Holy Spirit University of Kaslik
Doctoral College

Ph.D. Thesis Proposal[1]

General Information		
Ph.D. Thesis Title	***Vitale Station: Electricity and service***	
USEK Doctoral Program	NA	
Research Center	NA	
Research Group	NA	
Research Axis	**Sustainability**	
Ph.D. Supervisor	Name & Title : Dr. Bechara NEHME, assistant Professor Email : becharanehme@usek.edu.lb	University Address : Holy Spirit University of Kaslik- USEK
Ph.D. Co-supervisor (if applicable)	Name & Title : Prof. Nacer K Msirdi, Professor Email : kouider-nacer.msirdi@lis-lab.fr	University Address : Aix Marseille Université (AMU), LIS UMR 7020 CNRS
Location (s)	Location 1: USEK	Work shift calendar /per year (%): 75
	Location 2: AMU	Work shift calendar /per year (%): 25
Potential funding and scholarship	PHC CEDRE	

Applicant Profile and/or Special Requirements	Holder of a Master degree or equivalent in the field of Electrical and Electronics Engineering. Previous knowledge in Microgrids and Artificial Intelligence is an addition.
Comps Exam Language (to be check-marked by the Ph.D. Supervisor)	☑ Oral Assessment ☐ Written Assessment ☐ Arabic ☐ French ☐ English

Subject's national or worldwide Context, Objectives & Research lines
Lebanon is exhausted by multidimensional problems. The COVID-19 pandemic imposes physical distancing, the economic and financial crisis involves cuts in spending, and the Beirut explosion which has resulted in 200 deaths and thousands of injuries. In this research project, we are proposing a solution that could help Lebanon to mitigate these multidisciplinary problems. In the coming months, the Lebanese state will no longer be able to secure its electricity generation. This will prevent the country from enduring its war on COVID-19. Unfortunately, COVID-19 hospital patients will suffer from the power cut. Patients on mechanical ventilators will no longer be able to breathe. Chilled vaccines will be rotten. In addition, the country will no longer be able to provide minimal communications, Internet, water pumping services… which will prevent teleworking and daily work from continuing. In addition, public transport is not developed in Lebanon, it consists of several unorganized buses that circulate on the coast. This is another reason that increases the import of energy and the import of vehicles that are not produced in Lebanon. Citizens are currently unable to buy cars. This project aims to develop a multiservice station for local communities in Lebanon;

[1] The Ph.D. Thesis Proposal should not exceed three pages.

Vitale Station: Electricity and service. The primary components of the station are renewable energy sources (photovoltaic solar panels and wind turbines), one or more electric cars with a charging station. A small agricultural greenhouse for vegetables, and collection points for recycling materials can be added. Citizens have the capacity to rent the electric car, the station will power telecommunications and internet services. The development of the station should start by an optimization design aiming to reduce cost and increase power production. The latter design should be dynamic since it depends on the location and main load of the station. Then a control strategy should be elaborated to coordinate power production, consumption, and car rental. Internet of things infrastructure should be elaborated with proper algorithm to ensure durability and essentially preventive maintenance and distance intervention. The Vital Station will be a prototype to be distributed in Lebanese countries.

Outcomes (OCs) : What do we wish to achieve?	
OC1:	Optimization design of the vital station: PV panels, Wind Turbines, Electric Cars
OC2:	Development of a control strategy for power allocation, storage, and injection to the grid
OC3:	Development of a remote monitoring and preventive maintenance platform

References (R) (5 most recent peer-reviewed publications in the field)	
R1:	Nehme, B., M'Sirdi, N. K., Naamane, A., & Akiki, T. (2017). Analysis and Characterization of Faults in PV Panels. Energy Procedia, 111, 1020-1029.
R2:	L. Zhang and H. Liu, "Research on the Optimization Method of Capacity Configuration of DC Microgrid," *2020 IEEE 4th Conference on Energy Internet and Energy System Integration (EI2)*, 2020, pp. 597-600, doi: 10.1109/EI250167.2020.9347075.
R3:	E. Foruzan, L. Soh and S. Asgarpoor, "Reinforcement Learning Approach for Optimal Distributed Energy Management in a Microgrid," in *IEEE Transactions on Power Systems*, vol. 33, no. 5, pp. 5749-5758, Sept. 2018, doi: 10.1109/TPWRS.2018.2823641.
R4:	X. Fang, J. Wang, C. Yin, Y. Han and Q. Zhao, "Multiagent Reinforcement Learning With Learning Automata for Microgrid Energy Management and Decision Optimization," in - 2020 Chinese Control And Decision Conference (CCDC), 2020, pp. 779-784.
R5:	D. Sun, Y. Tang, B. Yang, X. Feng, Y. Wang and H. Li, "Research on Preventive-Emergency Control Method Based on Multi-communications in Island Microgrid," *2018 International Conference on Power System Technology (POWERCON)*, 2018, pp. 1579-1585, doi: 10.1109/POWERCON.2018.8602043.