Department of Electrical Engineering

Jamia Millia Islamia, Jamia Nagar-New Delhi

Smart Energy Systems Automation laboratory

Lab Incharge: Prof. Majid Jamil

SMART ENERGY SYSTEM: A smart energy system is a cost-effective, sustainable and secure energy system in which renewable energy production, infrastructures and consumption are integrated and coordinated through energy services, active users and enabling technologies.

For the hassle-free life and growing advancement, dependency on the uninterrupted power becomes the foremost requirement. This increase in demand for persistent power motivated the concept of smart, micro, and nano grid. Across the world, intelligent energy systems (coupling major energy sectors like conventional source (grid), renewable sources (solar, wind, bio-gas etc) and stored energy (batteries, capacitor etc.) are considered as a key solution to promote clean energy, improve efficiency and costs. Intelligence across systems is a strict requirement to transform the system planning and energy strategies for environmental friendly and sustainable future. However, there are only few smart energy installations or real-time systems that allow experiencing the challenges and developing the required standards for the business. In order to realize the energy balance and economic benefits in a system with high penetration of renewable, increasing demand, flexible loads, increased transmission capacity, international trading and new actors, a close synergy between energy vectors is foreseeable. The main aspects of such intelligent energy systems are the ICT infrastructure, energy networks and systems itself. The research and development activities in this area need to account for actual control and communication layers upon a realistic model of the energy networks and systems, which requires scientific expertise as well as highly specialized hardware and software.

The Smart Energy Systems Automation Laboratory is a multidisciplinary lab having facilities of power system, power electronics and communication system that captures all

domains, layers and zones from the Smart Grid Architecture Model. The Real-Time Hardware facilities such as three phase voltage source converter, DC-DC Buck-Boost Converter, Interleaved boost converter, dSPACE 1104 controller, Facilities of Solar PV modules connections with different types of solar cells, different kind of batteries, digital storage oscilloscope, and Digital substation having IEDs, protection and control units, analog merging unit makes this laboratory a state-of-the-art research area with well capable of conducting advance experiments. In addition, softwares provisions such as MATLAB, PVSyst, Test Universe, Mi Power, Sigra and DIGSI4 are also accessible in the laboratory. It enables the Model Based Design approach for intelligent energy systems analytics and functionalities. The facilities available in this laboratory would encourage the fresh researchers to develop prototypes for practical results as well as vetting existing and new topologies. The laboratory has excellent facilities for research in emerging areas of renewable energy and power automation. It will also be useful for under-graduate as well as post-graduate students.

Facilities Available

Hardware

- ABB IED Line Distance Protection type REL-670
- ABB IED bay Controller REC-670
- ABB Ethernet Switch-AFS670
- Siemens Overcurrent Protection & Control Unit 7SJ64
- Siemens Distance Protection Unit 7SA612
- Siemens Differential Protection Unit 7UT61
- Vizimax Analog Merging Unit-MUG0100000
- Omicron Tool Kit-CMC256-6
- PCs-Client and Server
- 3-Phase bridge rectifier and 3-Phase inverter stake
- 3-Phase bridge rectifier and 3-Phase inverter stake-4 leg
- Two channel digital Storage oscilloscope
- dSPACE
- Weather Station
- Lithium-ion Battery
- Nickel Cadmium Battery
- Lead-Acid battery
- Solar Panel- Mono Crystalline, Poly Crystalline and Thin Film (Total 2 kW)

Software

- PVSyst
- Mi Power
- PSCAD

- MATLAB
- DIGSI4
- Test Universe

DEPARTMENT OF ELECTRICAL ENGINEERING

JAMIA MILLIA ISLAMIA

Jamia Nagar, New Delhi-110025

Smart Energy Systems Automation Laboratory

SMART ENERGY SYSTEM:

A smart energy system is a cost-effective, sustainable and secure energy system in which renewable energy production, infrastructures and consumption are integrated and coordinated through energy services, active users and enabling technologies.

About Laboratory:

- One of the state-of-the-art laboratory having multidisciplinary facilities of power system, power electronics and communication system that captures all domains, layers and zones from the Smart Grid Architecture Model.
- Equipped with Real-Time Hardware facilities
- Advance softwares available for simulations and analysis
- The laboratory has excellent facilities for research in emerging areas of renewable energy and power automation.
- Beneficial for under-graduate as well as post-graduate students.

