

# Postgraduate Certificate

## Role of the Biochemistry Laboratory in the Field of Clinical Analysis





## Postgraduate Certificate

### Role of the Biochemistry Laboratory in the Field of Clinical Analysis

Course Modality: Online

Duration: 12 weeks

Certificate: TECH Technological University

Teaching Hours: 300 hours.

Website: [www.techtute.com/us/medicine/postgraduate-certificate/role-biochemistry-laboratory-field-clinical-analysis](http://www.techtute.com/us/medicine/postgraduate-certificate/role-biochemistry-laboratory-field-clinical-analysis)

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# 01

# Introduction

This Postgraduate Certificate delves into the study of the different aspects of work in biochemistry, within the clinical analysis laboratory. The relevance of the work in this area implies the need for a broad and complete training that allows the professional to perform all the techniques and protocols necessary to achieve the precise results demanded.



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*Update your knowledge in the latest techniques and work systems in Biochemistry in the clinical analysis laboratory, with the most efficient teaching*

The most clinical part of this modality is oriented to the analysis in hospital laboratories that allows the assistance to the patient as a clinical support of the doctors. Therefore, research in clinical biochemistry or biomedicine is an essential science nowadays since it serves to study the molecular mechanisms of the physiological processes that occur in our organism and at the same time, they allow investigating the failure of these physiological processes and their consequences for health.

The Postgraduate Certificate addresses the biochemical base underlying the molecular pathology of diseases. It develops the physiological regulation that governs the correct functioning of biochemical processes, as well as the reasons why the interruption or incorrect functioning of these processes leads to the development of a pathology.

It also analyzes the molecular basis that initiates biochemically based pathologies and their diagnosis by means of the management of analytical parameters through the practical resolution of clinical cases. Practical learning through clinical cases is a fundamental part of the work of the module, with a view to the work environment.

It addresses the molecular origin of diseases with the biochemical parameters to which they are associated in laboratory diagnostic tests. This training is the foundation of any clinical laboratory in the hospital setting and provides students with the necessary tools for their professional development.

In addition, the molecular causes of diseases will be reviewed in depth, allowing us, on the one hand, to identify the most appropriate therapeutic targets and altered functions. On the other hand, to establish a diagnosis through the recognition and management of different analytical parameters and the practical resolution of clinical cases. This knowledge is essential in any clinical laboratory and will allow the clinician to obtain the knowledge and tools necessary for professional growth and development.

A compendium and deepening of knowledge that will lead you to excellence in your profession.

This **Postgraduate Certificate in Role of the Biochemistry Laboratory in the Field of Clinical Analysis** offers you the advantages of a high-level scientific, teaching and technological course. These are some of its most notable features:

- ◆ The latest technology in online teaching software
- ◆ A highly visual teaching system, supported by graphic and schematic contents that are easy to assimilate and understand
- ◆ Practical cases presented by practising experts
- ◆ State-of-the-art interactive video systems.
- ◆ Teaching supported by telepractice
- ◆ Continuous updating and recycling systems
- ◆ Autonomous learning: full compatibility with other occupations
- ◆ Practical exercises for self-evaluation and learning verification
- ◆ Support groups and educational synergies: questions to the expert, debate and knowledge forums.
- ◆ Communication with the teacher and individual reflection work
- ◆ Content that is accessible from any fixed or portable device with an Internet connection
- ◆ Supplementary documentation databases are permanently available, even after the course



*With this Postgraduate Certificate you will be able to combine high intensity training with your personal and professional life, achieving your goals in a simple and real way”*

“ *A program created and directed by active professionals who are experts in this field of work, which makes this course a unique opportunity for professional growth.* ”

The teachers of this course are professionals currently working in a modern and accredited Clinical Laboratory, with a very solid training base and up-to-date knowledge in both scientific and purely technical disciplines.

In this way, we ensure that we provide you with the training update we are aiming for. A multidisciplinary team of professionals trained and experienced in different environments, who will cover the theoretical knowledge in an efficient way, but, above all, will put university the practical knowledge derived from their own experience at the service of the course: one of the differential qualities of this course.

