Power Electronics in Microgrids
Short-Course Outline

1. Introduction to state of the art microgrids (Kevin Meagher)
   a. Types of microgrids; motivation for setting up a microgrid; what were the drivers behind this. (this is the emphasis; needs to give a good overview of what are the driver and functionalities)
   b. Commercial: data centers, hospitals, universities
   c. Review of implementations; types of implementations.
   d. Examples of actual implementations (requires publication review)

2. Fundamentals of components resources in microgrids (Len White)
   a. PV, storage, wind,
   b. Gensets (SM basics); Len has some practical information as well
   c. Power electronics interfaces to renewables

3. Protection (Mesut Baran)
   a. Basics of protection challenges and issues

4. Primary and secondary control of microgrids (Srdjan Lukic, Iqbal Husain)
   a. Part 1 current practices
      i. Primary Control: voltage and current control mode;
      ii. Droop control; Secondary Control for stabilizing voltage/frequency in islanded mode;
   b. Advanced concepts
      i. Islanding transitions
      ii. Advanced control modes: Synthetic inertia, oscillator control
      iii. Advanced concepts: FREEDM

5. Energy management in microgrids (Ning Lu)
   a. Overview
   b. Strategies
   c. Use cases:
      i. Off grid energy management
      ii. Providing grid services
      iii. Minimizing energy payment
6. Cost benefit analysis (David Lubkeman)
   a. Methodology of how to do cost benefit study
   b. Example: FREEDM cost benefit
   c. Sample cases -- showing operation of the microgrid and it changes with assets and microgrid formation
   d. Introduction of HOMER and demo different scenarios

7. Field Implementation of Microgrid (Aleks Vukojevic)
   a. Engineering lessons learned from the field associated with Microgrid planning, design, commissioning and implementation of control schemes

8. Forward Looking Implementation (Kevin Meagher)
   a. High tech implementation/product of a microgrid: renewable energy group; an ABB person – integration group; battery energy storage person.

9. Lab sessions
   a. GEH or Multi SST lab: LV SST Lab -- grid connected and islanding?? Mode.
   b. Distributed Control Microgrid Lab
   c. Central Control Microgrid Lab + Energy Management Demo (Ning Lu)
   d. Power Analytics Demo (Kevin Meagher)