The Pennsylvania State University
Department of Bioengineering

The Bioengineering Graduate Program Survival Guide

2005

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For further information, consult the department website:

www.bioe.psu.edu

Departmental Contacts

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For Campus Specific Questions:
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The Bioengineering Students Guide to the Graduate Program FAQs, 2005

The following guidelines are designed to assist incoming graduate students in selecting courses for their future program of study leading to the MS or PhD degrees. The attached Course Plan should be completed following consultation with your academic/research advisor, and submitted to the Graduate Secretary for Departmental approval.

What are the requirements for the MS degree?

The course requirements are spelled out in detail in the Graduate Bulletin (White Book) and can be found on-line at **http://www.gradsch.psu.edu/bulletin/**. Course requirements for the MS are summarized on page 10. Students studying for the MS program should fill out the attached course plan ("yellow sheet," page 12) following consultation with their research advisor and submit it to the Graduate Secretary for Departmental approval.

How do I obtain a research advisor?

New students who are already on Graduate Assistantships have an advisor who has been designated in the offer letter. All others are encouraged to seek out a potential advisor who has a research project of interest to the student. Students may peruse the web site for members of the Graduate Faculty in Bioengineering who may have a research project of interest. The graduate faculty may be found at: http://www.bioe.psu.edu/navigate/faculty.html

What if I can't find an advisor immediately?

Send a mini curriculum vitae (see page 9) by e-mail to Dr. Lipowsky, and it will be forwarded to all faculty members. However, please make sure you obtain a PSU e-mail address first so that interested faculty may respond if interested. Please follow the suggested format closely and do not send a full, multi-page resume.

What should I take in the way of course work for my first semester here?

Required courses should be taken as soon as possible. To maintain full time student status, you must take between 9 and 12 credits. It is suggested that during the first (fall) semester, you take the following:

Biol 472	Physiology	3 cr
Bioe 512	Cell and Molecular Bioengineering	3 cr.

and choose one of the following:

Bioe 506	Medical Imaging	3 cr
Bioe 508	Biomedical Materials	3 cr
Bioe 497A	Bio Microfluidics	3 cr

Are there any other courses I should be taking?

All MS students should plan on registering for Bioe 590, Colloquium, during their **fourth** semester of study. A student registered for Bioe 590 will make a formal presentation on their research at the end of the semester. An MS student must register for this course at least once during their studies and a PhD student must register twice. **All graduate students are required to attend the Departmental weekly seminar series.**

Is a thesis required for the MS degree?

Yes, a thesis is required of all MS students. A minimum of three faculty members must serve on the MS thesis committee; i.e. the advisor plus two additional members. The Department Head also signs off on the thesis and will review it along with the thesis committee for general conformity to graduate school guidelines. The thesis must be submitted to the Department Head for review at least **two weeks prior to the deadline** for submission to the graduate school.

How many original copies do I need of the signature page?

Only three original signature pages are needed for final thesis: Graduate school copy, Department copy for library, and copy for student if he/she wants one bound. The Department copy of the thesis should be given to the graduate staff assistant the same day the original thesis is due to the graduate school. Photocopies may be used for all other copies.

I am studying for a Ph.D. Must I obtain the MS degree first?

If you already have an MS degree from Penn State or another institution, the answer is usually no. However, if you do not have an MS degree already, the option to complete an MS thesis is left to the advisor, however students are strongly encouraged to complete the MS thesis.

What courses must Ph.D. students take?

Each Ph.D. student is expected to demonstrate a level of academic achievement that includes material covered by courses required for the M.S. degree, and to take a minimum of five courses in bioengineering, five graduate level courses in engineering, mathematics and physics, and at least two advanced graduate level life science courses. Each doctoral student is expected to register at least twice as a participant in the Bioengineering Colloquium. Thus, Ph.D. students should plan on taking all courses necessary for the MS degree, and additional courses as required in the Graduate School Bulletin.

When do I officially become a Ph.D. student?

Students are admitted to the graduate program with the intent of pursing a Ph.D. However, they are not admitted to the Ph.D. program until successfully passing the Ph.D. candidacy examination.

What is the candidacy examination and when should I take it?

The purpose of the candidacy examination in Bioengineering is to ensure that the student will have all of the qualifications expected of a Ph.D. graduate and can perform as expected upon completion of the degree. The candidacy examination should be taken as soon as possible, and either within one year of first entry into the Bioengineering Graduate Program, or upon completion of the MS degree. In most cases, international students are encouraged to take the examination after their second year of study to allow them sufficient time to develop their English language skills.

