PH 471 – Senior Design Principles
0.5 credit
~7 class meetings/semester

Taken in conjunction with PH 481 Senior Design Practice
2.5 credits

Taken with project adviser

Memo to anyone considering a thesis master’s:
Choose an adviser who is willing and able to advise you on your master’s thesis
Bean Counting

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On campus T, Θ, F only

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Make an appointment! (I cd go out for a walk)
My bio

Degrees from Institute of Optics, U of Rochester
Asst Prof at Rensselaer, U of Waterloo, 60’s, 70’s
Consultant to GE R&D Center, patent-law firm, others
Physicist, NIST, Boulder, for 23 years
  Optical fiber metrology, microscopy, and instrumentation
  Chairman, Editorial Review Board for 11 years
  Visiting Scientist at Weizmann Institute of Science
Wrote, edited books on optics, tech writing, other
More than you want to know:  www.mines.edu/~mmyoung
If I can’t remember your name:

Which face most resembles the face to the left?
From *Pygmalion*, by Shaw:

HIGGINS. ... If you come back I shall treat you just as I have always treated you. I can't change my nature; and I don't intend to change my manners. My manners are exactly the same as Colonel Pickering's.

LIZA. That's not true. He treats a flower girl as if she was a duchess.

HIGGINS. And I treat a duchess as if she was a flower girl.

LIZA. I see. ... The same to everybody.

*I treat students the same as I treat Nobel Prize winners*
Class schedule

On the Web, PHGN 471 Home Page

~7 meetings/semester

Meet from 9 till 10

Attendance is required

And equal to 10 % of your grade
Assignments

First term:

Draft of interim (first-term) report/proposal—~6 weeks before end of term (team activity)

Interim report/proposal—~2 weeks before end of term (team activity)

Second term:

Report on scientific ethics, intellectual property, or philosophy of science (individual activity)

Final report—~2 weeks before end of term (team activity)

Poster session—last week of term (individual activity)
Late and unexcused papers or presentations

Grade no higher than 59 % (highest possible F)

0 after 1 week

Unless excused in advance

(Flimsy excuses accepted graciously)

Flu policy:

Flu is no different from anything else – let me know as soon as you can

No, you do not need a diagnosis
What’s in the course

*Most important:* Research with adviser (separate courses, PH 481-2, 491-2)

Planning

Teamwork

Lab skills, instrumentation

and/or

Theoretical, computational skills

Notebooks

*I do not get involved directly with the project or the adviser*
Next most important: Technical writing and communication

How to write a technical paper

How to organize and prepare the paper

How to express numbers and units (SI system)

How to format references

How to write a proposal

How to prepare an oral presentation

Before a group

Poster paper

You will eventually spend 40% or more of your time writing reports, papers, proposals; giving presentations
Writing across the Curriculum

This is a writing course

This is a *writing* course

*This* is a writing course

This *is* a writing course

This is (mostly) a *technical* writing course
Young Workers: U Nd 2 Improve Ur Writing Skills

What skills do entry level job seekers lack the most?

(Question put to HR executives. Respondents could select more than one answer. Boldface in original. NYT, 26 Aug 07)
What HR executives said

Written communication 45%
Critical thinking 27
Other 27
Workload/time management 9
Computer/technology 5
Listening 5
Verbal [oral] communication 0
Also important
Scientific ethics
Intellectual property
   Patents
   Copyrights
   Trade secrets
And not to overlook
How to apply to grad school (T Furtak?)
Philosophy of science
Having high standards

Q: What’s a lasting impression that an educator made on your life?

A: I had a coach and teacher that I didn’t like very much as a student—and he didn’t much care if I liked him or not. He set very high expectations for me and pushed me. As an adult, I realized how valuable that was.

Chris King
Superintendent of Schools
Boulder Valley School District
March 21, 2007
Two comments

“I am very grateful for the research/tech. writing skills I acquired in this class. I honestly feel that senior design (esp in the PH-department) is one of the most valuable/practical courses we offer.”

“Thank you for your help in the Sr. Design courses. You really painted a clear picture of what to expect as a scientist. This image has allowed me to set more concrete personal academic goals for the future.”
What can be changed to help you learn better?

More teamwork—working on that, but teams generally self-selected

One report per team—agreed (but team members may not get the same grades)

One poster per team—nope, sorry!

Explain assignments better—will try, but some assignments deliberately left open-ended

Provide more examples of posters, reports—OK, good idea!

See senior design home page

Not enough time to get job done—sigh
Strategy for solving typical open-ended engineering problem

Identify problem

Suggest solutions

Decide plan and define subsystems

Do subsystem research

Are solutions tenable?

yes

Is customer satisfied?

yes

Complete project

Generate final report

no

no
Case study

*Measure the diameter of an optical fiber within 0.1 μm*

1. Identify problem (defined for us in this case):
   - Measure fiber diameter
   - Prepare measured fibers for sale to industry

2. Suggest solutions
   - Design contact micrometer for routine measurements
   - Verify its measurements with 2 or more independent techniques
   - Design scanning confocal microscope & probe instrument
3. Decide plan and define subsystems

(a) Ted will build Matt a state-of the-art micrometer

(b) Steve & Matt will build a scanning confocal microscope

(c) Paul will build a scanning probe instrument (atomic-force microscope)
4. Do subsystem research

(a) Ted’s %#$*&#@ micrometer is too rough
(b) There is a theoretical problem with the microscope (if we knew what we were doing, it wouldn’t be research)
(c) The %#$*&#@ scanning probe won’t lock onto a cleaved fiber
5. Are solutions tenable? No:
   (a) Send the micrometer to an optics shop for polishing
   (b) Resolve the theoretical problem
   (c) Abandon the probe & design instead an *interference microscope*
6. Go thru the loop again (new plan, new subsystems if necessary)

7. Are solutions tenable?
   (a) All instruments agree within 0.1 μm
   (b) But scanning microscope shows systematic error
       Systematic error can be understood
   (c) Accept result of micrometer
       Uncertainty = 40 nm (0.04 μm)
8. Is customer satisfied? Yes (very)

9. Complete project
   (a) Prepare measured fibers for sale as standards
   (b) Cost about $1600 each

10. Generate final report

11. Win Department of Commerce Gold Medal

12. Get on mousepad