

## **AEEGY 101A Grid Connected Photovoltaics Power System**

### **PART (1)**

### **CLASS LESSON NOTES FOR BASIC CONCEPTS AT FOUNDATION/ADVANCED DIPLOMA LEVEL**

In this subject you will learn the basics about photovoltaics and grid design. You will develop knowledge and applied skills relating to:

- Solar geometry
- Solar radiation terms and measurements
- Photovoltaic cell and module characteristics
- Manufacture of photovoltaic modules
- Photovoltaic array design and characteristics
- Effects of tilt, orientation, temperature and shading
- Workplace health and safety standards, Australian and industry standards
- Inverter principles and requirements for grid-connected inverters in Australia
- Inverter and Array matching
- Wiring, Protection and Earthing
- Metering and Tariff arrangements
- Installation and Commissioning
- Maintenance.

K035Inverter K035PV\_Inverter

Stage 4 Part 17.zip

[http://www.filefactory.com/file/c0cc76b/n/Stage\\_4\\_Part\\_17.zip](http://www.filefactory.com/file/c0cc76b/n/Stage_4_Part_17.zip)

K035\_Tutorials.zip

Stage 4 Part 16.zip

[http://www.filefactory.com/file/c0cc703/n/Stage\\_4\\_Part\\_16.zip](http://www.filefactory.com/file/c0cc703/n/Stage_4_Part_16.zip)

Renewable Energy-K025+K035.zip

[http://www.filefactory.com/file/c0b7c5e/n/Renewable\\_Energy-K025\\_K035.zip](http://www.filefactory.com/file/c0b7c5e/n/Renewable_Energy-K025_K035.zip)

EE308 Sustainability (Grid Connected PV Inverter)

EE308 Part 1 EE308 Part 2 EE308 Part 3

[http://www.filefactory.com/file/59rpcqog18ux/n/K035\\_Answer\\_sheet\\_doc](http://www.filefactory.com/file/59rpcqog18ux/n/K035_Answer_sheet_doc)

[http://www.filefactory.com/file/6uye10nst3ad/n/K035\\_Test\\_pdf](http://www.filefactory.com/file/6uye10nst3ad/n/K035_Test_pdf)

## Study Guide EE07 &amp; EE011

What to study		Which exercises to do		What practical to do	Resources		
Main study		Additional study	Main exercise		Additional exercises for EE011		
EE07 Unit	EE011 Unit		Study Option (1) EE-07	Study Option (2) EE-07			
<b>UEENEEK 035B</b> Design grid connected power supply systems	<b>UEENEEK 135A</b> Design grid connected photovoltaic power supply systems <b>UEENEEK 148A</b> Install, configure and commission LV grid connected photovoltaic power systems	See 5 below	See 6 below	See 7 below	See 8 below	See 9 below	See 10 below
<b>Study Option 1</b>	<b>Study Option 1</b>	EE011 = EE07 + Additional					
See 1 below	See 3 below						
<b>Study Option 2</b>	<b>Study Option 2</b>						
See 2 below	See 4 below						

1 [Renewable Energy-K025+K035.zip](#)

[http://www.filefactory.com/file/c0b7c5e/n/Renewable\\_Energy-K025\\_K035.zip](http://www.filefactory.com/file/c0b7c5e/n/Renewable_Energy-K025_K035.zip)

2	<p><u>Stage 4 Part 17.zip</u>  <a href="http://www.filefactory.com/file/c0cc76b/n/Stage_4_Part_17.zip">http://www.filefactory.com/file/c0cc76b/n/Stage_4_Part_17.zip</a>          K035Inverter          K035PV Inverter</p>
3	As 1
4	As 2
5	<p><b><u>www.electricaldiploma.zoomshare.com</u></b></p> <p><b>Islanding</b></p> <p><b>to download the followings</b></p> <p><a href="#"><u>2.bUnintentional islanding in distribution grids with a high penetration of inverter-based DG.mht</u></a></p> <p><a href="#"><u>2.Un intentional islanding in distribution grids-Part 2 2.c.pdf</u></a></p> <p><a href="#"><u>2.Un intentional islanding in distribution grids-Part 3 2.d-1.pdf</u></a></p> <p><a href="#"><u>2.Distribution Network 1 2b Distribution Network.pdf</u></a></p> <p><a href="#"><u>2.Distribution Network 2 2d-2.pdf</u></a></p> <p><a href="#"><u>2.Distribution Network 3 2d-3.pdfRenewable Energy+ Photovoltaic Inverter</u></a></p> <p>K035 Lesson 1-Inverter principle.zip</p> <p><a href="http://www.filefactory.com/file/c0b6a01/n/K035_Lesson_1-Inverter_principle.zip">http://www.filefactory.com/file/c0b6a01/n/K035_Lesson_1-Inverter_principle.zip</a></p> <p>K035 Lesson 2-Modified sine wave inverter.zip</p> <p><a href="http://www.filefactory.com/file/c0b6a26/n/K035_Lesson_2-Modified_sine_wave_inverter.zip">http://www.filefactory.com/file/c0b6a26/n/K035_Lesson_2-Modified_sine_wave_inverter.zip</a></p> <p>K035 Lesson 3-Pulse width modulation.zip</p>