The examination is given during the summer semester Please complete the Candidacy form (Page 13) signifying your intent to take this examination and submit it the graduate secretary by April 1st.

What is the English proficiency examination?

A candidate for the degree of Doctor of Philosophy is required to demonstrate a high-level competence in use of the English language, including reading, writing, and speaking, as part of the language and communication requirements for the Ph.D. (Note: this is separate from the teaching assistant testing.)

To fulfill this requirement, the English proficiency of each Doctoral student in Bioengineering will be evaluated during the written and oral candidacy examination. To assess the candidate's writing skills, the written exam will contain one or more essay type questions. Verbal communication skill will be assessed during the oral portion of the candidacy exam. The candidate's communication skills will be examined by the Candidacy Committee and a judgment of acceptability will be made or a recommendation for remedial course work in English will be made.

Note that competence in English must be formally certified by all graduate programs before the doctoral **comprehensive examination** is scheduled. (International students should note that passage of the minimal TOEFL requirement does not demonstrate the level of competence expected of a Ph.D. from Penn State.) It is the responsibility of the student to meet these requirements by taking whatever remedial steps are necessary to demonstrate an acceptable command of the English language.

What is the next step?

The next step toward the Ph.D. degree is the **Comprehensive Examination** which must take place at least one year prior to the thesis defense. Please see the Graduate Secretary for scheduling of this examination. The Department of Bioengineering uses the Comprehensive Examination as an opportunity to review the Ph.D. student's thesis proposal and hence you should prepare your proposal according to departmental guidelines and submit this proposal to my office and the committee at least two weeks prior to the examination. The final step in the process is submission of the final proposal to the committee and the Department Head, the thesis defense, followed by submission of your dissertation. The thesis defense will be in the form of a regular seminar open to the public during our Department's weekly Colloquium, followed by a closed session with your thesis committee.

How do I schedule a Comprehensive Examination?

The proposal is due to the committee and the Department Head three weeks before the exam is scheduled. A copy of the proposal goes to each committee member and the Department Head. Before you schedule your exam, make sure all committee members agree on the time and date of the exam. The graduate staff assistant will help you schedule your exam and the room you will take your exam in.

How do I select a Ph.D. thesis committee?

In consultation with your research advisor, each student will select a thesis committee, which will be formally appointed upon scheduling of the Comprehensive Examination. General guidance of a doctoral candidate is the responsibility of a doctoral committee consisting of four or more active members of the Graduate Faculty, which includes at least two faculty members in the major field. This committee is appointed by the graduate dean through the Office of Graduate Enrollment Services, upon recommendation of the head of the major program, soon after the student is admitted to candidacy. A person not affiliated with Penn State who has particular expertise in the candidate's research area may be added as a special member, upon recommendation by the head of the program and approval of the graduate dean. A special member is expected to participate fully in the functions of the doctoral committee. If the outside expert is asked only to read and approve the doctoral thesis, that person is designated a special signatory of the thesis. Occasionally, special signatories may be drawn from within the Penn State faculty in particular situations. At least one regular member of the doctoral committee must be from outside the candidate's major program. For candidates who are in one of the inter-college graduate degree programs, such as Bioengineering, all members of the doctoral committee may be from the major program graduate faculty, but the committee membership must have representation from more than one department. If the candidate has a minor, that field must be represented on the committee.

What are the deadlines for submission of thesis proposals and a thesis?

Graduate students should allow sufficient time for all members of their committees, and the Department Chair, to review the "final" form of all MS theses and Ph.D. dissertations. Thus, allow at least two weeks prior to the deadlines specified by the Graduate School. It makes good sense to check with your committee members to see if they will be in town at the time you expect to submit your final thesis versions, and plan your schedule accordingly.

All MS and PhD theses must be submitted to the Department Head for approval prior to submission to the Graduate School. The Department Head reads these theses to ensure conformity to all thesis regulations, and when necessary, request clarification or modification of the presentation of technical material. Hence, please allow sufficient time for this review. A minimum of two weeks is suggested. Three original signature pages are required for signature: Graduate School, Department, and student's copy. Department copies of the thesis are due in the department the same day the graduate school requires their originals. Photocopies may be used for all other copies. Academic deadlines may be found on the grad school web site located at:

http://www.gradsch.psu.edu/calendar/gradcal.html

Mini Curriculum Vitae

Instructions: If you need assistance in finding a thesis advisor and research project, please send a facsimile of this form in the body of an e-mail to Dr. Lipowsky at HHLBIO@engr.psu.edu. Students who already have an advisor do not need to submit this form.

