# A report on Faculty Internship Program (1st to 10th July, 2019)

**submitted to**

**TEQIP Cell, IIT Hyderabad**

**by**

**Dr. Pranjal Saikia, Associate Professor,**

**Guwahati University Institute of Science and Technology (GUIST), Guwahati-781014**

**Assam**

## "Development of Energy Storage Devices"

In light of the changing global economy, energy has become one of the vital focus of the scientific community. Advancements in the field of sustainable and suitable energy storage devices are equally important along with sustainable energy production technologies. Unfortunately, energy storage technology is still in its budding stage and the leading energy storage technologies are fuel cells (FCs), Li and Na ion batteries, and supercapacitors to name a few. Despite the advantageous aspects of energy storage devices, all of these technologies have one or other serious drawbacks to be addressed. For example, FCs have the highest energy density but not free from safety, operational issues and cost. LIBs are costly, Li &Co sources are limited and have limited current and voltage range with low cycle life, along with short circuit and abnormal temperature behavior. Supercapacitors have very high power densities but very low energy densities. Considering all these aspects, I tried to focus on the recent research developments to mitigate these problems of energy storage devices in Dr. Martha's group at IIT Hyderabad during my short visit of 10 days. Dr. Martha's group is one of the leading groups in the country to work in this area, and the research team comprises 6 Ph.D., 2 M.Sc., 1 project and 3 Post-doctoral students working on various aspects of energy storage. His group is focused on investigating the fundamentals of electrochemistry in various energy storage devices like Li and Na-ion batteries, Lead-acid batteries, supercapacitors, ultra-batteries etc. So, my humble effort was to become familiar with the principles and basics of energy storage research, and to have some hands-on experience in cell fabrication and testing.

Accordingly, the first two days were devoted to literature survey, making work plan and laboratory visit. Third and fourth days were devoted to fabrication of a lead acid battery cell and testing of the same. The active material used was an already synthesized material. On day 5, a group seminar was held and some of the on-going research works were reviewed. Also, different aspects of the electrodeposition technique were learnt on that day. On the sixth and seventh days, synthesis of a cathode material was done and a Na-ion battery cell (coin cell)

was carried out in glove box. On 8$^{th}$ and 9$^{th}$ days, the electrochemical performance of an already synthesized material was tested for supercapacitor application. All these days, the testing of the materials was performed by using electrochemical measurements like impedance, cyclic voltammetry and galvanostatic charge-discharge studies. The final day was devoted to final discussion with all the group members, preparation of the report and submission thereof to the TEQIP office, IITH.

On the whole, the visit has been of immense pleasure for me to learn the basics of energy storage research and also to build confidence to work in this emerging field. In this short period, I could use and familiarize with sophisticated instruments like Glove Box, Ball Mill, and different electrochemical workstations (Solartron, Biologic, Neware and Bitrode). Considering the present days thrust research areas, this visit helped a lot to make a cordial relation with Dr. Martha's research group and it is an important step forward to have collaborative research activities in the future.