APS112&113 Winter 2017 Quiz #1 Solutions Notes for Short-Answer Questions

1. (7 MARKS) Give ONE primary function, TWO important objectives, and ONE important constraint for Client Statement #2 – Photovoltaic Cells. Metrics are required for the objectives and constraint, but you do not need to include goals or limits.

- Objectives/constraints and metrics were considered together: one must support and make measurable the other.
- Each objective was assigned a weight of 0.5 and each metric was assigned a weight of 1.5 points.
- Though a specific grading scheme and answer key were used, answers were graded holistically: the strength and internal coherence—relationship between functions, objectives, and metrics—of each response were considered and reflected in the grades given.
- Objective-metric and constraint-metric combinations must be **actionable: t**here must be a goal, a unit of measure, and a means for achieving the goal presented. Therefore:
    - # maintenance visits/year or time/wash or last # years without failure, for example, are good metrics, but if presented alone, they are baseless. Must present more tangible means of achieving these goals for full marks.
- The objective or constraint "must be effective" or "must remove dirt well" coupled with a % dirt removal or # times satisfactorily cleaned/week metric were not awarded points. These are reiterations of the primary function: setting goals for the design to do what it is intended to do is redundant. Unless detailed means were provided, this answer earned 0 points.
- By the same token, "must operate in all weather conditions/hot, sunny conditions" is not an objective, it is a statement that the design must function in its intended service environment: a restatement of the primary function. A stronger, more tangible objective-metric combination might be "Heat-tolerant; # or % of panel washing system components made up of thermostable materials"

2. (7 MARKS) While designing a solution for Client Statement #2 – Photovoltaic Cells, you need to know the amount of water consumed washing panels at the 550 Megawatt (MW) Desert Sunlight Solar Farm in the Mojave Desert. If the panels are washed twice a week in the traditional way, estimate the annual water consumption for this task in Litres. Use reasonable assumptions based on your personal knowledge and the information provided here. You don't have to get an exact answer, but you do have to compute a number and demonstrate structured thinking.

Structured Thinking: 4 Marks

- # Panels in the solar farm
    - Simply assuming a number for the # Panels without justification (- 1.5)
    - Making an unreasonable assumption of power rating of solar panels without any justifications (- 1.5)
    - Making an unreasonable assumption of power rating of a single solar panels with some justifications (- 1.0)
- Assumptions made in how many L of water per panel
    - If an unreasonable estimate is made (- 1.0)
    - If an unreasonable estimate is made with some justifications (- 0.5)
- Answer given in L per year after calculations
    - If unit given in gallons (- 0.5)
    - Did not consider annual amount (- 1.0)

Stating Assumptions & Why assuming it: 1 Mark

- Did not state the amount of water per panel is an assumption (- 1.0)

Other Calculation Issues: 1 Mark

- Stating the incorrect number of weeks in a year without justification (- 0.5)
- MW not properly converted to 10^6 W (- 0.5)

Concluding Statement: 1 Mark

3. (7 MARKS) Given Client Statement #2 – Photovoltaic Cells, provide a Functional Decomposition of the cleaning device.

a) In your Functional Decomposition, identify the Primary Function, three subfunctions, and at least one viable solution for each subfunction. (/6)

2 marks for each sub-function and it's corresponding example.

Sub-functions must be elements of the primary function you identified (i.e. you can re-combine the sub-functions to perform the primary function). I was mainly looking for coherence between the primary and sub-functions here.
Example: 'Prevent cell from getting dirty' is not a sub-function of 'Clean the cell', as these are two different processes, but this might be an acceptable sub-function if your primary function is to 'Prevent the degradation of power output due to dirt and grime on the cells'. 'Dry the cell' is not a sub-function of 'Clean the cell', unless you specify that you're removing the dirty water, not simply suggesting air drying the dirty water onto the cell.

Sub-functions must be substantially different from one another to get marks for each.
Example: 'Remove dirt' and 'Remove dust' are not separate sub-functions, unless you adequately explain why these are separate steps in the same overall process.

I was fairly lenient with whether a solution was 'viable', but some required additional explanation to explain how solution could be viable, and these did not receive marks.
Example: 'Cover the panel with a clear cover' came up often, but simply transfers the problem to cleaning the cover of dust and dirt.

b) Use these viable solutions to propose an overall solution. (/1)

0.5 marks for some effort to combine examples given above.
0.5 marks for a reasonable overall solution that could potentially perform the primary function given in (a).