A) SOLAR CELL EXPT. SETUP (ST1)

B) Spectral Response & Carrier life time expt. panel (ST2)

C) SPV STAND

D) MAIN RACK

SALIENT FEATURES

- i) **Basic model** consisting of ST1 panel mounted in rack above (**without** peltier module) + ST3 + EMT8 & EMT9 panels + 500W lamp.
  ii) **NISE/DGET compliant** consisting of SPV stands (2 nos) with EMT8, EMT9 & Optimised rack with Rheostat + EMT68 (2 nos.) + ST3 + ST4 + EMT6 + ST5 + EMT7 + ST4A (Optional).
  iii) **Advanced model** consisting of (ii) above + **(i)** (**with** peltier module) and ST2 panel.
- Table top aluminum profile modular flat demo panel rack with tiltable lockable frame 0-90° in steps to mount various types of SPV modules. Employs 1000W halogen lamps as variable intensity sun simulator.
- NISE/DGET curriculum based laboratory experiments supported. Useful for laboratory experimental learning by students in renewable energy basics, energy conservation, charge controller, storage system etc.
- Optional single phase (Stand alone or Grid tied) inverter to demonstrate power export using bidirectional multifunction meter.
- Closed loop temperature control using peltier module to study temperature effect on solar cell characteristics.
- Panels ST1 and ST2 facilitates understanding of underlying physics by measuring carrier life time & spectral response of a solar cell & calibration. Removes dependance on costly pyranometer through use of calibration. Certificate from NISE delhi for solar cell supplied. (optional)
- Optionally table top electro-scopie and hand held solar power meter are supplied.
- Optionally IV curve tester & PC interface, **Solar DC pump** setup can be provided.
- Set of Instructor Guide & Student Workbook.

TECHNICAL SPECIFICATIONS

A) Solar cell experiment setup, needs three panels

◆ Consists of table top aluminium profile rack (30x30) size:- 970(H) x 700(W) x 300(D) holding various panels

◆ **Solar cell experiment panel (ST1)- 1 No.**

- Mounted on horizontal member.
- 50 x 50 mm x 2 nos. crystalline silicon solar cells (3V/150mA) mounted in aluminium tray with heatsink and fan.
- Loading pots (500E and 5K).
- Series & parallel combination arrangement.
- Optionally cell temp controlled by Peltier module (40W), Foil type PT100 sensor to measure temperature, 12Vdc cooling Fan to maintain heatsink temp (Range 15°C - 75°C).

Mechanical : 90(H) x 200(W) x 150(D) mm/ Net Wt.:- 8Kg

◆ **Instrumentation power supply cum multichannel DPM panel (EMT8)- 1 No.**

- DC Multi Output power supply.
- Provides 1 Ph. AC supply through 3 MCB's, 4A each to power up other panels in the rack.
- Multi channel DPM for temperature display.
- 20 pin FRC power bus to supply power to neighboring
- Green shrouded socket provided to extend earth

◆ **SCR actuator cum sensor signal conditioning panel (EMT 9)- 1 No.**

- SCR based AC controller to set intensity of halogen lamp.
- Supports signal conditioning circuit for temperature to give output 0-2.5Vdc.

◆ **DC Application panel (ST3)**

- Common 12V DC fan for both solar cell and SPV
- Separate LED lamps for 3V solar cell and 12V SPV
- 6V battery mounted from behind for solar cell

List of experiments

1) Study of I-V Characteristics of Solar cell.
2) Study of series combination of solar cells.
3) Study of parallel combination of solar cells.
4) Study of dependency of solar cell I-V characteristics on light intensity.
5) Study of dependency of solar cell I-V characteristics on temperature.
6) Study of shading effect on solar cell parameters.
7) Study of Photovoltaic effect in ubiquitous semiconductor PN junction (diode).
8) Study of 6V battery charging using solar cell
9) Study of 6V battery discharging using DC fan & LED lamp

Note: Specifications are subject to change.

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B) Spectral Response & Carrier Lifetime Measurement setup enables you to study physics of solar cell (ST2)

- Stand alone table top kit with built in +/- 12V power supply.
- 50 x 50 mm x 2 nos. crystalline silicon solar cells mounted in aluminium tray.
- 11 different wavelength LED's @ constant 20 mA current to determine spectral response parameter. 1Pole/2W selector switch to select different wave length LEDs.
- White led bank of 8 LED's to determine carrier life time parameter.

List of experiments

1) Measurement of Carrier Lifetime for a solar cell.
2) Measurement of Spectral Response for a solar cell.

Mechanical :- 120(H) x 200(W) x 150(D) mm

Net Wt.:- 2.5Kg

C) SPV Stand- 2 Nos.

◆ SPV module details (Specification subject to change)

S. N.	SPV rating W/V/A/No. of cells per module	SPV dim. (HXWXT)	Rack dim. (HXWXD)	Profile size	SPV stands	Series parallel	Max rating	Default
1	20/21/1.2/36	485x350x22	910x530x300	30x30	2	Series	40W/42V	Yes
2	100/21/6.5/36	1150x675x35	1580x915x400	45x45	2	Series	200W/84V	--
3	250/43/9.2/72	1960x990x42	2385x1230x400	45x45	2	Series	500W/216V	--

◆ Instrumentation power supply cum multichannel DPM panel (EMT8)- 2 No.

