DETAILED PROJECT GUIDELINES

ETHICS:

Plagiarism is the representation of someone else's work as if it is your work without proper citation to the original work or without giving proper credit to the original owner. Plagiarism is **NOT** allowed and such an act – representation of someone else's work as yours OR reusing another class's project (prepared by yourself/someone) for this class – leads to an automatic "0" points grade for the entire project component along with ethical misconduct violation filing.

PROJECT TIMELINE:

- **Due April 6th (Saturday) by 9 pm:** One-paragraph abstract with a project title
- **Due April 13th (Saturday) by 9 pm:** One-page Project Outline.
- **Due April 21st (Sunday) by 9 pm:** All final project components. Students are asked to place all project related components into one folder named "YourName". This folder, once ready, should be uploaded to "box.illinois.edu" and shared with the instructor by the deadline. Please share the folder ONLY AFTER the folder is uploaded completely and you agree with the contents are fully uploaded. This folder named "YourName" **must** include

  (a) one PDF final report file titled "YourName.pdf",

  (b) one PPT final presentation file titled "YourName.ppt",

  (c) a subfolder named "Simulation Files" where all simulation files along with source codes are placed;

  (d) a subfolder named "References" where pdf papers/resources cited in your report are placed, properly numbered in the proper order of citation in the final report pdf file. The references - in general - are the actual pdfs of cited journal papers, conference proceeding papers, or dissertations.

The project submission is considered complete when all (a, b, c, d) parts are received.

- **PARTIAL SUBMISSIONS ARE NOT ACCEPTED.**
- For **LATE** submissions, 10% deduction per day is implemented. For instance, if you submit after two days of the 9:00 pm deadline, you will be graded over 100* 0.9 * 0.9 = 81% (rather than 100%).
- **The last day to submit the project is the last presentation day and before the class begins.**
- **Once submitted, NO changes to the submission are accepted.**

PRESENTATION SCHEDULE:

Students are to be ready to present on the day of the project submission deadline. Instructor prepares a tentative presentation schedule for in-class presentation schedule; however, if a student cannot present on the scheduled day two things will happen: **(1 Case A)** If the student has an excuse (medical or instructor-approved) then the student is automatically assigned to present in the next lecture; **(1 Case B)** If the student does NOT have an excuse or has an INVALID excuse, then the student gets an automatic 10% deduction in the presentation component of the project and is automatically assigned to present in the next lecture; **(2)** The student who is next in the initial tentative presentation agenda will present instead. **Thus, it is encouraged that all students to be ready to present at least one class in advance with respect to the tentative agenda**.

ON THE DAY OF THE PRESENTATION:

On the day of the tentative presentation, all students (who have not presented yet) should bring their presentations in a USB into the class and must be ready to present on short notice. If a student misses the day of the presentation that the project is assigned to, it is an automatic 10% deduction from the overall project grade accordingly. For every class the presentation is delayed, it is an additional 10% deduction. The presentation times are assigned tentatively based on the topic areas as listed in the later section of this document and does not represent the final presentation schedule – it is subject to change.

RUBRIC:

The project overall corresponds to 12.5% of the total grading of the class. *In order to receive a project grade, student MUST provide a written report, MUST present his/her slides, MUST provide his/her simulation files, and MUST provide his/her references.* Failure to provide either is an automatic project grade "0".

- (PASS OR FAIL) **ABSTRACT.** One-paragraph (< 200 words) abstract with a project title should be in a WORD document titled "YourName".doc. This should be emailed to the instructor before the deadline. This is a PASS or FAIL assignment with no specific grade attachment, but the timeliness might impact the class participation. The instructor will provide PASS or FAIL notice to the student via email with further instruction for the latter case. The student must then revise, resubmit, and PASS to proceed with the next outline and project submission steps.

  Here are some guidelines. Your abstract is expected to answer these questions (where "*this project"* is the topic you want to work on).

  * Why do I want to work on *this project*? What is the need *this project* will address?

  * What aspect of *this project* I am most interested in? How can I address the need?

  * What difference will *this project* make? What will be the outcome of *this project*?

  * Why is the outcome of *this project* important?

- (PASS OR FAIL) **Outline.** This should be a WORD document titled "YourName" doc. This should be emailed to the instructor by the deadline. This is a PASS or FAIL assignment with no specific grade attachment, but the timeliness might impact the class participation. The instructor will provide PASS or FAIL notice to the student via email with further instruction for the latter case. The student must then revise, resubmit, and PASS to proceed with the next project submission steps.

