**Grading Rubric**

***Lab 1 – Capacitance***

***( /42)***

Recall that your goal is to teach them through inquiry-based teaching, and therefore you should encourage discussions, and make them understand the concepts (and achieve the best marks possible) as opposed to strictly evaluating them. You should try and assess their understanding in the last 30 mins of the lab session, or before they leave.

Points are distributed in four parts: **Pre-lab**, **Log book structure**, **Session A** and **Session B**. For the latter two, there’s always a **Conceptual questions and Critical thinking** and sometimes **bonus points**. Only during Session B will there be a **Data presentation** subsection.

**Pre-lab (/2)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Unsatisfactory (0) | Minimally satisfactory (1) | Satisfactory (2) | Exceeding Expectations (3) |
| Pre-lab Activity | Did not attempt any of them | Gave an answer to all of them. Made some mistakes. | Gave an answer to all of them. Made no mistakes | - |

**Log book Structure (/4)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Unsatisfactory (0) | Minimally satisfactory (1) | Satisfactory (2) | Exceeding Expectations (3) |
| Session a | Did not write any introduction or conclusion | Introduction and conclusion sections are present. Made no effort in evaluating their sources of error, and potential follow-up. | Introduction and conclusion sections are present. Made some effort in evaluating their sources of error, and potential follow-up. | Introduction and conclusion sections are present. Put in a lot of effort in evaluating their sources of error, and potential follow-up. |
| Session b | Did not write any introduction or conclusion | Introduction and conclusion sections are present. Made no effort in evaluating their sources of error, and potential follow-up. | Introduction and conclusion sections are present. Made some effort in evaluating their sources of error, and potential follow-up. | Introduction and conclusion sections are present. Put in a lot of effort in evaluating their sources of error, and potential follow-up. |

**Session A**

No grading for this session.

**Session B**

**Conceptual questions and Critical thinking (/20)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Unsatisfactory (0) | Minimally satisfactory (2) | Satisfactory (4) | Exceeding Expectations (6) |
| Adjusted their initial proposal from the end of Session a after the group discussion. | After the group discussion, they still do not understand that they must vary the distance and area between the plates. |  | Intend to study the effect of and on the capacitance by following the expected protocol. | Offered an unexpected method to further test the effect of , or on the capacitance. |
| Responded to their observations from the previous lab. | Made observations in Session a, but did not correct for them in the Session b. | Responded to some of their observations. | Responded to all of their observations. | Proposed a better approach than the expected protocol. |
| Observed that the capacitance is proportional to the area of the plates. | Did no observe this. | Observed it, but their data was inconclusive, and did not provide a justification. | Observed it and obtained good data. Or obtained bad data but were able to justify their sources of error. | See “Satisfactory” conditions. Further noticed that the main source of error comes from misalignment of the plates |
| Observed that the capacitance is inversely proportional to the distance between the plates. | Took more than 3 layers but did not observe the behavior over the whole dataset. **Did not notice the behavior for less than 3 layers.** **Did not attempt** to explain the discrepancy. | Took more than 3 layers but did not observe the behavior over the whole dataset. **Did not notice the behavior for less than 3 layers.** **Attempted** to explain the discrepancy. | **Observed that for few layers, there is a behavior.** Observed that for large enough distances, there is a correction that deviates from . **Did not attempt** to give an explanation to this correction. | Observed that for large enough distances, there is a correction that deviates from . **Attempted** to give an explanation to this correction. |
| Gave a physical explanation why area and the distance affected the capacitance of the setup. | Did not answer the question. | Incorrectly answered the question. | Correctly answered the question. | Exceeded expectations by making connections to other topics. |

**Data presentation (/16)**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Unsatisfactory (0) | Minimally satisfactory (1) | Satisfactory (2) |
| Appropriate algebra (includes appropriate error propagation calculations) | Overwhelming number of mistakes | Made mistakes but it did not affect the overall understanding of the physical concepts. | Most calculations are correct. |
| Units (results and graphs) | Missing | Incorrectly used | Correctly used |
| Standard deviation  and significant figures | Missing | Incorrectly used | Correctly used |
| Title (figures and tables) | Missing | Incorrectly used | Correctly used |
| Axes labels | Missing | Incorrectly used | Correctly used |
| Error bars on graphs | Missing | Incorrectly used | Correctly used |
| Fit equation for graphs | Missing | Incorrectly used | Correctly used |
| value for graphs | Missing | Incorrectly used | Correctly used |

**Bonus points:**

* Fixed a technical issue with the setup **(+2)**.
  + Since this lab has more freedom than the others, it is unlikely that we’ve accounted for every possible scenarios and therefore, if students can help us improve these labs, they should be rewarded for doing so.
* Improved the Arduino code **(+2)**.
  + See the explanation above.
* Discusses the mathematical description of the electric field between the parallel plates (in comparison with that of an electric charge) **(+2)**.
  + The electric field is constant for an infinite plane
* Contrast the electric field of an infinite plane to that of a point charge or infinite line **(+2)**.
  + The former is and the latter is .