	<p><a href="http://www.filefactory.com/file/c0b6a33/n/K035_Lesson_3-Pulse_width_modulation.zip">http://www.filefactory.com/file/c0b6a33/n/K035_Lesson_3-Pulse_width_modulation.zip</a></p> <p>K035 Lesson 4-PV Inverter.zip</p> <p><a href="http://www.filefactory.com/file/c0b6a6c/n/K035_Lesson_4-PV_Inverter.zip">http://www.filefactory.com/file/c0b6a6c/n/K035_Lesson_4-PV_Inverter.zip</a></p> <p>K035 Lesson-5 MOSFET Driver.zip</p> <p><a href="http://www.filefactory.com/file/c0b5978/n/K035_Lesson-5_MOSFET_Driver.zip">http://www.filefactory.com/file/c0b5978/n/K035_Lesson-5_MOSFET_Driver.zip</a></p> <p>K035 Lesson-6 PWM Inverter.zip</p> <p><a href="http://www.filefactory.com/file/c0b6ac2/n/K035_Lesson-6_PWM_Inverter.zip">http://www.filefactory.com/file/c0b6ac2/n/K035_Lesson-6_PWM_Inverter.zip</a></p> <p>K035 Lesson-7 Grid Connected Inverter.zip</p> <p><a href="http://www.filefactory.com/file/c108253/n/K035_Lesson-7_Grid_Connected_Inverter.zip">http://www.filefactory.com/file/c108253/n/K035_Lesson-7_Grid_Connected_Inverter.zip</a></p> <p>K035 Lesson-8 Inverter Power Flow Model.zip</p> <p><a href="http://www.filefactory.com/file/c0b6aff/n/K035_Lesson-8_Inverter_Power_Flow_Model.zip">http://www.filefactory.com/file/c0b6aff/n/K035_Lesson-8_Inverter_Power_Flow_Model.zip</a></p>
6	<p>Click <a href="#">HERE</a> to download other Exercises</p>
7	<p><b>EE07 &amp; EE011 units mapping for Theory study &amp; Exercises</b>  <a href="#">Stage 4 Part 16.zip</a></p> <p><a href="http://www.filefactory.com/file/c0cc703/n/Stage_4_Part_16.zip">http://www.filefactory.com/file/c0cc703/n/Stage_4_Part_16.zip</a></p> <p>K035_Tutorials.zip</p>