  Examples of outlines can be found online. A good outline must show headers and sub-headers one is planning to write on. An example can be reached at:

  https://academicguides.waldenu.edu/writingcenter/writingprocess/outlining

A proper outline is a 1-pager with a standard single-spaced 12 pt format.

Title

[A revised version of your submitted title]

I. Abstract

[A revised version of your submitted abstract]

II. Introduction

[Describes the general field and your goal - A few sentences]

III. Background Information on the Problem

HINT: This part typically answers the following questions: What is the problem you are solving? Why is it worth working on? What are "we" (as in "humanity") going to win if you succeed?

IV. State of the Art on the Current Approaches

[Explains the background in the field and the state of the art in the field]

HINT: This part typically answers the following questions: What are the available approaches regarding the problem you are solving? What are the advantages and disadvantages of these approaches? Why do you need a new approach?

V. Research Plan

[Details what you want to work on with specific objectives]

Va. TYPE YOUR Research Objective 1

[ADD A FEW SENTENCES TO DESCRIBE YOUR OBJECTIVE]

Vb. TYPE YOUR Research Objective 2

[ADD A FEW SENTENCES TO DESCRIBE YOUR OBJECTIVE]

Vc. TYPE YOUR Research Objective 3

[ADD A FEW SENTENCES TO DESCRIBE YOUR OBJECTIVE]

VI. Summary / Conclusion

[Restate basics of the expected (project) results]

- (12.5%) **FINAL PROJECT.** Students are asked to place all project related components into one folder named "YourName". This folder, once ready, should be uploaded to "box.illinois.edu" and then be shared with the instructor by the deadline. Please share the folder ONLY AFTER the folder is uploaded completely and you agree with the contents are fully uploaded.

  The distribution of this 12.5% final project component is as follows:

  - Presentation (in-class) (5.0%)
    - Peer grading *(2.5%)*

      See the provided sheet for how your peers will be grading your presentation. After each talk, these sheets will be collected before going to the next talk.

    - Instructor/TA grading *(2.5%)*

      Grading will be done in-class during your presentation and Q&A.
  - Written report grading (7.5%)
    - Style/Format *(2.5%)*

      See the written report formatting guidelines.

    - Content/Technical *(5.0%)*

      The technical content relates to the "what", "why", "how" components of the project.

Final conference-style presentations (in Spring 2024, 6-minute talk with a 4-minute Q&A) will occur in the week(s) before the final. Please refer to the calendar provided for more scheduling details.

GENERAL GUIDELINESS:

In your report (minimum 10, and maximum 15 pages), it is expected that you answer the following questions:

(***FUNDAMENTALS***): *- a good introduction is about more than 1 and less than 2 pages.*

1) What is this project about? Why is this project important? What will it change if it is successful?
2) What is existing in this area? What are the existing systems/devices today? Why are the existing systems/devices not enough?

   SUGGESTION*: It always helps to make a table for comparing technologies.*

(***PHYSICS&TECHNOLOGY***): *- a good project body is about more than 6 and less than 12 pages.*

3) What is this device? How does it work?
4) Why does it work the way it works? What are the governing physics and engineering principles of this device? It always helps to insert the governing equations.
5) How does its band diagram look like? What are the typical doping values, doping types, materials, material contents of this device/structure? Detail the device as much as you can. Tabulate the key design parameters. It always helps to sketch the structure and simulate this device.
6) What is the bottleneck of this device? What are the trade-offs in your design?

(***SUMMARY&CONCLUSION&ANALYSIS***): *- a good summary is about 1 page*

7) What are the overall benefits and bottlenecks of your proposed solution?

WRITTEN REPORT INFORMATION AND FORMATTING DETAILS:

FORMATTING:

Your abstract/outline/report should be formatted according to the following (NSF-based) guidelines:

a. Use Times New Roman at a font size of 12 points; (a smaller font size may be used for mathematical formulas or equations, figures, table or diagram captions and when using a Symbol font to insert Greek letters or special characters. Students are cautioned, however, that the text must still be readable)

b. Use single line-spaced text.

c. Margins, in all directions, must be an inch.

d. Students must use only a standard, single-column format for the text.

The guidelines specified above establish the minimum type size requirements; however, students are advised that readability is of paramount importance and should take precedence in selection of an appropriate font for use in the proposal. Small type size makes it difficult for instructors/TAs to read the project report; consequently, adherence to type size and line spacing requirements also is necessary to ensure that no student will have an unfair advantage, by using smaller type or line spacing to provide more text in the proposal.