This mastery of the subject is complemented by the effectiveness of the methodological design of this Course in Biochemistry. Developed by a multidisciplinary team, it integrates the latest advances in educational technology. This way, you will be able to study with a range of comfortable and versatile multimedia tools that will give you the operability you need in your training.

The design of this program is based on Problem-Based Learning: an approach that conceives learning as a highly practical process. To achieve this remotely, we will use telepractice learning: with the help of an innovative interactive video system, and learning from an expert, you will be able to acquire the knowledge as if you were actually dealing with the scenario you are learning about. A concept that will allow you to integrate and fix learning in a more realistic and permanent way.

*The learning in this Postgraduate Certificate is developed through the most performed didactic methods in online teaching to guarantee that your efforts produce the best results possible.*

*Our innovative telepractice concept will give you the opportunity to learn through an immersive experience, which will provide you with a faster integration and a much more realistic view of the contents: “Learning from an Expert”*



# 02 Objectives

The objective of this training is to offer professionals who work in clinical analysis laboratories, the necessary knowledge and skills to perform their duties using the most advanced protocols and techniques of the moment. Through a study plan totally adapted to the student, this Postgraduate Certificate will progressively allow you to acquire the skills that will push you towards a much higher professional level.







*Learn from the best and study the techniques and work procedures of Clinical Analysis to be able to work in the best laboratories in the field.*



## General Objectives

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- ◆ Analyze the molecular basis of biochemically based pathologies.
- ◆ Develop skills in the management and analysis of biochemical diagnosis parameters.
- ◆ Identify and define diseases with a biochemical base through analysis and practical cases.
- ◆ Apply different biochemical analytical techniques to the diagnosis of human diseases.
- ◆ Establish the molecular bases of human diseases.
- ◆ Know the routine procedures used in the field of biomedicine and the clinical analysis for generating, transmitting and divulging the scientific information.
- ◆ Develop skills for the analysis, synthesis and critical reasoning in the application of the scientific method.



*A boost to your CV that will give you the competitiveness of the best prepared professionals in the labor market"*





## Specific Objectives

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- ◆ Critically and thoroughly analyse the analytical data to perform a molecular diagnosis.
- ◆ Propose specific biochemical tests for the diagnosis of a molecular disease.
- ◆ Develop practical skills in the management of reference intervals and critical biochemical parameters for diagnosis.
- ◆ Collect and review scientific literature in an agile and exhaustive manner to conduct molecular diagnostics.
- ◆ Demonstrate the capacity to understand and explain the physiological and pathological mechanisms from a molecular perspective.
- ◆ Explain the applications of biochemical analysis in the clinical diagnosis of diseases.
- ◆ Identify the importance and complexity of the regulation of the biochemical processes that give rise to the various functions of the organism.
- ◆ Develop specialised knowledge of the different molecular mechanisms implicated in the biological process.
- ◆ Analyze the relative problems in the molecular bases of physiological processes and their consequences.
- ◆ Gain advanced knowledge in relation to the genetic bases of diseases.
- ◆ Demonstrate a good management of laboratory practice with clinical orientation.
- ◆ Analyze the experimental approximations and their limitations.
- ◆ Interpret scientific results and establish a relationship between those results and the genetic bases of the disease.
- ◆ Identify the applications of molecular diagnostic applications in clinical practice.

03

# Course Management

For our course to be of the highest quality, we are proud to work with a teaching staff of the highest level, chosen for their proven track record. Professionals from different areas and fields of expertise that make up a complete, multidisciplinary team. A unique opportunity to learn from the best.





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*An impressive teaching staff, made up of professionals from different areas of expertise will be your teachers during your training: a unique opportunity not to be missed"*

## International Guest Director

Jeffrey Jhang, M.D. is a dedicated expert in Clinical Pathology and Laboratory Medicine. He has won several awards in these areas, including the Dr. Joseph G. Fink Award from the Columbia University College of Medicine and Surgery, among other recognitions from the College of American Pathologists.

