**Thesis Research Concept**

[Delete this text box and all text in red: This concept template can help your proposed supervisor to guide you in your discussions. It is preferable to meet your supervisor in person. If not possible, send them this document via email or print it out and leave it in the supervisor’s pigeonhole at the departmental office. The department does not allocate supervisors, and it is up to the student to contact the supervisor. Do not exceed one page. Updated on 2025-07-28]

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| **Proposed Topic** | Design and Implementation of a Solar-Powered Smart Microgrid for Rural Electrification in Kenya |
| **Proposed Supervisor** |  Prof. Supervisor One supervisorone@uonbi.ac.ke  |
| **Background** | Access to reliable electricity remains a critical challenge in rural Kenya, where grid extension is often economically unfeasible. Solar energy presents a viable alternative due to Kenya’s abundant sunlight. However, standalone solar systems face limitations in scalability and reliability. Smart microgrids, integrating renewable energy sources, energy storage, and intelligent load management, can optimize power distribution, reduce outages, and improve energy access. Advances in IoT and machine learning enable real-time monitoring and adaptive control, making microgrids more efficient and resilient. |
| **Problem** | Over 70% of rural Kenyan households lack access to stable electricity, relying on costly and polluting alternatives like diesel generators. Existing solar solutions often suffer from inefficiencies, battery degradation, and lack of grid-like reliability. A smart microgrid could address these issues by balancing supply-demand dynamically, integrating storage, and enabling peer-to-peer energy sharing among users. |
| **Overall Objective** | To design and prototype a solar-powered smart microgrid system that enhances energy reliability and efficiency for rural communities in Kenya. |
| **Specific Objectives** (minimum of three) | 1. Design a hybrid solar-battery microgrid architecture with IoT-based monitoring and control.
2. Implement a machine learning algorithm to predict energy demand and optimize battery usage.
3. Evaluate the system’s performance in terms of cost, scalability, and reliability compared to conventional solutions.
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| **Methodology** | **Simulation**: Model the microgrid using tools like MATLAB/Simulink or HOMER to optimize component sizing (solar panels, batteries, inverters).**Prototyping**: Build a small-scale microgrid with PV panels, lithium-ion batteries, and IoT sensors (e.g., Raspberry Pi/Arduino for data acquisition). **Testing**: Deploy the prototype in a controlled environment (e.g., university lab) to validate energy management algorithms under varying load conditions. **Analysis**: Compare results with existing systems using metrics like energy efficiency, cost per kWh, and outage frequency. |
| **Proposed Timeline** | Approximately six months |
| **Alternative Topics** | I am free/not free to take up any other topic.  |