Facilities Available:

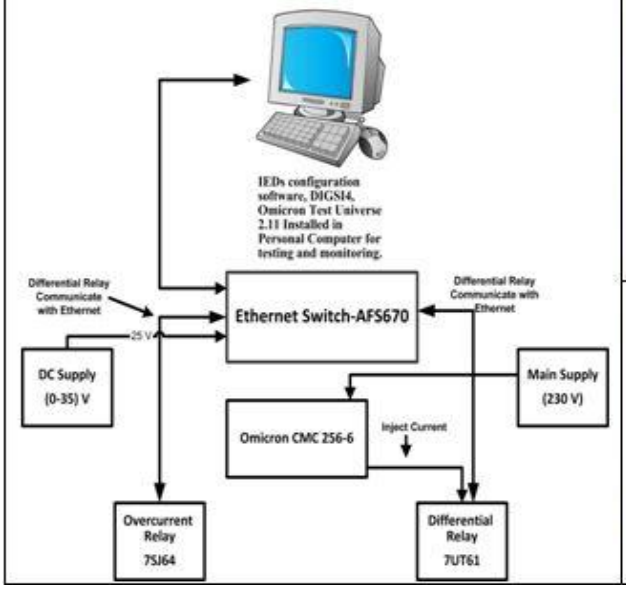
Hardware	Software
• Siemens Differential Protection Unit 7UT61 • Siemens Over-Current Protection Unit 7SJ64 • Siemens Distance Protection Unit 7SA612 • ABB IED Line Distance Protection type REL-670 • ABB IED bay Controller REC-670 • Virtmax Analog Merging Unit-MUG0100000 • Omicron Tool Kit-CMC256-6	• PVSyst • Mi Power • MATLAB

Few Prototypes Developed in the Laboratory:

Department of Electrical Engineering

Jamia Millia Islamia, Jamia Nagar-New Delhi

Real-Time Harmonics Analysis of Digital Substation Equipment Based on IEC-61850



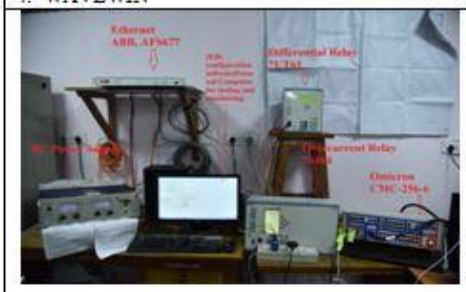
Substation Component

Hardware:-

1. Siemens IED Differential Protection, 7UT61
2. Siemens IED Overcurrent Protection, 7SJ64
3. Omicron Kit CMC 256-6
4. ABB Ethernet Switch-AFS-670
5. DC Power (0-35) V
6. PC

Software

1. DIGSI4
2. Test Universe
3. SIGRA
4. WAVEWIN



Objectives:-

1. Harmonics Study
2. Developed hardware Model
3. Second Harmonic Blocking of both side (HV-LV) side of Differential Relay
4. Fifth harmonic blocking of both side (HV-LV) side of Differential Relay
5. Healthy condition of both side (HV-LV) side of Differential Relay

Research Scholar = Abdul Azeem
Supervisor = Prof. Majid Jamil

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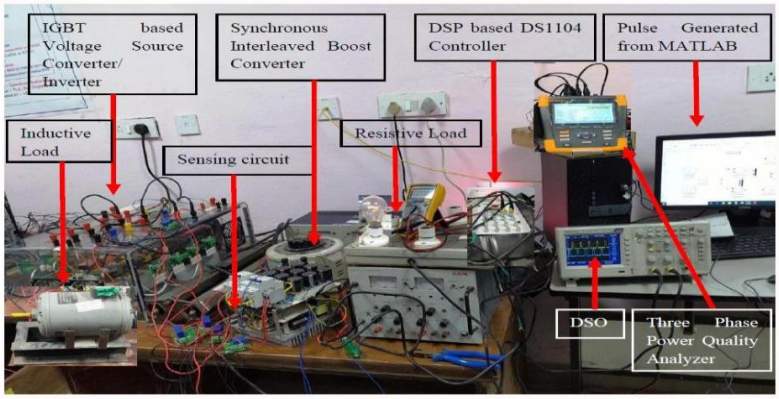
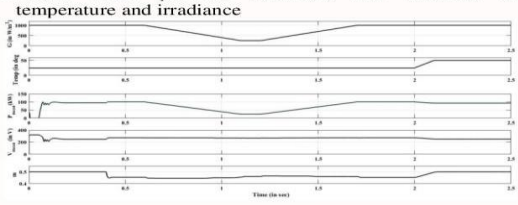
Analysis of Photovoltaic System Integration into Distribution Grid



