

PHYS 5660 Semiconductor Physics and Devices [2020-2021 Term 2]

Term Paper Guidelines

The Term Paper (48%) and the Presentation (12%) account for 60% of the score in the course. Below is a brief guideline. I intentionally leave much freedom for you to decide on the topic and the depth of the coverage. I understand that you might want to explore or learn different aspects of the physics and skills through this exercise depending on your status (research postgraduate students or taught postgraduate students).

Time line (due dates):

1. Outline (8 points) [on or before 27 Feb 2021]
2. Term Paper (40 points) [due 26 April 2021 (Monday), day after the teaching term ends]
3. Presentation (12 points): To be scheduled in the week after the teaching term ends

Broad Guidelines

Choice of Topic

- The general principle is “up to you”.
- It could be related to your current research (strongly encouraged for the PhD students), or to an area that you want to self-learn (for the M.Sc. and undergraduate students who want to pick up the background of an area that you may apply to research groups for further studies), or an area that you want to write a story (for those who want to learn more on scientific communications).
- The topic could be pure or applied, theoretical or experimental or computational.
- For example, you may write about chosen (narrowed) details of a particular aspect of semiconductors (or solids broadly), e.g. transport properties, optical properties, heterostructures (quantum wells, superlattices, quantum wires, quantum dots), how specific semiconductors are put into some particular applications (electronics, optoelectronics, night vision, lasers, solar cells), wide-bandgap and narrow bandgap materials, theoretical methods (e.g. band calculations, ETBM, effective-mass theory, electron dynamics), how specific semiconductors are put into good use on fundamental research (quantum Hall effect and its related areas, anomalous spin Hall effect, semiconductor qubits, detectors in particle physics experiments), how defects and spins play out in semiconductors, why some work in semiconductors were awarded important prizes (transistors, integrated circuits, blue lasers), how scientists work to turn silicon into a better optical materials and what the current status is, experimental techniques in fabricating and characterizing samples, comparison of materials for a particular application.

For PhD students or students with research experience in materials

- You may think along the line of **writing (a part of) an introductory chapter** of your future thesis on your work or **writing (a part of) a postdoc position application** (research plan) or **writing (a part of) a PhD position application for the M.Sc. students**

(why you are interested in an area). I can imagine that some of you can write about: why some materials are thought to be good for solar cells, what are so special about nanoparticles (or core-shell structured particles, metal particles) or quantum dots, what a particular computational method is about, what is the problem related to diffusion of defects into a semiconductor, what happens to a solid state system when pressure and high magnetic fields are applied, what factors come in when two different semiconductors are put together to form a heterostructure, and how defects can work as a sensor.

- The overall picture is that you may take this opportunity to learn something about the background of your current research project.

For some M.Sc. students

- You may take a semiconductor textbook and select a particular section (or sections) and work through (go deeper) the details by yourself, or you may write about the Nobel Prizes related to semiconductors (latest one was awarded to the blue laser work in 2014).

Outline (due 27 Feb 2021) [Submit outline to Submission Folder in Blackboard]

- Give your choose of topic, narrow it down to more specific points that you want to cover, give an outline in bullet point form down to sections and subsections, give a few KEY REFERENCES that will steer your paper
- What to do and what not to do? Be focused, narrow the topic down to something that you can go deeper and make a few good physics points. For example, "Optical Properties of Semiconductors" will be too broad. "GaN as a material emitting blue light" is narrower.
- Up to two A4 pages (including the KEY REFERENCES)
- Outline will be marked (8 points)
- You may start working on the team paper once your outline is approved
- The sooner you submit the outline, the earlier you will receive the approval

The Team Paper (due 26 April 2021)

- About 2000 words (page 1 of this document has 430 words, so it is about 5 pages) [c.f.: an article in Nature is restricted to 1500 words], shorter or longer papers are acceptable as long as they are not too short or too long (way off limit)
- References and figures/tables are NOT counted into the estimated page limit
- Materials that you want to include but off the page limit could be included as appendix (appendices) for completeness [may not be marked]
- Title, your name, an abstract, proper sectioning, proper citations in good style are expected
- For research postgraduate students, you may consider that you are writing an application to the Hong Kong granting agency (called Research Grants Council (RGC)) for

a RGC Postdoctoral Fellowship in which you are asked to include a Research Proposal. In the Research Proposal, the first part is about the Background, including what you want to investigate, what the key issues are and why, and what others have done. If you are applying for a faculty position (a few years down the road), you will need to write grant proposals as well. There is always a part on the Background of your proposed research (usually 3 pages of words plus figures/tables/references). This is the case for Hong Kong RGC grant proposals. In Mainland, this corresponds to the part of 立項依據 in NSFC grant applications. For M.Sc. students, some PhD position applications also require a (usually shorter) proposal on what you are interested in and what you want to do.

What am I looking for in the Paper?

- A sensible choice of topic (not too broad and not too shallow) that fits to your preparation and ability
- An effort in explaining the physics and materials science behind the topic [e.g. when you said this material is good for a particular application, explain why.]
- You can convey the physics and materials science at a level that your peers can understand
- You understand what you are saying
- Good scientific style [short sentences that are up to the point, proper way to cite references and acknowledge sources (if you use figures/tables from sources)]

Academic Honesty (extremely important)

- You MUST write the Paper in YOUR OWN WORDS
- You MUST CITE REFERENCES properly
- CUHK has a zero-tolerance policy against academic dishonesty (especially plagiarism). Even the “minimum penalty” is severe.
- The CUHK website https://www.cuhk.edu.hk/policy/academichonesty/Eng.htm#files_2013-14/index_page2.htm has a section on “citation styles” and an appendix on “Detailed guidelines on proper use of source materials” with many examples (and a video). All students should take a careful look if you have not done so.

Presentation (12%)

- To be scheduled (end of Term)
- 15 minutes (plus 3 minutes of Q&A) based on your team paper

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15 Feb 2021