8	<p>Solar Power System Design Project work</p> <p><a href="http://www.filefactory.com/file/3qun68epu0lp/n/Advanced_Diploma_in_Electrical_Engineering_Exercises_EE01_1_pdf">http://www.filefactory.com/file/3qun68epu0lp/n/Advanced_Diploma_in_Electrical_Engineering_Exercises_EE01_1_pdf</a></p>
9	<p><b>EE07 &amp; EE011 units mapping for Theory study &amp; Exercises</b>  <b><u>Practicals</u></b> <b><u>Work performance and practical instruction</u></b></p> <p>Click <a href="#">HERE</a> to download practicals</p>
1 0	<p><u>Solar Inspector Training.zip</u></p> <p>ESI_22.2_Voltage_surge_control.zip</p> <p>ESI_33.5_Harmonic_in_transformer.zip</p> <p>ESI_33.6_Power_Quality_Improvement_Capacitor_bank.zip</p> <p>ESI_33.7_Power_Quality_Improvement-Filter.zip</p> <p>ESI_33.8_Power_Quality_Improvement-General.zip</p> <p>ESI_33.9_Power_Quality_Improvement-Power_Conditioner.zip</p> <p>ESI_25_27_31_32_Part_2_Installation_and_testing_0.zip</p> <p>ESI_25_27_31_32_Part_3_Electrical_Drawing.zip</p> <p>ESI_25_27_31_32_Part_4_Data_Com_and_Wiring.zip</p> <p>ESI_25_27_31_32_Part_5_Installation_Work_Books.zip</p> <p>ESI_25_27_31_32_Part_6_Switching_1_2.zip</p> <p>ESI_25_27_31_32_Part_7_Switching_3_4.zip</p> <p>ESI_25_27_31_32_Part_8a_Electrical_Installation_Requirement_1.zip</p> <p>ESI_25_27_31_32_Part_8b_Electrical_Installation_Requirement_2.zip</p> <p>ESI_13_Voltage_Regulating_Devices.zip</p> <p>ESI_27.7_CT_and_PT.zip</p> <p>ESI_27.9_Comparator.zip ESI_27.10_Static_relay.zip</p> <p>ESI_27.11_Test_and_maintenance.zip</p> <p>In</p>

	<a href="http://www.electricaldiploma2013.zoomshare.com">www.electricaldiploma2013.zoomshare.com</a>
	Advanced Diploma of Electricity Supply Industry
1 1	<b><u>BACK UP FOR 2 &amp; 10</u></b>

## Study Guide EE07 & EE011

What to study		Which exercises to do		What practical to do	Resources		
Main study	Additional study	Main exercise				Additional exercises for EE011	
EE07 Unit	EE011 Unit	For EE07+EE011 +Video	Study Option (1) EE-07	Study Option (2) EE-07			
<b>UEENEEK 025C</b> Solve basic problems in photovoltaic energy apparatus	<b>UEENEEK 125A</b> Solve basic problems in photovoltaic energy apparatus and systems		See 5 below	See 6 below	See 7 below	See 8 below	See 9 below
<b>Study Option 1</b>	<b>Study Option 1</b>	EE011 = EE07 + Additional					
See 1 below	See 3 below						
<b>Study Option 2</b>	<b>Study Option 2</b>						
See 2 below	See 4 below						

1	<b>Renewable Energy-K025+K035.zip</b>  <a href="http://www.filefactory.com/file/c0b7c5e/n/Renewable_Energy-K025_K035.zip">http://www.filefactory.com/file/c0b7c5e/n/Renewable_Energy-K025_K035.zip</a>
2	<b>Stage 2 Part 4.zip</b> <a href="http://www.filefactory.com/file/c0ccb53/n/Stage_2_Part_4.zip">http://www.filefactory.com/file/c0ccb53/n/Stage_2_Part_4.zip</a> K025 Note 1 K025 Note 2

3	As 1
4	As 2
5	<p><a href="#">Renewable Energy-K025+K035.zip</a></p> <p><a href="http://www.filefactory.com/file/c0b7c5e/n/Renewable_Energy-K025_K035.zip">http://www.filefactory.com/file/c0b7c5e/n/Renewable_Energy-K025_K035.zip</a></p>
6	Click <a href="#">HERE</a> to download other Exercises
7	<p><b>EE07 &amp; EE011 units mapping for Theory study &amp; Exercises</b></p> <p><b>Stage 2 Part 4.zip</b></p> <p><a href="http://www.filefactory.com/file/c0ccb53/n/Stage_2_Part_4.zip">http://www.filefactory.com/file/c0ccb53/n/Stage_2_Part_4.zip</a> K025_Tutorials</p>
8	<a href="http://www.filefactory.com/file/3qun68epu0lp/n/Advanced_Diploma_in_Electrical_Engineering_Exercises_EE011.pdf">http://www.filefactory.com/file/3qun68epu0lp/n/Advanced_Diploma_in_Electrical_Engineering_Exercises_EE011.pdf</a>
9	<p><b>EE07&amp; EE011 units mapping for Theory study &amp; Exercises</b></p> <p><b>Practicals <a href="#">Work performance and practical instruction</a></b></p> <p>Click <a href="#">HERE</a> to download practicals</p>
1 0	<p><b>K025 Resources</b></p> <p><b>Stage 2 Part 5.zip</b></p> <p><a href="http://www.filefactory.com/file/c0cc187/n/Stage_2_Part_5.zip">http://www.filefactory.com/file/c0cc187/n/Stage_2_Part_5.zip</a> Protection_1 Protection_2 PV_System_installation_Overview_-_PV_Power_Systems PVSoftware Regulatory_Requirement SPS_Components</p> <p><b>Stage 2 Part 2A.zip</b></p> <p><a href="http://www.filefactory.com/file/c0cca4a/n/Stage_2_Part_2A.zip">http://www.filefactory.com/file/c0cca4a/n/Stage_2_Part_2A.zip</a> Electrical_safe_working Electrical_trade_review_questions_and_answers ELV_Accessories_-_SPS_Components ELV_Cable_termination</p> <p><b>Stage 3 Part 1B.zip</b></p> <p><a href="http://www.filefactory.com/file/c0ccc42/n/Stage_3_Part_1B.zip">http://www.filefactory.com/file/c0ccc42/n/Stage_3_Part_1B.zip</a> Cable_CktProt_E_Accessories</p> <p>Cable_Conduit_E_Accessories</p>
1 1	<b><u><a href="#">BACK UP FOR 2 &amp; 10</a></u></b>

