



## Solar Laboratory Tender

Item #	Required specifications	Quantity Unit
1.	<b><u>Apparatus name:</u></b>	1
	<p><b><u>Objective:</u></b> This Equipment is used to enable the students to investigate the sun radiation measurements, Properties of photovoltaic devices, open circuit voltage and short circuit current, maximum power point (MPP), the efficiency of solar cells, parallel and series solar cells, study the effect of shadow, temperature and dust, battery charging and control, off grid connection and on grid connection.</p> <p><b><u>(Experiments to be done):</u></b></p> <ol style="list-style-type: none"> <li>1. Multiple Solar Cell Module Direction Towards the Sun Light and Its effect to Solar Cell Output</li> <li>2. Covered and Uncovered Multiple Solar Cells and its effect to the total Output Voltage</li> <li>3. Effect of Sun Light Blocking on Multiple Solar Cell to the total Output Current.</li> <li>4. Understanding the Calculation of Actual Solar Cell Efficiency</li> <li>5. Regulating Solar-cell Output</li> </ol>	

	6. Configuration of Solar-cell from DC output to 220VAC 7. Effect of Light Intensity to Solar Cell Power Output 8. Applying Solar-cell System as Voltage Source for Lighting (Lamp) with Different Wattage 9. Applying Solar-cell System as Voltage Source to Inductive Load 10. Applying Solar-cell connection System: series and parallel. 11. Photovoltaic On grid system (grid tie) 12. Photovoltaic Off grid system	
	<b>Technical specifications as below: -</b>	
	<ul style="list-style-type: none"> <li>• Multiple Solar Cell Module –           <ul style="list-style-type: none"> <li>– Maximum Power (Pmax) : approx. Not less than 100 W</li> <li>– Maximum Power Voltage (Vmp) : 0 - 3 %</li> <li>– Maximum Power Current (Imp) : 5 to 10 A</li> <li>– Open - Circuit Voltage (Voc) : 20 to 24 V</li> <li>– Short - Circuit Current (Isc) : 5 to 7 A</li> <li>– Nominal Operating Cell Temperature : 45 ±2 °C</li> <li>– Operating Temperature : - 40 °C to 85 °C</li> </ul> </li> </ul>	4
	<ul style="list-style-type: none"> <li>• Battery Charger Regulator</li> <li>• Inverter 300 Watt - DC to AC Conversion</li> <li>• DC Outlet to Inverter - For connection between the regulator inverter</li> <li>• AC lamp 220 V/between 60-80 W- For Load application</li> <li>• SL Lamp 220V/between 60-80 W - For Load application</li> <li>• AC Electric Motor 220V/between 120W - 150W – Application Module</li> <li>• AC Fan 220V/ Ampere between (0.1 – 1A) - Application Module</li> <li>• AC Amperemeter 0-1A - Measurement Module</li> <li>• AC Voltmeter 0-250 V - Measurement Module</li> <li>• DC Amperemeter 1-10A - Measurement Module</li> <li>• DC Voltmeter 0-30 V - Measurement Modules</li> </ul>	1

	<ul style="list-style-type: none"> <li>• Frame For Solar Panel and application Modules</li> <li>• Set of connecting cables Includes operation manual with theory and student experiments.</li> <li>• Rheostat Module</li> <li>• Solar Charge Controller Module with Modbus</li> <li>• AC Watt Meter Measurement Module</li> <li>• DC Watt Meter Measurement Module</li> <li>• Temperature Measurement Module</li> <li>• Solar Irradiation Measurement Module</li> </ul> <p><b>Data Acquisition Hardware &amp; Software</b> for monitoring and analysis of system performance with USB computer interface</p> <p><b>Indoor High Intensity Lamps Not less than 1000 W</b> This item is used to provide lighting to the photovoltaic solar module. This enables the training systems to be used indoor as this light source will replace the sun for generating PV power.</p> <p>All the dimensions mentioned above are approximate. Different dimensions can be provided.</p>	
2.	<b>Apparatus name:</b>	1
	<b>Objective:</b> This Equipment is used to study the unsteady-state or transient heat transfer by conduction and convection.	
	<b>Technical specifications as below: -</b>	
	<ul style="list-style-type: none"> <li>– Hot water tank : Approx. 30 L, stainless steel</li> <li>– Hot water pump : Variable speed</li> <li>– Heater: 3,000 W</li> <li>– Solid shape : three shapes with two different materials</li> </ul>	

	<ul style="list-style-type: none"> <li>– Cylinder: 20 mm diameter × 100 mm brass and stainless steel 30 mm diameter × 100 mm stainless steel</li> <li>– Sphere : 45 mm diameter brass and stainless steel</li> <li>– Slab : 15 × 70 × 76 mm (W × L × H) brass and stainless steel</li> <li>– Sensors with digital display : Voltage and current for input power measurement, Temperatures</li> <li>– Power supply: 220 V, 1 Ph, 50 Hz.</li> </ul>	
<b>3.</b>	<b>Apparatus name:</b>	<b>1</b>
	<p><b>Objective:</b> This Equipment is used to enable the students to investigate the basic principles of thermal energy, and how it can be collected, stored, and supplied. Students learn how to install the system components, operate the system, and measure different parameters, such as pressure, temperature, and flow rate.</p> <p><b>(Experiments to be done):</b></p> <ol style="list-style-type: none"> <li>1. Familiarization of Solar Thermal Trainer, Evacuated Tube Solar Collector Type</li> <li>2. Normal Operation of Solar Thermal Trainer, Evacuated Tube Solar Collector Type</li> <li>3. System Performance of Solar Thermal Trainer, Evacuated Tube Solar Collector Type</li> <li>4. Effect of Water Flow Rate on Solar Thermal trainer, Evacuated Tube Solar Collector Type</li> <li>5. Effect of Angle of Incidence on Solar Thermal Trainer, Evacuated Tube Solar Collector Type</li> <li>6. Effect of Illuminances on Solar Thermal Trainer, Evacuated Tube Solar Collector Type</li> <li>7. Water Flushing Procedure on Solar Thermal Energy Trainer, Evacuated Tube Collector Type</li> </ol>	

	<b>Technical specifications as below: -</b>	
	<ol style="list-style-type: none"> <li>1. Mobile stand made from powder coated galvanize steel.</li> <li>2. Evacuated tube Solar Collector with Temperature Sensor</li> <li>3. Water storage tank with circulation unit</li> <li>4. Capacity of water storage tank approx. 40 liters at least.</li> <li>5. Electric Heater as an auxiliary heating system.</li> <li>6. Circulation unit including water pump, shut off valves, dial pressure gauge, expansion vessel tank and connection line.</li> <li>7. Control panel with instrumentation including voltmeter, ampere meter, liquid flow meter, pump controls and temperature display panel meters</li> <li>8. Data Acquisition Hardware &amp; Software for monitoring and analysis of system performance with USB computer interface</li> <li>9. Indoor High Intensity Lamps up to 1000 W.</li> </ol> <p>This item is used to provide lighting to the solar module. This enables the training systems to be used indoor as this light source will replace the sun for generating power</p>	
4.	<b>Desktop Computer</b> Min PC specs (Intel core i7, processor speed: 16 GHz, DDR memory: 1TB, hard disk: 1T, OS: windows 10) or higher. 20 inches Monitor, Keyboard, Mouse.	1