Name: _____

E-Mail Address:_____

Degree Sought: MS____ Ph.D.____

Nationality: US_____ Other_____
Specify

Undergraduate Degree:
Institution:_____

BS Degree:
Major: _____

Minor 1: _____

Minor 2: _____

Graduate Degree
Institution: _____

MS Degree
Major: _____

Minor 1: _____

Minor 2: _____

GRE Scores (V/Q/A): ____/____ /____
Jr./Sr. GPA (4.0 Scale):_____

Special Skills:

(Do not exceed one page.)

Bioengineering Program

M.S. Degree Requirements

I. Graduate School Requirements

Minimum Requirements:
(1) 30 credits
(2) 20 credits earned at a Penn State Campus recognized by the Graduate School
(3) 18 credits of 500 and 600 level course work
(Bioengineering requires 12 credits of 500 and 6 credits of 600)
(4) 12 credits of 400 plus 500 level Bioengineering courses in contrast to thesis research
(5) 6 credits of thesis research

II. Bioengineering Program Requirements

Bioengineering Courses	**credit**	**Life Sciences**	**credit**	**Tech or Bioe Electives**	**credit**
Bioe 402 Biomedical Instrumental†	3	Biol 472 Physiology††	3	400 or 500	6
Bioe 512 Cell and Biomolecular Eng†		Bioe 597 Biomolecular Techniques*	3		
Select 6 credits 500	6				
Bioe 590	1				
Bioe 600	6				
	19		6		6

†Students with undergraduate degrees in bioengineering who have had this material may substitute a 400 or 500 level course.

††Students who have had physiology previously may substitute another 400/500 level life science elective.

*An alternative 400/500 level life science elective may be substituted for this course.
Total = 31 credits

Bioengineering Program: MS/Ph.D Degree Course Plan September 2005

Student Name		**Advisor**	

Bioengineering Courses*	Sem/ Yr	**Life Science Courses**	**Sem/ Yr**	**Technical Electives**	**Sem/ Yr**
Bioe 402 Biomedical Instr & Measurements - 3 cr		Univ Park: **Biol 472 – Physiology†** - 3 cr			
Bioe 512 Cell and BioMolecular Engineering† – 3 cr		Univ Park: **Bioe 5xx Lab Biomolecular Techniques - 3 cr.****			
Bioe 5xx - 6 cr		HMC: **PSIO 504 - Physiol** - 3 cr			
501 Bioeng Transport Phenom -3 cr		HMC: **PSIO 505 - Physiol** -3 cr			
503 Fluid Mech of Bioeng Syst - 3 cr					
505 Bioengineering Mechanics -3 cr		PhD. students must take six (6) credits of life science course work in addition to		PhD. students must take nine (9) credits	
506 Medical Imaging - 3 cr		six (6) credits required for MS degree.		of tech. Electives in addition to six (6)	
507 Biomedical Signal Processing -3 cr				credits required for MS degree.	
510 BioMEMs – 3 cr					
516 Ultrasonic Imaging - 3 cr					
519 Artificial Organ Design - 3 cr					
552 Mech of Musculoskeletal Sys -3 cr					
553 Engineering of Human Work - 3 cr					
576 Bioeng of the Cardiovasc Syst -3 cr					
580 Bioengineering Internship - 3 cr					
Bioe 597 Specialty Courses - 3 cr					
Bioe 590 Bioeng Colloq - 1 cr					
Bioe 600 Thesis Research - 6 cr					
Total Credits	19		6		6
Total Credits Required					31

*Required courses are indicated in bold type.

†Students with undergraduate degree in bioengineering who have had this material may substitute a 400 or 500 level Bioe course.

††Students who have had physiology previously may substitute another 400/500 level life science elective .

**An alternative 400/500 level life science elective may be substituted for this course.

Advanced Placement Credit and Waivers	**Dept Approval Date**

Advisor's Approval Date	**Dept Approval Date**

Instructions: *Each new graduate student should discuss his/her program of study with their assigned advisor and complete a proposed plan of course work. Submit the completed form to the Grad Secretary for Dept approval, no later that the first week of the semester of entry into the program.*

Department of Bioengineering

Ph.D. Candidacy Exam Procedures*

April, 2004

***Please note these procedures may be updated or changed at the time of your candidacy exam, please check with department secretary for any changes.**

Introduction

The overall objective of the Ph.D. candidacy (qualifying) exam shall be to determine the potential of the candidate to pursue a meaningful and productive career in research, teaching and management of engineering activities in the biological and medical sciences. To this end, the focus of the exam shall aim to provide convincing evidence that the candidate has the creativity, maturity and confidence to achieve these ultimate goals. Measures of the candidate's successful performance in the examination shall be based upon:

(1) Demonstration of a mastery of the course work undertaken during prior academic programs at the undergraduate and graduate level,

(2) a well defined and superior ability to approach the solution of new problems by the methodical and logical application of sound scientific methods based upon fundamental principles of engineering and the physical sciences, and

(3) the ability to demonstrate extensive general knowledge of a traditional engineering or physical science discipline in which the candidate possesses a major and readily recognizable strength.