**PART (2)**  
**REFERENCE TEXT BOOKS & WEEKLY –LESSONS AT**  
**ASSOCIATE DEGREE LEVEL (SELF STUDY)**

**TEXT BOOK- Textbooks can be copied from USBs & DVD.**

**Prescribed Texts:**

Stapleton G & Neill S 2012, *Grid-Connected Solar Electric Systems*, Earthscan, Abingdon,  
Oxon



WEEK NO:	TOPICS AND ACTIVITIES
<b>Orientation Week</b>	<p><b>Orientation activities</b> Review of syllabus and assessment activities.</p>
<b>Week 1</b>	<p>Topic description: Solar geometry, solar radiation terms and measurement, solar data, site assessment.</p> <p>Reading list:</p> <ol style="list-style-type: none"> <li>1. Stapleton G, Neill S. 2012, <i>Grid-Connected Solar Electric Systems</i>, Earthscan, Abingdon, Oxon. pp 26-42 , pp 160-165</li> <li>2. Solar Pathfinder Manual</li> <li>3. How the Solar Pathfinder Works</li> <li>4. Estimating shading object elevation angles with the Solar Pathfinder</li> <li>5. Solmetric Suneye 200 Product data sheet</li> <li>6. Solmetric Suneye 200 series user manual</li> </ol> <p>List items 2 to 4 are available from <a href="http://www.solarpathfinder.com">www.solarpathfinder.com</a> List items 5 and 6 are available from <a href="http://www.solmetric.com">www.solmetric.com</a></p> <p>Tutorial Questions: Questions can be downloaded from Equella</p>
<b>Week 2</b>	<p>Topic description: PV cell and module characteristics and the manufacture of PV cells &amp; modules</p> <p>Reading List:</p> <ol style="list-style-type: none"> <li>1. Stapleton G, Neill S. 2012, <i>Grid-Connected Solar Electric Systems</i>, Earthscan, Abingdon, Oxon. pp 54-81</li> <li>2. NREL Cell Efficiency comparisons – downloadable from Equella</li> </ol> <p>Tutorial topic/Question: Questions can be downloaded from Equella</p>
<b>Week 3</b>	<p>Topic description: PV array design, the effects of tilt, orientation and shading. Tracking, Wind loading, AS5033 and industry standards.</p> <p>Reading List:</p> <ol style="list-style-type: none"> <li>1. Stapleton G, Neill S. 2012, <i>Grid-Connected Solar Electric Systems</i>, Earthscan, Abingdon, Oxon. pp. 108-129, 175-180</li> <li>2. AS5033:2012</li> <li>3. Clean Energy Council Grid Connect Design Guidelines.</li> </ol> <p>List item 2 can be downloaded with assistance from your local TAFE library List item 3 can be downloaded from <a href="http://solaraccreditation.com.au">solaraccreditation.com.au</a></p> <p>Tutorial topic/Question: Questions can be downloaded from Equella</p>
<b>Week 4</b>	<p>Topic description: WH&amp;S Requirements. Commercial PV Mounting Systems, system protection, cable</p>