- +12V, -12V, @500 mA. & +5V@300 mA.
- Multi channel DPM for temperature display.
- 20 pin FRC power bus to supply power to neighboring
- Green shrouded socket provided to extend earth

◆ SCR actuator cum sensor signal conditioning panel (EMT9)- 2 No.

- SCR based AC controller to set intensity of halogen lamp.
- Supports signal conditioning circuit for temperature to give output 0-2.5Vdc.

D) Main rack - 1 No.

Consists of table top aluminium profile rack (45x45) holding various panels

◆ DC Application panel (ST3)

- Common 12V DC fan for both solar cell and SPV
- Separate LED lamps for 3V solar cell and 12V SPV
- 6V battery mounted from behind for solar cell

◆ DC voltmeter & DC Ammeter panel (EMT68)- 2 nos.

- DC voltmeter (0-50V)
- DC ammeter (0-5A) with polarity protection diode.

◆ Stand-alone Inverter Panel (ST5)- 1 no

- I/P DC voltage-10-15Vdc, O/P AC voltage- 230Vac
- O/P power rating- 210 VA

◆ MPPT Charge Control Panel (ST4)- 1 no

- Rated voltage- 12Vdc, Max current- 6A
- Max PV voltage-15V
- Min PV voltage-10V
- Battery rated voltage- 12V, Capacity- 7Ah
- Battery type- Lead acid

◆ Lamp load panel (EMT7)- 1 no

- 230V/15/40/60/100W x 3 bulbs with individual ON/OFF using 6A toggle switches.

◆ AC voltmeter & AC ammeter panel (EMT6)- 1 no

- Voltmeter: 300V, Ammeter: 0.5A

◆ Rheostat as load for SPV modules (600E/1A)- 1 no

Note: Specifications are subject to change.

List of experiments : Covers NISE/ DGET course curriculum

1) To study the I-V & P-V characteristics of PV module with varying radiation and temperature level
2) To study the I-V & P-V characteristics of series combination of PV module
3) To study the I-V & P-V characteristics of parallel combination of PV module
4) To show the effect of variation in tilt angle on module power
5) To demonstrate effect of shading on module output power
6) To demonstrate the working of diode as blocking diode
7) To draw charging and discharging characteristics of battery
8) Observe the O/P waveform of inverter in auto mode
9) Workout power flow calculations of standalone PV system AC load with battery
10) Workout power flow calculation of standalone PV system DC load with battery
11) Find MPP by varying the resistive load across the PV panel
12) To study effect of shading on the O/P of solar panel
13) To do shading analysis on the site where solar PV systems to be setup
14) **Battery characteristics:** To study battery characteristics by finding out battery capacity (Ah) based on manufacturers data & discharging curve (Cxx) experimentally.
15) To understand difference between MPPT & PWM charge controllers, efficiency of MPPT & PWM charge controller & energy flow in a system involving MPPT & PWM charge controller
16) To understand and determine the DC flow in a solar system
17) To understand how a solar PV standalone system works
18) To determine power flow in a solar system
19) To convert normal inverter to a solar inverter system
20) To compare the performance of two inverters using electro-scopie (Optional)
21) **IV/PV characteristics** of PV module on PC screen using VWB software, MPPT controller or data logger with its built in calculator & graph window/ IV Curve Tester (Optional)
22) To perform experiment of MPPT charge controller using **ST8** panel & **VWB** software with following algorithms/ schemes (Optional) i) Incremental Conductance ii) Perturb and Observe iii) 75% of VOC
23) Optional **DC solar pump** experiment needs **separate setup** containing DC pump, rotameter, turbine sensor, EMT68 panel.

E) Optional PC interface - STT needs following additional panels: ST8, CIP-II & one more EMT8 panel.

◆ MPPT charge controller Panel (ST8)- 1 no

- 2 IGBT modules, 1st for charging control & 2nd for load ON/OFF
- 5 nos of analog outputs AI (0-2.5V) for RE voltage, RE current, Battery voltage, Irradiance measurement & Load/ battery voltage
- 2 nos of DAC inputs for PWM control and load ON/OFF
- Built in battery- 12V/7Ah, Type: Lead acid

◆ Computer interface Panel (CIP-II)- 1 no

- Connects to PC (Win7/8/10) USB port through USB IO module & type A to mini B cable
- 8 ADC channels I/P: 0 to 2.5V FS with 1 no. input simulation pot. 2 DAC channels O/P 0-2.5V FS
- V to I function block: I/P 0 to 2.5V and O/P 0-20 or 4-20mA (100 ohm load) switch settable.
- I to V function block: I/P 4 to 20mA and O/P 0-2.5V
- USB converter to interface 25 pin D connector on CIP panel to USB enclosed in 25 pin D shell using type A to mini B type cable

◆ Software on CD

- Virtual Workbench (VWB) software package is a USB based software working on windows .net platform coupled with USB IO module useful as general purpose S/W utility which supports different control strategies like graph plotting in XY, MPPT controller etc.

◆ Mechanical : 545(H) x 960(W) x 300(D) mm,

Net Wt.:- 35Kg, Gross Wt.:- 45Kg.

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