His scientific leadership has been latent thanks to his exhaustive work as Medical Director of the Clinical Laboratory Center, attached to the Icahn School of Medicine at Mount Sinai. At the same institution, he coordinates the Department of Transfusion Medicine and Cell Therapy. In addition, Dr. Jhang has held management positions in the Clinical Laboratory at the Langone Health Center of New York University and as Chief of the Laboratory Service at Tisch Hospital.

Through these experiences, the expert has mastered different functions such as the supervision and management of laboratory operations, complying with the main regulatory standards and protocols. In turn, he has collaborated with interdisciplinary teams to contribute to the accurate diagnosis and care of different patients. On the other hand, he has spearheaded initiatives to improve the quality, performance and efficiency of analytical technical facilities.



## Dr. Jhang, Jeffrey

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- Director of Clinical Laboratories at NYU Langone Health, New York, United States
- Director of Clinical Laboratories at NYU Tisch Hospital, New York
- Professor of Pathology at the NYU Grossman School of Medicine
- Medical Director of the Clinical Laboratory Center at Mount Sinai Health System
- Director of the Blood Bank and Transfusion Service at Mount Sinai Hospital
- Director of Hematology and Coagulation Specialty Laboratory at Columbia University Irving Medical Center
- Director of the Parathyroid Tissue Collection and Processing Center at Columbia University Irving Medical Center
- Assistant Director of Transfusion Medicine at Columbia University Irving Medical Center
- Transfusion Medicine Specialist at the New York Blood Bank
- M.D. from the Icahn School of Medicine at Mount Sinai
- Anatomic and Clinical Pathology Residency at NewYork-Presbyterian Hospital
- Member of:

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*Thanks to TECH, you will be able to learn with the best professionals in the world”*

## Management



### Ms. Cano Armenteros, Montserrat

- ♦ Bachelor's Degree in Biology. University of Alicante
- ♦ Master's Degree in Clinical Trials University of Seville
- ♦ Official Master's Degree in Primary Care Research by the Miguel Hernández University of Alicante for the Doctorate
- ♦ Recognition from the University of Chicago, USA Outstanding
- ♦ Certificate of Pedagogical Aptitude (CAP) University of Alicante

## Professors

### Dr. Utrilla Carriazo, Carmen Lucía

- ♦ Degree in Biochemistry from the Complutense University of Madrid, 2019.
- ♦ Master's Degree in Neurosciences from the Complutense University Madrid (2019 - 2020).
- ♦ Degree in Biochemistry from the Complutense University Madrid (2015 - 2019).

### Dr. Cela Rodríguez, Carmela

- ♦ Degree in Biochemistry from the Complutense University of Madrid, 2019.
- ♦ Research Master's Degree in Immunology from the Complutense University Madrid (2020).
- ♦ Research Master's Degree in Immunology. Complutense University of Madrid (2019/2020)  
Average Mark: 9.6/ 10
- ♦ Master's Thesis: "Preclinical targeting of T-ALL relapse using a novel immunotherapy with anti-pre-TCR CAR-T cells" Honorary Degree
- ♦ Degree in Biochemistry Complutense University of Madrid (2015-2019)
- ♦ Erasmus+ Placement Trinity College Dublin (2018-2019)
- ♦ Degree Thesis: "Synthesis and characterization of nanomaterials with biomedical applications". Qualification 9.8.





# 04

# Structure and Content

The contents of this Postgraduate Certificate have been developed by the different teachers of this course, with a clear purpose: to ensure that our students acquire each and every one of the skills necessary to become true experts in this field.

A complete and well-structured program that will take you to the highest standards of quality and success.