REFERENCES:

The references in the written report has to be cited properly as in the format of “C. Bayram, J. Ott, K.-T. Shiu, C.-W. Cheng, Y. Zhu, J. Kim, M. Razeghi, and D.K. Sadana, “Cubic Phase GaN on Nano-grooved Si (100) via Maskless Selective Area Epitaxy, Advanced Functional Materials 24 (28) 4491(2014).” and the ***direct link should be hyperlinked to the references***. We will check the references through these hyperlinks thus any broken or wrong link will lead to a deduction.

COMMON REPORT MISTAKES:

- Missing page numbers
- Missing motivation
- Formatting errors (too small or too large texts/figures used for space fillers)
- Using too larger figures as space fillers
- Using too small or unreadable text in the figures
- No table to show the set of key simulation parameters used
- Lack of detailed analysis on the presented data
- Vague statements (without providing any quantification or physical background)

- Lack of scientific rigor

HOW TO AVOID COMMON REPORT MISTAKES:

- Start your project early.
- Choose a topic early.
- Choose a topic you are passionate about.
- Choose a topic you are comfortable completing within one semester.
- Investigate the physics, engineering, material science, and chemistry aspects of the project. Science is interdisciplinary so as the final report...
- Be careful about formatting and the provided guidelines.

YOUR GOAL SHOULD BE TO PREPARE A CLEAR, PRECISE, COHERENT, AND FOCUSED PROJECT REPORT.

PRESENTATION FORMATTING INFORMATION:

For a 10-minute talk with 5 minutes Q&A, the recommended number of slides (excluding cover and/or transition slides) is 10. This enables 1-minute talk time per slide in general. Students should think in term of "**If I am going to talk about this slide in less than a minute, is this slide really necessary?**" Any overtime is an automatic deduction of 10% in the presentation component of the project.

In a 10-slide presentation, 1-2 slides are the introductory and motivation slides, 7-8 slides are technical slides, and 1 slide is a conclusion slide. ***In the introductory/motivation slides***, students are expected to explain why this subject/work is important, what is the available technologies that can benefit from these devices. ***In the technical slides***, students are encouraged to first talk about the available competing technologies and explain their limitations, followed by their proposed device approach. Students must explain their device concepts in detail and use physics and engineering principles in explaining doing so. ***The conclusion slide*** summarizes the overall presentation and the results of student's project.

Peer grading will be realized in-class according to the provided guidelines. Before each talk, a new peer grading sheet will be distributed to each registered student and after each talk these will be collected. This peer grading sheets will be used for tracking the individual attendance.

COMMON PRESENTATION MISTAKES:

- Missing slide numbers on the slides
- Too much text or too many (more than two is too many) graphs on each slide
- Not facing/engaging the audience (i.e. looking at the slides all the time)
- Spending too little time on a slide (because it was covered in the class or by previous speaker – assume nothing is covered and know your audience, your class)
- Going overtime
- Placing references in the very end (they need to be on the slide where they are used)
- Having large/many papers in hand and reading them during presentation

HOW TO AVOID COMMON PRESENTATION MISTAKES:

- Start your project early.
- Practice at least 10 times before your talk.
- During your practice talks, time yourself and present even you have a problem.
- Know your audience. Who you are talking to? What are their backgrounds? What do they already know and what do they not know (and I need to talk more about)?

- Face and engage with your audience.
- Respect time.
- Spend a minimum of 1-minute per slide so that you can first describe the slide and then show your analysis and results.
- Teach one-thing but do it well. Make the audience remember your talk/results/work.

AS YOU ARE FINALIZING YOUR SLIDES, YOU SHOULD ASK YOURSELF: "IF I WANT THE CLASS TO LEARN ONE THING FROM MY TALK, WHAT WILL IT BE?" AND PREPARE YOUR TALK AROUND YOUR KEY TEACHING POINT.

SOFTWARE RESOURCES:

NOTE: Students must use Crosslight finite element modelling tool introduced in the class to have their simulation component of the project evaluated over the full credit. The use of software that are not accessible to the instructor and/or TAs are prohibited. For any inquiries, please contact the course director.

*ADVANCED SEMICONDUCTOR SIMULATION (RECOMMENDED FOR ALL STUDENTS)

No grad student will be assigned the letter grade of "A+" unless they complete their simulation work with TCAD Crosslight Software (www.crosslight.com). This software is an industry standard and will be available from Jan. 26th (Friday) to April 26th (Friday) (software availability is for 3 months) in the EWS Labs (EH 406B8) with 24/7 access. Due to the licensing regulation, students can only use it when in the lab (no remote access at this stage).