Procedures

(1) The candidacy exam will consist of the preparation of a written research proposal followed by an oral defense before the examining committee.

(2) The exam will be taken during the summer following the student's first year of study. For students who switch from MS to PhD after their first year, the exam will be taken in the summer of their second year.

(3) A standing candidacy exam committee made up of three core or affiliated Bioengineering faculty plus the student's advisor will administer the exam.

(4) The student will prepare a research proposal, suitable for PhD level research. The proposal will be in the form of an abbreviated NIH research grant; the maximum number of pages permitted will be limited to 11, excluding title page, abstract and references. All figures must fit within the 11 page limit. The student may include preliminary data they have collected but it is expected that the proposal will be based primarily on data from the literature. The topic of the proposal may be drawn from the literature or based upon the student's research experiences to date. If the student proposes research based upon their prior research, the proposed research may not repeat studies performed previously. In all cases, the proposal should focus on new research activities that have not been done to date by the student or anyone else.

(5) The student will submit an application to take the candidacy exam by April 1st, of the year in which it is administered. The application will contain a subject for the proposal which will be approved by the committee. Upon approval of the subject, the student will be notified by the chair of the committee in time to allow no more than six weeks for completion of the proposal; typically by May 15th. The student will then have until June 30th to submit the proposal to the committee. The graduate secretary will then coordinate with the student and committee the time for the oral defense of the proposal. Up to three hours will be allotted for the defense.

6) The format of the research proposal will consist of the following sections, with recommended page limitations given as follows:

I. Title Page (see attached sample)

(a) Provide a succinct title for the proposal and the estimated starting and ending dates of the research.
(b) Name of the student,
(c) Name of thesis advisor

II. Summary Description of the Proposal (½ page maximum)

State the proposal's broad, long-term objectives and specific aims, making reference to the health or biology relatedness of the project. Describe concisely the research design and methods for achieving these goals. Avoid summaries of past accomplishments and the use of the first person. This abstract is meant to serve as a succinct and accurate description of the proposed work when separated from the proposal. Do not exceed the ½ page limit.

III. Specific Aims (½ page)

List the broad long-term objectives and describe concisely and realistically what the specific research described in this proposal is intended to accomplish and any hypotheses to be tested. The long term aims may be summarized in a brief paragraph, followed by a list of two to four specific aims, each described in one or two sentences.

IV. Background and Significance

Briefly sketch the background leading to the present proposal, critically evaluate existing knowledge, and specifically identify the gaps which the project is intended to fill. State concisely the importance of the research described in this proposal by relating the specific aims to the broad long-term objectives and to health relevance. Two to three pages are recommended.

V. Preliminary Studies

Provide a summary description of preliminary studies performed by the candidate or others leading to this proposal. For students who have performed ***MS*** thesis research that has led to this proposal, provide a synopsis of these studies. Describe related research studies that have been done subsequent to the completion of the ***MS*** degree or following initial entry into the ***Ph.D.*** program. Limit this section to a maximum of two to four pages.

VI. Research Design and Methods

Describe the research design and the procedures to be used to accomplish the specific aims of the project. Include the means by which the data will be collected, analyzed, and interpreted. Describe any new methodology and its advantage over existing methodologies. Discuss the potential difficulties and limitations of the proposed procedures and alternative approaches to achieve the aims. Provide a tentative sequences or time-table for the investigation. Limit this section to a maximum of five to seven pages including all figures and tables.

VII. Bibliography

Provide a list of all references cited in the above sections, that is in the format of articles written for major journals, such as the American Journal of Physiology, or Journal of Biomechanics. Citations
within the text may be made by either author (year) or by number. The references should be listed in alphabetical order and limited in number to less than 40. Provide the full citation in the bibliography, i.e. authors, title,
journal, volume, page numbers and year.

The proposal should be typed (using either Word Perfect or Microsoft Word). All text should be typed single space and a minimum font size of 11 points should be used. A 3/4 inch margin should be maintained on the top, bottom and sides of each page. Each page should be numbered at the bottom. Submit a hard copy of the proposal and e-mail the word processor file to the Graduate Secretary.

