanding of the theory.

2.Practical exams (Conduct clinical chemical analyzes (manually) to diagnose associated diseases and determine their concentrations inside the body.

3.Logbook (documentation of the performance of the practical procedure)

4.Formative assessment :

- Examination of the first and second semesters, theoretical and practical

- Daily or quick theoretical and practical exams

- Theoretical and practical mid-year exams

- Theoretical and practical year-end exams

- Research evaluation

Grading and Evaluation:

The grading system for the course will be as follows:

-Pass mark = 50%

Type exam	1st course	2st course	mid-year exams	final exam	Total
Theoretical exam	6 %	6 %	20%	50%	100%
Practical exam	1.5 %	1.5 %	5 %	10%	

Textbooks approved

1- Martin A Crook , Clinical biochemistry and metabolic medicine , Hodder Arnold , 4th ed

2- Lippincott's Illustrated Reviews: Biochemistry integrates and summarizes the essentials of medical biochemistry, 4th Ed.

Lecturers:

1- Dr. Lamees Majid - Head of Clinical Biochemistry Department.
2- Dr.Idrise Muhson Abeed - Establisher of Clinical Biochemistry Department
3- Ass. Prof Dr. Wajdy J. Majid - Clinical Biochemistry Department
4- Lecturer Dr. Ula Abbas Zeki- Clinical Biochemistry Department
5- Lecturer Dr.Zainab Ali Kadhim - Clinical Biochemistry Department