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*A comprehensive teaching program, structured in well-developed teaching units, oriented towards learning that is compatible with your personal and professional life"*

## Module 1. Biochemistry I

- 1.1. Biochemical and Molecular Base of Diseases
  - 1.1.1. Genetic Alterations
  - 1.1.2. Cell Signaling Alterations
  - 1.1.3. Metabolism Alterations
- 1.2. Metabolism of Nutrients
  - 1.2.1. Concept of Metabolism
  - 1.2.2. Biochemical Phases of Nutrition: Digestion, Transport, Metabolism, Excretion
  - 1.2.3. Clinical Laboratory in the Study of Alterations in Digestion, Absorption and Metabolism of Nutrients
- 1.3. Biochemical Study of Vitamins and Vitamin Deficiency
  - 1.3.1. Liposoluble Vitamins
  - 1.3.2. Hydrosoluble Vitamins
  - 1.3.3. Vitamin Deficiencies
- 1.4. Biochemical Study of Protein Alterations and Nitrogen Compounds
  - 1.4.1. Plasmatic Proteins
  - 1.4.2. Clinical Enzymology
  - 1.4.3. Evaluation of Biochemical Markers in Renal Function
- 1.5. Biochemical Study of Carbohydrate Metabolism Regulation and its Pathophysiological Alterations
  - 1.5.1. Hypoglycemia
  - 1.5.2. Hyperglycemia
  - 1.5.3. Diabetes Mellitus: Diagnosis and Monitoring in a Clinical Laboratory
- 1.6. Biochemical Study of the Pathophysiological Alterations of Lipids and Plasma Lipoproteins
  - 1.6.1. Lipoproteins
  - 3.6.2. Primary Dyslipidemia
  - 3.6.3. Hyperlipoproteinemia
  - 3.6.4. Sphingolipidosis
- 1.7. Biochemistry of Blood in a Chemical Laboratory
  - 1.7.1. Blood Hemostasis
  - 1.7.2. Coagulation and Fibrinolysis
  - 1.7.3. Biochemical Analysis of Iron Metabolism
- 1.8. Mineral Metabolism and its Clinical Alterations

- 1.8.1. Calcium Homeostasis
- 1.8.2. Phosphorus Homeostasis
- 1.8.3. Magnesium Homeostasis
- 1.8.4. Biochemical Markers of Bone Remodeling
- 1.9. Acid-Base Balance and Peripheral Blood Gas Study
  - 1.9.1. Acid-Base Balance
  - 1.9.2. Peripheral Blood Gasometry
  - 1.9.3. Gasometry Markers
- 1.10. Hydroelectrolyte Balance and its Alterations
  - 1.9.4. Sodium
  - 1.9.5. Potassium
  - 1.9.6. Chlorine

## Module 2. Biochemistry II

- 2.1. Congenital Alterations of Carbohydrate Metabolism
  - 1.1.1. Alterations in the Digestion and Intestinal Absorption of Carbohydrates
  - 1.1.2. Galactose Metabolism Alterations
  - 1.1.3. Fructose Metabolism Alterations
  - 1.1.4. Glucogen Metabolism Alterations
    - 1.1.4.1. Glucogenesis: Types
- 2.2. Congenital Alterations of Amino Acid Metabolism
  - 1.2.1. Aromatic Amino Acid Metabolism Alterations
    - 1.2.1.1. Phenylketonuria.
    - 1.2.1.2. Glutaric Aciduria Type 1
  - 1.2.2. Alterations of Branched Amino Acid Metabolism
    - 1.2.2.1. Maple Syrup Urine Disease
    - 1.2.2.2. Isovaleric Acidemia
  - 1.2.3. Alterations in the Metabolism of Sulfur Amino Acids
    - 1.2.3.1. Homocysturia
- 2.3. Congenital Alterations of Lipid Metabolism
  - 2.3.1. Beta-Oxidation of Fatty Acids
    - 4.3.1.1. Introduction to Beta-Oxidation of Fatty Acids
    - 4.3.1.2. Fatty Acid Beta-Oxidation Alterations
  - 2.3.2. Carnitine Cycle