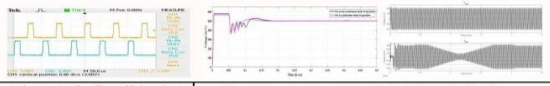
Salient Features:

- One of the state-of-the-art boost converters having advantages of both interleave and synchronous mode of operation
- Less oscillations at the output
- Reduced power loss across the converter
- Low input current ripples
- Faster response
- Tested under practical situations like variation in temperature and irradiance



System Description:

Synchronous Interleaved Boost Converter	• Two-leg IGBT - SKM100GB12T4, 1200 V, 100 A (2 Nos.) • DC Link Capacitor - 1200 µF, 500 V, 100 kΩ resistor is connected across capacitor (1 No.) • Interleaved Inductor - 2.5 mH (2 Nos.) • Input Capacitor - 470 µF (1 No.) • HRC Fuse - 500V, 100 kA, 10X38, IEC269 (2 Nos.)
Voltage Source Converter	• Three phase, 10 kVA, 415 V AC, 50 Hz • DC voltage range - 200 V to 800 V • Switching Frequency - up to 20 kHz • Switch - Semikron make SKM100GB12T4 IGBT with driver circuit (4 Nos.)



Sensing and Conditioning Circuit	• Current sensor - LEM LA 25 P (3 Nos.) • Voltage sensor - LEM LV 25 P (3 Nos.)
Controller	dSPACE 1104 R&D controller board
DC/AC Side Controller	PSO based MPPT/ SRF-PLL based AC controller
Load Connected	• Resistive – 20 W, 230 V (5 Nos.) • Inductive – 1-Φ, 230V AC, 1 HP IM

Research Scholar: Anirudh Dube
Supervisor (s): Prof. Majid Jamil, JMI
Dr. M. Rizwan, DTU

July, 2020

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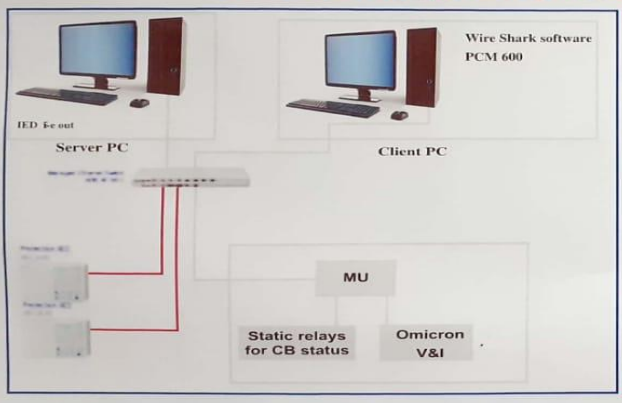
JAMIA MILLIA ISLAMIA
Jamia Nagar, New Delhi-110 025

