Ph.D. Thesis proposal

General Information		
Ph.D. Thesis Title	***Development of an electrochemical biosensor for the detection of salivary Heart Failure markers (NT-proBNP, ACE2 and TMPRSS2) in COVID-19 patients***	
USEK Doctoral Program	***PhD in chemistry***	
Research Center	NA	
Research Group	NA	
Research Axis	***Axis: Equilibrium between phases and advanced analysis*** ***Theme: Development and validation of analytical procedures for heart failure markers***	
PhD Supervisor	Name & Title : Joseph Saab, Professor Email : josephsaab@usek.edu.lb	University Address : Holy Spirit University of Kaslik-USEK
Co-supervisor (if applicable)	Name & Title :Abdelhamid Errachid, Professor Email :abdelhamid.errachid-el-salhi@univ-lyon1.fr	University Address : Claude Bernard University Lyon 1-UCB Lyon 1
Location (s)	Location 1: USEK	Work shift calendar /per year (%): 40-50
	Location 2: Claude Bernard University Lyon 1- UCB Lyon 1	Work shift calendar /per year (%): 50-60

Applicant Profile and/or Special Requirements	Applicant Profile: Master's degree in Biochemistry, Pharmacology Special requirements: practical experience in electrochemical analysis, Microfluidic Systems.
Comps Exam Language (to be check-marked by the Ph.D. Supervisor)	X Oral Assessment X Written Assessment ☐ Arabic ☐ French X English

Context of the Topic & Scientific Methods ***(Research impact, objectives, design, methods, and outputs)***
The main objective of this project is to develop a miniaturized platform based on flexible substrates for the separation, analysis and detection of heart failure biomarkers in biological fluids in relation with the corona virus covid19. This approach requires the development of new electrochemical functionalities. As part of this program (Short-term objective), we will evaluate theoretically and experimentally the capabilities of an approach combining microfluidics and electrochemical analysis techniques (potentiometry, impedancemetry) for selective detection of HF biomarkers, contained in the biological fluids. In fact, we will develop steps or tools that allow (1) the elimination of interfering species from solutions during the markers detection and allow (2) the independent quantification based on differential measurement. This platform for heart failure markers requires analytical validation (3) of the protocol of quantification. This step should be done by comparing the analytical results from the developed microsystem with those from the standard chemical analysis done in the medical laboratory. This lab-on-chip could also serve

to measure the concentrations of certain elements in blood or biological tissues, as they provide a common basis for biosensors and only biochemical recognition changes from one detection to another. Finally, we intend in the long term for a fast, simple, low-cost, and high-sensitivity analysis. This platform will be built with modern microfabrication techniques and should offer the possibility to monitor in real time Heart Failure markers content of an aqueous matrix for biomedical targets.

Outcomes (OCs) : What do we wish to achieve?	
OC1:	Fabrication of the microplatform with arrays of microelectrodes using simple and low cost processes
OC2:	Chemical functionalization of receptors for high specificity assay of Heart Failure markers
OC3 :	Evaluation of the performance of the Bio-platform analysis system in the clinical laboratory
OC4 :	Comparing the results obtain via the sensor to clinical laboratory results

References (R) (5 most recent peer-reviewed publications in the field)	
R1:	Capacitance electrochemical biosensor based on silicon nitride transducer for TNF-α cytokine detection in artificial human saliva: Heart failure (HF), Talanta, Volume 209, 2020, 120501, ISSN 0039-9140, Mohamed Bahri, Abdoullatif Baraket, Nadia Zine, Mounir Ben Ali, Joan Bausells, Abdelhamid Errachid.
R2:	Pulmonary, cardiac and renal distribution of ACE2, furin, TMPRSS2 and ADAM17 in rats with heart failure: Potential implication for COVID-19 disease. J Cell Mol Med. 2021 Apr;25(8):3840-3855. Khoury EE, Knaney Y, Fokra A, Kinaneh S, Azzam Z, Heyman SN, Abassi Z.
R3 :	Characterization of NT-proBNP in a large cohort of COVID-19 patients. Caro-Codón J, Rey JR, Buño A, Iniesta AM, Rosillo SO, Castrejon-Castrejon S, Rodriguez-Sotelo L, Martinez LA, Marco I, Merino C, Martin-Polo L, Garcia-Veas JM, Martinez-Cossiani M, Gonzalez-Valle L, Herrero A, López-de-Sa E, Merino JL; CARD-COVID Investigators.
R4 :	ACE2/ADAM17/TMPRSS2 Interplay May Be the Main Risk Factor for COVID-19. Zipeto Donato, Palmeira Julys da Fonseca, Argañaraz Gustavo A., Argañaraz Enrique R.
R5 :	Microfluidics Integrated Biosensors: A Leading Technology towards Lab-on-a-Chip and Sensing Applications. George Luka, Ali Ahmadi, Homayoun Najjaran, Evangelyn Alocilja, Maria DeRosa , Kirsten Wolthers, Ahmed Malki, Hassan Aziz, Asmaa Althani 4,5 and Mina Hoorfar