- 4.3.2.1. Introduction to Carnitine Cycle
    - 4.3.2.2. Carnitine Cycle Alterations
- 2.4. Urea Cycle Disorders
  - 2.4.1. Urea Cycle
  - 2.4.2. Genetic Alterations of the Urea Cycle
    - 2.4.2.1. Ornithine Transcarbamylase (OTC) Deficiency
    - 2.4.2.2. Other Urea Cycle Disorders
  - 2.4.3. Diagnosis and Treatment of Urea Cycle Diseases
- 2.5. Molecular Pathologies of Nucleotide Bases Alterations of Purine and Pyrimidine Metabolism
  - 2.5.1. Introduction to Purine and Pyrimidine Metabolism
  - 2.5.2. Purine Metabolism Disorders
  - 2.5.3. Pyrimidine Metabolism Disorders.
  - 2.5.4. Diagnosis of Purine and Pyrimidine Disorders
- 2.6. Porphyrins. Alterations in the Synthesis of the Heme Group
  - 2.6.1. Heme Group Synthesis
  - 2.6.2. Porphyrins: Types
    - 2.6.2.1. Liver Porphyrins
      - 2.6.2.1.1. Acute Porphyrins
      - 2.6.2.2. Hematopoietic Porphyrins
  - 2.6.3. Diagnosis and Treatment of Porphyrins
- 2.7. Jaundice Bilirubin Metabolism Disorders
  - 2.7.1. Introduction to Bilirubin Metabolism
  - 2.7.2. Congenital Jaundice
    - 2.7.2.1. Unconjugated hyperbilirubinaemia
    - 2.7.2.2. Conjugated Hyperbilirubinemia
  - 2.7.3. Diagnosis and Treatment of Jaundice
- 2.8. Oxidative Phosphorylation
  - 2.8.1. Mitochondria
    - 2.8.1.1. Mitochondrial Enzyme and Protein Constituents
  - 2.8.2. Electronic Transport Chain
    - 2.8.2.1. Electronic Transporters
    - 2.8.2.2. Electronic Complexes
  - 2.8.3. Coupling of Electronic Transport to ATP Synthesis
    - 2.8.3.1. ATP Synthase
    - 2.8.3.2. Oxidative Phosphorylation Uncoupling Agents
  - 2.8.4. NADH Shuttle
- 2.9. Mitochondrial Disorders
  - 2.9.1. Maternal Inheritance
  - 2.9.2. Heteroplasmy and Homoplasmy
  - 2.9.3. Mitochondrial Diseases
    - 2.9.3.1. Leber Hereditary Optic Neuropathy
    - 2.9.3.2. Leigh Disease
    - 2.9.3.3. MELAS Syndrome
    - 2.9.3.4. Myoclonic Epilepsy with Ragged Red Fibers (MERRF)
  - 2.9.4. Diagnosis and Treatment of Mitochondrial Diseases
- 2.10. Other Disorders Produced by Alterations in Other Organelles
  - 2.10.1. Lysosomes
    - 2.10.1.1. Lysosomal Diseases
      - 2.10.1.1.1. Esfingolipidosis
      - 2.10.1.1.2. Mucopolisaccharidosis
  - 2.10.2. Peroxisomes
    - 2.10.2.1. Lysosomal Diseases
      - 2.10.2.1.1. Zellweger Syndrome
  - 2.10.3. Golgi Apparatus
    - 2.10.3.1. Golgi Apparatus Diseases
      - 2.10.3.1.1. Mucopolipidosis II



*This Postgraduate Certificate contains the most complete and up-to-date program on the market"*

# 05 Methodology

This academic program offers students a different way of learning. Our methodology uses a cyclical learning approach: ***Re-learning***.

This teaching system is used, for example, in the most prestigious medical schools in the world, and major publications such as the ***New England Journal of Medicine*** have ***considered it to be one of the most effective***.