DIGITAL SUBSTATION



Substation Components :-

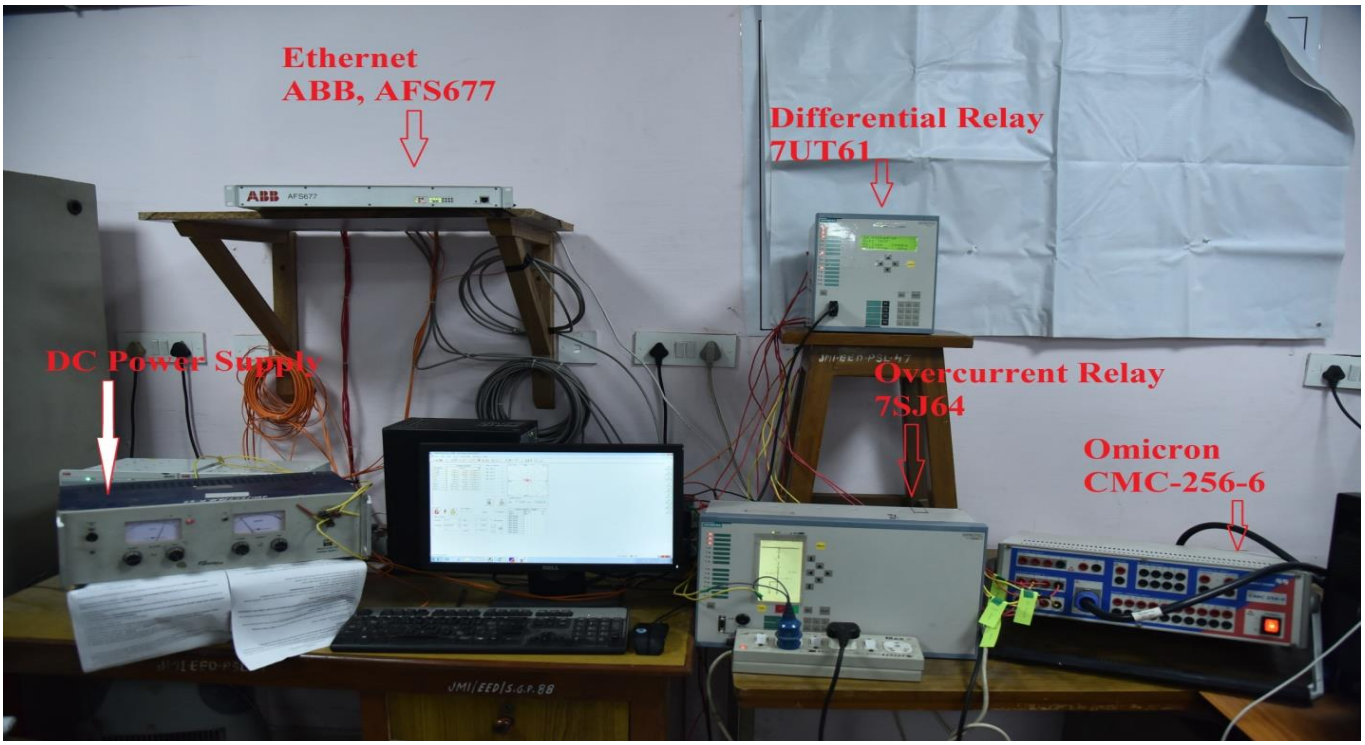
1. ABB IED line distance protection type-REL670
2. ABB IED bay controller REC670
3. ABB Ethernet Switch-AFS670
4. Vizimax Analog Merging Unit-MUG010000
5. Omicron Toolkit-CMC256-6
6. PCs-Client and Server

