

## **GT-1500 (STEM) Alternative Energy Lab Overview**

### **90 HOURS**

#### **1. Basic Wind Turbine Operation**

Installing and Testing a Wind Turbine

- Identify the Major Parts of the Wind Turbine
- Mounting The Wind Turbine
- Testing the Direct Output of the Wind Turbine
- Adjusting the Output of the Wind Turbine
- Document Wind Turbine Output at Various Speeds (RPM)
- Correlate Wind Power-to-Turbine Speed-to-Power Generation (Efficiency)

#### **2. Off-Grid Wind Turbine Systems**

Configuring and Testing Off Grid Installations

- Connecting the Wind Turbine to Protective/Control Devices
- Connecting the Wind Turbine to Monitoring Devices
- Connect the Wind Turbine Circuitry to Storage Batteries
  - Testing Battery Configuration Variations
- Driving a DC Load with the Wind Turbine System
  - Document Battery Charge/Discharge Rates
- Driving an AC Load with the Wind Turbine System
  - Connecting the Wind Turbine Circuitry to an AC Inverter
  - Document Battery Charge/Discharge Rates vs. Inverter Output (System Efficiency)
- Excess Capacity Management
  - Driving Auxiliary Loads

#### **3. Wind Power Research**

- Wind Turbine Types (Horizontal/Vertical)
- Local/National Wind Data
- Local Wind Turbine Legislation
- Propeller Design
- Gear Ratios/Torque
- Electric Generators
  - Motors, Generators, Alternators, Inverters
- Wind Turbine Site Strategies
- Wind Turbine Hazards
- Over-Speed Protection Designs
- Excess Energy Management

#### **4. Wind Power System Design**

Design/Create a Wind Turbine

- DC Motor/Generator/Alternator Selection
- Wind Turbine Body Design
- Propeller Blade Design
- Tower Design
- Proper Wire Size Selection

## **5. Basic Solar Power Operation**

Installing, Combining and Testing Solar Cells

- Testing the Direct Output of the Solar Cell
- Configuring Solar Cells to Achieve Necessary Voltage/Current/Power Requirements
- Mounting the Solar Cells to Create a Solar Panel
- Document Solar Panel Output at Various Light Intensities
- Correlate Light Intensity-to-Power Generation

## **6. Advanced Solar Panel Systems**

Configuring, Testing and Operating Off Grid Solar Installations

- Connecting the Solar Panel to Protective/Control Devices
- Connecting the Solar Panel to Monitoring Devices
- Connect the Solar Panel Circuitry to Storage Batteries
  - Battery Configuration Variations
- Driving a DC Load with the Solar Panel System
  - Document Battery Charge/Discharge Rates
- Driving an AC Load with the Solar Panel System
  - Connect the Solar Panel Circuitry to an AC Inverter
  - Document Battery Charge/Discharge Rates vs. Inverter Output (System Efficiency)
- Excess Capacity Management
  - Driving Auxiliary Loads

## **7. Solar Power Research**

- Local/National Solar Availability Data
- Local Solar Panel Legislation
- Solar Cell Types
- Solar Cell Connections
- Solar Cell Power Generation Capabilities
- Light Concentration Strategies
  - Mirrors/Fresnel Lens'/Magnifying Lens'
- Excess Energy Management

## **9. Solar Power System Design**

Design/Create a Solar Charging System for Portable Hand Held Devices

## **10. Combining Wind and Solar Power Systems**

Configuring and Testing Combined Alternative Energy Systems for Off Grid Operations

- Interconnecting the Wind Turbine/Solar Panel Configuration to Protective/Control Devices
- Interconnecting the Wind Turbine/Solar Panel Configuration to Monitoring Devices
- Interconnecting the Wind Turbine/Solar Panel Configuration Circuitry to Storage Batteries
- Document Wind Turbine/Solar Panel Configuration Output at Various Wind Speeds and Light Intensity Combinations
- Driving a DC Load with the Wind Turbine/Solar Panel System
- Document Battery Charge/Discharge Rates
- Driving an AC Load with the Wind Turbine/Solar Panel System
- Connect the Wind Turbine/Solar Panel Circuitry to an AC Inverter
- Document Battery Charge/Discharge Rates vs. Inverter Output

## **11. Connecting Alternative Power Systems to the Grid**

Configuring and Testing On Grid Installations

- Connecting the Output of the Inverter to the Safety/Control Devices
- Connecting the Wind Turbine/Solar Panel Configuration Circuitry to the Existing Power System
- Document Current Flow Levels from All Sources (Including the Grid) at Different Wind Speeds and Light Intensity Combinations

## **12. Basic Fuel Cell Operation**

Connecting a Fuel Cell for Electrical Generation

- Identify the Major Parts of the Fuel Cell
- Testing the Direct Output of the Fuel Cell
- Adjusting the Output of the Fuel Cell by Stacking
- Document Fuel Cell Output in Various Configurations (Serial vs. Parallel)
- Correlate Power Generation to Hydrogen Consumption (Efficiency)

## **13. Advanced Fuel Cell Operations**

Configuring, Testing and Operating Off Grid Fuel Cell Installations

- Connecting the Fuel Cell to Protective/Control Devices
- Connecting the Fuel Cell to Monitoring Devices
- Connect the Fuel Cell Circuitry to Storage Batteries
  - Testing Battery Configuration Variations
- Driving a DC Load with the Fuel Cell System
  - Document Battery Charge/Discharge Rates

## **14. Fuel Cell Research**

- Fuel Cell Types
- Fuel Cell Connections
- Fuel Cell Power Generation Capabilities
- Stacked Fuel Cells
- Hydrogen Source/Storage Options
- Cooling

## **15. Fuel Cell Application/Design**

Design/Create a Fuel Cell system to power a radio controlled racecar.

## **16. Adding a Fuel Cell to an Alternative Power System**

Connecting a Fuel Cell into Alternative Energy Systems for Off Grid Operations

- Interconnecting the Fuel Cell to the Wind Turbine/Solar Panel Configuration to Protective/Control Devices
- Interconnecting the Fuel Cell to the Wind Turbine/Solar Panel Configuration to Monitoring Devices
- Interconnecting the Fuel Cell to the Wind Turbine/Solar Panel Configuration Circuitry to Storage Batteries
- Document the Fuel Cell/Wind Turbine/Solar Panel Configuration Output at Various Wind Speeds and Light Intensity Combinations

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