(1) Problem 4.6 (Messenger and Abtahi, modified) (40 pts)
Using Module #1 as described in the first row of the table below and an inverter that has $V_{in}(\text{max}) = 600V$, $V_{m}(\text{min}) = 250V$, $I_{in}(\text{max}) = 30A$, and is rated at 7000W output power, with provisions for 4 inputs, determine three symmetrical configurations of the modules that will provide between 7000 and 8000 watts to the inverter.

<table>
<thead>
<tr>
<th>Module</th>
<th>$V_{oc}$ (nominal)</th>
<th>$V_{oc}$ (max)</th>
<th>$I_{sc}$</th>
<th>$V_{m}$ (nominal)</th>
<th>$V_{m}$ (min)</th>
<th>$I_{m}$</th>
<th>$P_{m}$ (nominal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>33 V</td>
<td>37 V</td>
<td>8 A</td>
<td>27 V</td>
<td>20 V</td>
<td>7 A</td>
<td>189 W</td>
</tr>
<tr>
<td>2</td>
<td>44 V</td>
<td>49 V</td>
<td>5.5 A</td>
<td>36 V</td>
<td>27 V</td>
<td>5 A</td>
<td>180 W</td>
</tr>
</tbody>
</table>

Using the above values for $V_{oc}(\text{max}) = 37V$ and $V_{m}(\text{min}) = 20V$, we can figure out the upper and lower limits for the number of modules in a source circuit. The lower limit is established by rounding up $250V/20V = 12.5$ (to 13), and the upper limit is established by rounding down $600V/37V = 15.8$ (to 15)

So the range for modules in one source circuit is:

13, 14, 15

The power requirement range of 7000 to 8000W adds this module range for all source circuits ($P_{module} = 189W$) by considering $7000W/189W = 37.0$ (left at 37) and $8000/189 = 42.3$ (rounded down to 42)

37, 38, 39, 40, 41, 42

So only two symmetrical combinations meet these two requirements:

3 x 13 (39 total)
3 x 14 (42 total)

The three source circuits will each deliver a maximum current of 8A, for a total of 24A – this is below the inverter maximum of 30A. Neither two nor four source circuits would work.

Note: Non-symmetrical combinations can be constructed (e.g., 1 x 12 + 2 x 13 = 38), but then way more than three combinations are possible.