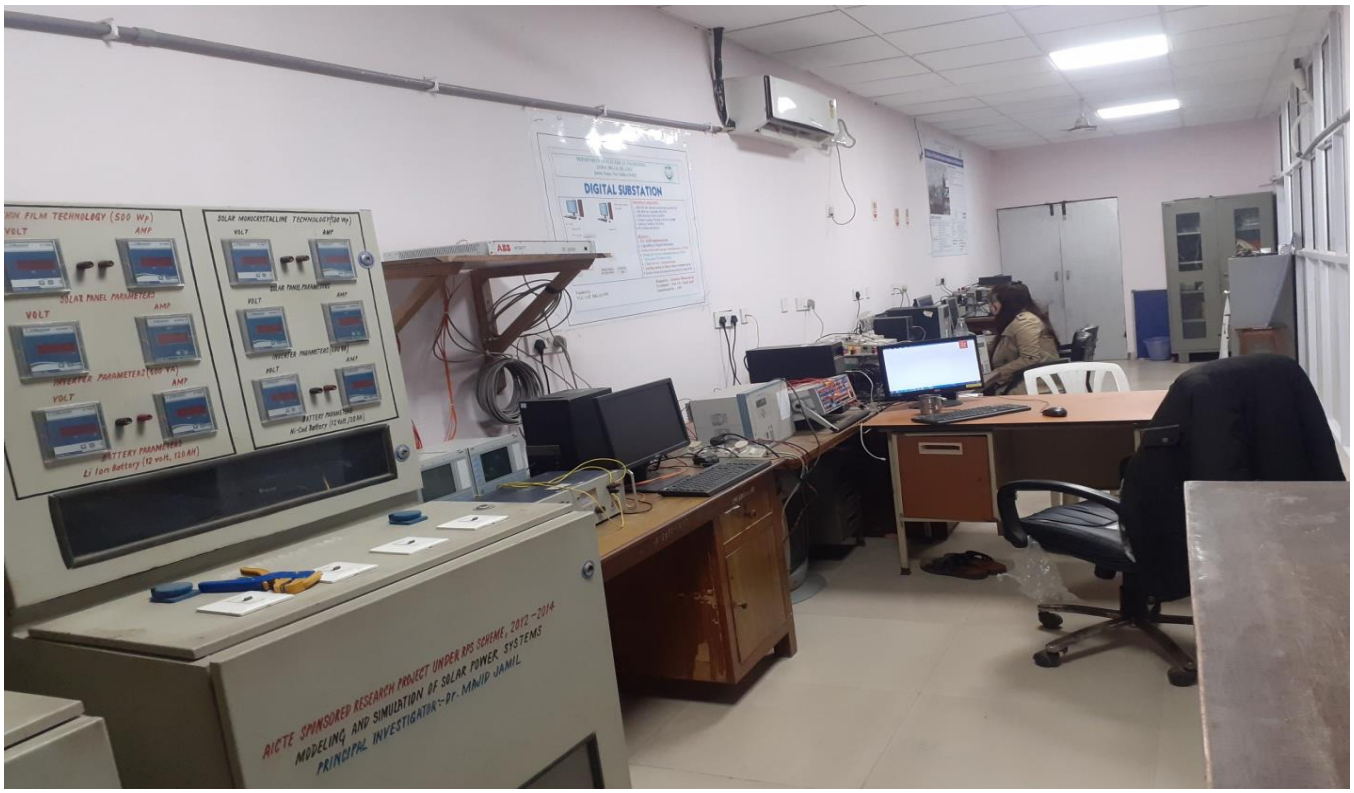
Objectives :-

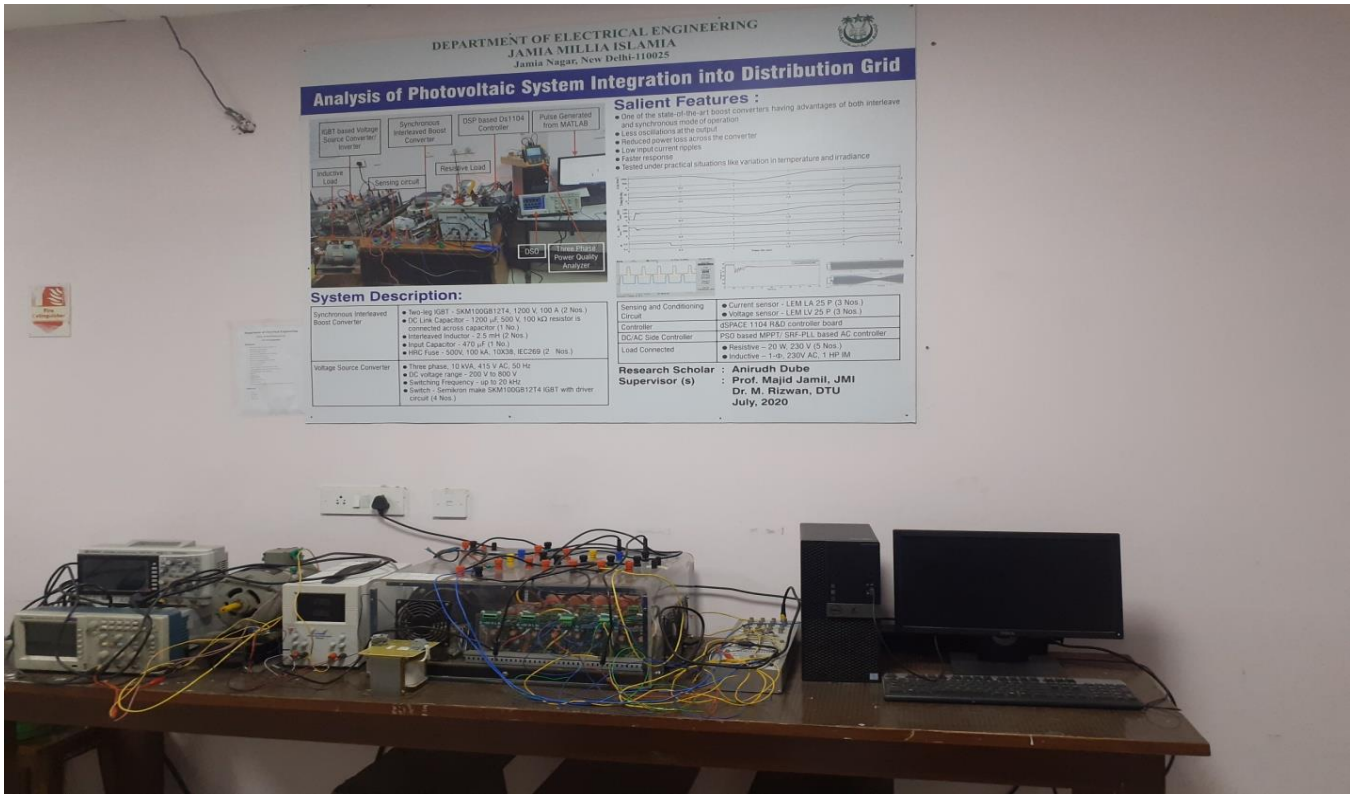
1. IEC 61850 implementation
2. Upgrading to Digital Substation
3. Testing of horizontal message communication or GOOSE
4. Testing of vertical communication or SMVs
5. Substation Prtection study
6. Client Service Communication
7. Sending analog or binary data to remote server
8. Breaker closing and opening demonstration by station HMI