“

*Discover Re-learning, a system that abandons conventional linear learning, to take you through cyclical teaching systems: a way of learning that has proven to be extremely effective, especially in subjects that require memorization"*

## At TECH we use the Case Method

What should a professional do in a given situation? Throughout the program, students will face multiple simulated clinical cases, based on real patients, in which they will have to do research, establish hypotheses, and ultimately resolve the situation. There is an abundance of scientific evidence on the effectiveness of the method. Specialists learn better, faster, and more sustainably over time.

*With TECH you will experience a way of learning that is shaking the foundations of traditional universities around the world.*



According to Dr. Gérvas, the clinical case is the annotated presentation of a patient, or group of patients, which becomes a "case", an example or model that illustrates some peculiar clinical component, either because of its teaching power or because of its uniqueness or rarity. It is essential that the case is based on current professional life, trying to recreate the real conditions in the physician's professional practice.



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*Did you know that this method was developed in 1912, at Harvard, for law students? The case method consisted of presenting students with real-life, complex situations for them to make decisions and justify their decisions on how to solve them. In 1924, Harvard adopted it as a standard teaching method.*

The effectiveness of the method is justified by four fundamental

1. Students who follow this method not only achieve the assimilation of concepts, but also a development of their mental capacity, through exercises that evaluate real situations and the application of knowledge.
2. Learning is solidly translated into practical skills that allow the student to better integrate into the real world.
3. Ideas and concepts are understood more efficiently, given that the example situations are based on real-life.
4. Students like to feel that the effort they put into their studies is worthwhile. This then translates into a greater interest in learning and more time dedicated to working on the course.



## Re-learning Methodology

At TECH we enhance the Harvard case method with the best 100% online teaching methodology available: Re-learning.

Our University is the first in the world to combine the study of clinical cases with a 100% online learning system based on repetition, combining a minimum of 8 different elements in each lesson, which represent a real revolution with respect to simply studying and analyzing cases.



*The physician will learn through real cases and by solving complex situations in simulated learning environments. These simulations are developed using state-of-the-art software to facilitate immersive learning.*

At the forefront of world teaching, the Re-learning method has managed to improve the overall satisfaction levels of professionals who complete their studies, with respect to the quality indicators of the best online university (Columbia University).

With this methodology, more than 250,000 physicians have been trained with unprecedented success in all clinical specialties regardless of surgical load. Our pedagogical methodology is developed in a highly competitive environment, with a university student body with a strong socioeconomic profile and an average age of 43.5 years old.

*Re-learning will allow you to learn with less effort and better performance, involving you more in your specialization, developing a critical mindset, defending arguments, and contrasting opinions: a direct equation to success.*

In our program, learning is not a linear process, but rather a spiral (learn, unlearn, forget, and re-learn). Therefore, we combine each of these elements concentrically.

The overall score obtained by TECH's learning system is 8.01, according to the highest international standards.



This program offers the best educational material, prepared with professionals in mind:



#### Study Material

All teaching material is produced by the specialists who teach the course, specifically for the course, so that the teaching content is highly specific and precise.

These contents are then applied to the audiovisual format, to create the TECH online working method. All this, with the latest techniques that offer high quality pieces in each and every one of the materials that are made available to the student.



#### Surgical Techniques and Procedures on Video

TECH introduces students to the latest techniques, the latest educational advances and to the forefront of current medical techniques. All of this in direct contact with students and explained in detail so as to aid their assimilation and understanding. And best of all, you can watch the videos as many times as you like.



#### Interactive Summaries

The TECH team presents the contents attractively and dynamically in multimedia lessons that include audio, videos, images, diagrams, and concept maps in order to reinforce knowledge.

This exclusive multimedia content presentation training Exclusive system was awarded by Microsoft as a "European Success Story".



#### Additional Reading

Recent articles, consensus documents and international guidelines, among others. In TECH's virtual library, students will have access to everything they need to complete their course.





**Expert-Led Case Studies and Case Analysis**

Effective learning ought to be contextual. Therefore, TECH presents real cases in which the expert will guide students, focusing on and solving the different situations: a clear and direct way to achieve the highest degree of understanding.