*FUNDAMENTAL BAND DIAGRAM AND DEVICE SIMULATION (BARE MINIMUM REQUIREMENT)

This is the minimum requirement to get partial credit for the technical component. Many useful exercises, demos, sample codes, and pdf sources are available at these links. Students are encouraged to use google and other search tools to seek further support. Please note that you can use any one or many of the tools below to satisfy bare minimum of the technical content of your project, in addition to writing your own numerical software code.

BAND SIMULATIONS

(Option 1) BandEng

- http://my.ece.ucsb.edu/mgrundmann/bandeng.htm

(Option 2) SimWindows

- http://dwwcommerce.wix.com/simwindows

SOLAR CELLS

(Option 3) PC1D

- http://my.ece.ucsb.edu/mgrundmann/bandeng.htm

(Option 4) wxamps

- https://wiki.cites.illinois.edu/wiki/display/solarcellsim/Simulation+Software

PAST PROJECT TITLES

These proposal titles are from past years and are shared to inspire you – rather than restrict you. The project titles are assigned as a first come-first-serve basis and if there is a significant overlap between the projects, the second submission will be declined. See https://443.ece.illinois.edu/past-final-projects/ for awarded projects.

SELECT PAST PROJECTS ON LIGHT EMITTING DIODES

- Ultraviolet LEDs for Disinfecting Your Home
- Replacement of WiFi with LiFi Through RGB LEDs
- Investigation of Visible Light Communication (VLC) Based on Bright Visible Light LED for Car-to-Car communication
- Visible Emitters for Light Fidelity (Li-Fi) Using White Light RGB LEDs for Indoor Applications
- Green LED (As/P-based) to Bridge the Efficiency Gap of White LEDs at 550 nm
- White LEDs for General Lighting (Blue LEDs + Phosphorous)
- Visible Emitters for Underwater Communications
- Creating Green LEDs Using GaAsP-based Quantum Dots
- Near IR LEDs for Treatment of Brain Disorders
- Light Emitting Diodes using $In_xGa_{1-x}P$ Quantum Well Structures for Wound Healing
- LEDs for Plant Growth
- LEDs for Photosynthesis at 660 nm
- Size Effects of Micro-LEDs on the Performance of Wearable Displays

SELECT PAST PROJECTS ON SOLAR CELLS

- Hot Carrier Solar Cell Theory and Simulation
- Silicon solar cells – Technology and Limitations
- Silicon Single Junction Solar Cells
- Low index dielectric layer for ultra-high efficiency light trapping in single junction GaAs solar cell
- Study of the influence of CuInSe2 and Cu(In,Ga)Se2 layer thickness on the electrical parameters of the solar cell
- Efficient Lead-Free Perovskite Solar Cell
- Triple Junction Solar Cells
- Multi-junction solar cells design for satellite use
- Simulation Study of room-temperature wafer-bonded InGaP/GaAs/InGaAsP/InGaAs four-junction solar cell
- Trade-off evaluation and design Optimization of High efficiency Terrestrial (AM1.5) Five-junction Solar Cell using Crosslight Apsys
- The manipulation of radiative coupling in mechanically stacked thin-film multi-junction solar cells

FREQUENTLY ASKED QUESTIONS & ANSWERS

1) **Can I submit only my project report?**

   No. The project submission is complete when all (a, b, c) parts of the projects are received. PARTIAL SUBMISSIONS ARE NOT ACCEPTED.

2) **Can I submit my project late? When is the last day of submission?**

   Yes - for late submissions, 10% deduction per day is implemented. For instance, if you submit after two days of the deadline, you will be graded over 100* 0.9 * 0.9 = 81% (rather than 100%). The last day to submit the project is three days after the deadline.

3) **Can I revise my submission?**

   No. Once submitted, NO changes to the project components are accepted.

4) **Can we work in pairs?**

   Yes. You can work in pairs. But each student must have a distinct and unique project submission. Collaboration between the students are encouraged to facilitate deeper understanding. Plagiarism is not allowed.

5) **Can we submit one joint project?**

   No. Each student must choose a topic of his/her interest and conduct his/her project in that topic. Each student must submit his/her own work on the project. No students can submit on the same topic/project.

6) **How can I be assigned a specific topic for the project?**

   Please email your research title with abstract as soon as possible. It is a first come first serve assignment. The email time stamp will be used in the assignment priorities.