WEEK NO:	TOPICS AND ACTIVITIES
	<p>types &amp; sizing. Installation &amp; Commissioning</p> <p>Reading List:</p> <ol style="list-style-type: none"> <li>1. Stapleton G, Neill S. 2012, <i>Grid-Connected Solar Electric Systems</i>, Earthscan, Abingdon, Oxon. pp 6-13, 108-129, 131-147, 202-217, 218-225, 250-276.</li> </ol> <p>Tutorial topic/Question: Questions can be downloaded from Equella</p>
<b>Week 5</b>	<p>Topic description: System Maintenance and Troubleshooting. Calculating losses in GCPV systems. Calculating GCPV system energy output.</p> <p>Reading List:</p> <ol style="list-style-type: none"> <li>1. Stapleton G, Neill S. 2012, <i>Grid-Connected Solar Electric Systems</i>, Earthscan, Abingdon, Oxon. pp 227-248, 277-282.</li> </ol> <p>Tutorial topic/Question: Questions can be downloaded from Equella</p>
<b>Week 6</b>	<p>Topic description: Matching the PV array and the inverter. Inverter principles and the requirements for Grid connected Inverters under AS4777</p> <p>Reading List:</p> <ol style="list-style-type: none"> <li>1. Stapleton G, Neill S. 2012, <i>Grid-Connected Solar Electric Systems</i>, Earthscan, Abingdon, Oxon. pp 83-106, 181-201.</li> <li>2. AS477:2005 Parts 1-3.</li> </ol> <p>List item 2 can be downloaded with assistance from your local TAFE library</p> <p>Tutorial topic/Question: Questions can be downloaded from Equella</p>
<b>Week 7</b>	<p><b>Examination Week A:</b> <b>Review of design project will take place. Partial assessment (15%)</b></p>
<b>Week 8</b>	<p>Topic description: Site Visit to inspect a commercial size Grid Connected PV System.(<math>\geq 10</math> kW)</p> <p>Reading List: <i>There is no reading list for week 8.</i></p> <p>Tutorial topic/Question: There are no tutorial questions this week</p>
<b>Week 9</b>	<p>Topic description: Energy Efficient Building design. Energy Efficiency measures for domestic and commercial premises.</p> <p>Reading List:</p> <ol style="list-style-type: none"> <li>1. Stapleton G, Neill S. 2012, <i>Grid-Connected Solar Electric Systems</i>, Earthscan, Abingdon, Oxon. pp 150-158.</li> <li>2. Energy Efficient Building Design Manual.</li> </ol> <p>List item 2 can be downloaded from <a href="http://www.yourhome.gov.au">www.yourhome.gov.au</a></p>

WEEK NO:	TOPICS AND ACTIVITIES
	Tutorial topic/Question: Questions can be downloaded from Equella
<b>Week 10</b>	Topic description: Review of Student Design Project and provide guidance where required  Reading List: <i>There is no reading list for Week 10</i>  Tutorial topic/Question: There are no tutorial questions this week
<b>Week 11</b>	Topic description: Metering, Tariff arrangements, Monetary payback, Smart meters & Grids. Costing a Grid Connected PV System and giving Advice to Clients  Reading List: <ol style="list-style-type: none"> <li>1. Stapleton G, Neill S. 2012, <i>Grid-Connected Solar Electric Systems</i>, Earthscan, Abingdon, Oxon. pp 143-146, 306-316, 318-325.</li> <li>2. Smart Grid Standards Roadmap.</li> </ol> List Item 2 can be downloaded from <a href="http://www.standards.org.au">www.standards.org.au</a>  Tutorial topic/Question: Questions can be downloaded from Equella
<b>Week 12</b>	Topic description: Large Commercial Grid Connected PV Systems and PV Farms  Reading List: <ol style="list-style-type: none"> <li>1. Stapleton G, Neill S. 2012, <i>Grid-Connected Solar Electric Systems</i>, Earthscan, Abingdon, Oxon pp 284-305.</li> </ol> Tutorial topic/Question: Questions can be downloaded from Equella
<b>Week 13</b>	Topic description: Review of Student Design Project and provide guidance where required.  Reading List: <i>There is no reading list for Week 13.</i>  Tutorial topic/Question: There are no tutorial questions this week
<b>Week 14</b>	<b>Study Week</b>
<b>Week 15</b>	<b>Examination Week B:</b> <b>GCPV Design assignment – 35%</b> <b>Written examination - 50%</b>