Funded by : -
UGC SAP, DRS-II (2018)

Designed by :- Tanushree Bhattacharjee
Co ordinator :- Prof. (Dr.) Majid Jamil
Commissioned by :- ABB




DIGITAL SUBSTATION
SOLAR PANEL PARAMETERS
INVERTER PARAMETERS
BATTERY PARAMETERS
AICTE SPONSORED RESEARCH PROJECT UNDER RPS SCHEME, 2012-2014
MODELING AND SIMULATION OF SOLAR POWER SYSTEMS
PRINCIPAL INVESTIGATOR:- Dr. MANJU JAMIL


DEPARTMENT OF ELECTRICAL ENGINEERING
JAMIA MILLIA ISLAMIA
Jamia Nagar, New Delhi-110025
Analysis of Photovoltaic System Integration into Distribution Grid
Salient Features :
System Description:
Research Scholar : Anirudh Dube
Supervisor (s) : Prof. Majid Jamil, JMI
Dr. M. Rizwan, DTU
July, 2020


DIGITAL SUBSTATION
ELECTRIC MACHINES
Power Electronics


System Description:
Research Scholar : Anirudh Dube
Supervisor (s) : Prof. Majid Jamil, JMI
Dr. M. Rizwan, DTU
July, 2020


OF ELECTRICAL ENGINEERING
JAMIA MILLIA ISLAMIA
Jamia Nagar, New Delhi-110025
Analysis of Photovoltaic System Integration into Distribution Grid
Salient Features :
System Description:
Synchronous Interleaved Boost Converter
Voltage Source Converter
Research Scholar : Aminudh Dutta
Supervisor (s) : Prof. Majid Jamil, JMI
Dr. M. Rizwan, DTU
July, 2020


DIGITAL SUBSTATION
ELECTRIC MACHINES


SOLAR POLYCRYSTALLINE TECHNOLOGY (500Wp)
VOLT
AMP
SOLAR PANEL PARAMETERS
INVERTER PARAMETERS(600 VA)
BATTERY PARAMETERS
LEAD ACID Battery (12 volt, 300 AH)
SOLAR POLYCRYSTALLINE TECHNOLOGY(500 Wp)
INVERTER PARAMETERS(600VA)
SOLAR THIN FILM TECHNOLOGY (500 Wp)
SOLAR PANEL PARAMETERS
INVERTER PARAMETERS (600 VA)
BATTERY PARAMETERS
Li Ion Battery (12 volt, 120 AH)
SOLAR MONOCRYSTALLINE TECHNOLOGY(500 Wp)
SOLAR PANEL PARAMETERS
INVERTER PARAMETERS (600 VA)
BATTERY PARAMETERS
Ni-Cad Battery (12 Volt, 120 AH)
AICTE SPONSORED RESEARCH PROJECT UNDER RPS SCHEME, 2012 -2014
MODELING AND SIMULATION OF SOLAR POWER SYSTEMS
PRINCIPAL INVESTIGATOR :- Dr. MAJID JAMIL