**Testing & Retesting**

We periodically evaluate and re-evaluate students' knowledge throughout the program, through assessment and self-assessment activities and exercises: so that they can see how they are achieving your goals.



**Classes**

There is scientific evidence on the usefulness of learning by observing experts: The system termed Learning from an Expert strengthens knowledge and recall capacity, and generates confidence in the face of difficult decisions in the future.



**Quick Action Guides**

TECH offers the most relevant contents of the course in the form of worksheets or quick action guides. A synthetic, practical, and effective way to help students progress in their learning.



# 06

# Certificate

Through a different and stimulating learning experience, you will be able to acquire the necessary skills to take a big step in your training. An opportunity to progress, with the support and monitoring of a modern and specialized university, which will propel you to another professional level.



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*Include in your training a Postgraduate Certificate in Role of the Biochemistry Laboratory in the field of Clinical Analysis: an added value of high qualification for any professional in this area"*

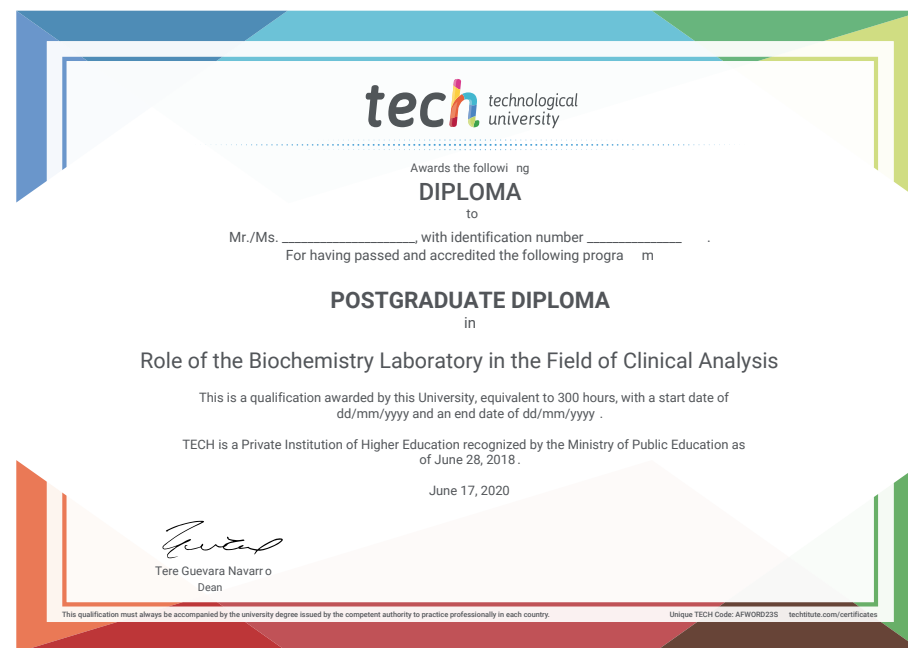
This **Postgraduate Certificate in Role of the Biochemistry Laboratory in the Field of Clinical Analysis** contains the most complete and up-to-date scientific program on the market.

After the student has passed the assessments, they will receive their corresponding **certificate** issued by **Technological University via tracked delivery**.

The diploma issued by TECH Technological University will specify the qualification obtained through the Postgraduate Certificate and meets the requirements commonly demanded by labor exchanges, competitive examinations, and professional career evaluation committees.

Title: **Postgraduate Certificate in Role of the Biochemistry Laboratory in the Field of Clinical Analysis**

Official N° of Hours: **300 hours**.





future  
health confidence people  
education information tutors  
guarantee accreditation teaching  
institutions technology learning  
community commitment  
personalized service innovation  
knowledge present  
development language  
virtual classroom

**tech** technological  
university

**Postgraduate  
Certificate**

Role of the  
Biochemistry  
Laboratory  
in the Field of Clinical  
Analysis

Course Modality: **Online**

# Postgraduate Certificate

Role of the Biochemistry  
Laboratory in the Field of  
Clinical Analysis