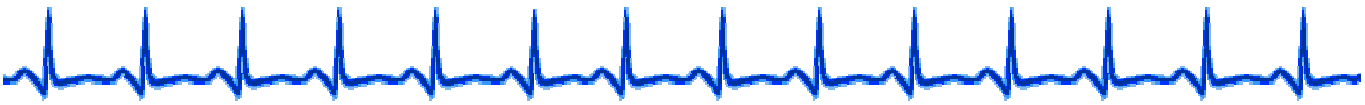
Students may solicit advice from faculty on the specific aims section of the grant. Otherwise, faculty should not be consulted to read and critique rough drafts of the proposal, though the candidate is encouraged to solicit critiques from fellow students.

(7) The oral exam will be scheduled during the summer semester. During the oral exam, the student will present a 30 minute (maximum) overview of the proposal which will be followed by a period of questions and answers from the committee. The committee will be charged with the task of evaluating the proposal and any questionable areas established by the student's academic record. The student is not expected to study for this phase of the exam but will be held responsible for demonstrating mastery of the fundamentals of his/her field.

(8) The committee will grade the written and oral components on a pass/fail basis, in each of the following areas:

a. Quality of technical content of proposal and presentation
b. Creativity and innovation in proposed experiments/design
c. Quality of writing (grammar, clarity, sentence structure)
d. Quality of oral presentation
e. Ability to respond to questions and logically reason through problems.

To receive a passing grade for the Candidacy Exam, a student must score satisfactorily on at least 4 of these 5 sections. If a student's performance is unsatisfactory in two areas, they may take the exam once again during the following year and must then pass all five areas. Unsatisfactory performance in three or more areas will constitute failure of the Candidacy Exam and the student may not continue with the PhD. In this case, the student may obtain a Master's degree upon completion of the requirements for that degree.



Important Dates

April 1st Submit Application to take candidacy exam with desired title of proposal.

May 15th Student notified of acceptability of proposed subject of proposal.

June 30th Proposal due within six weeks of approval of topic.

Summer Oral defense of proposal conducted upon consultation with student and committee.

SAMPLE TITLE PAGE

Department of Bioengineering
Ph.D. Candidacy Exam

Research Proposal

A New Method of Determining Molecular Dimensions

Proposed Start Date: September 1, 1904

Proposed Completion Date: April 1, 1905

Submitted by: Albert A. Einstein

Advisor: Professor I. Dunno

Bioengineering Upper Division and Graduate Courses:

The following courses are currently offered by the Bioengineering Program.

402 BIOMEDICAL INSTRUMENTATION AND MEASUREMENTS (3cr) Biomedical measurements, including consideration of techniques, equipment, and safety. Prerequisite: MATH 250; 3 credits in electrical circuits.

403 BIOMEDICAL INSTRUMENTATION LABORATORY (1cr) Biomedical measurements laboratory, including measurement of biopotentials, experiments in medical imaging techniques, and use of cardiovascular and pulmonary system instrumentation. Prerequisite: BIOE 402.

496 INDEPENDENT STUDIES (1-18cr) Opportunity for advanced undergraduate students to study independently in consultation with a faculty advisor.

497 SPECIAL TOPICS (1-9cr) This designation is assigned to new or developing undergraduate courses covering specialized areas of interest in bioengineering. Past offerings have focused on topics such as artificial organs, medical ultrasound imaging and biomedical instrumentation.

501 BIOENGINEERING TRANSPORT PHENOMENA (3cr) Application of the equations of mass, energy, and momentum conservation to physiological phenomena and to the design of artificial organs.

502 INTRODUCTION TO BIOELECTRIC PHENOMENA (3cr) Electric phenomena in nerve and muscle membrane potentials, Hodgkin-Huxley equations, volume conductor problem, applications to electrocardiography, electroencephalography, plethysmography.

503 FLUID MECHANICS OF BIOENGINEERING SYSTEMS (3cr) Cardiovascular system and blood flow, non-Newtonian fluid description, vessel flows, unsteady flows and wave motion, wind-kessel theory, transmission line theory.

504 PHYSIOLOGICAL SYSTEMS ANALYSIS (3cr) Application of systems theory, control theory, and analytic modeling strategies to the study of physiological systems. Prerequisites: BIOL 472, MATH 250.

505 BIOENGINEERING MECHANICS (3cr) Application of the principles of continuum mechanics to characterization of the passive and active mechanical properties of soft and hard tissues and their constituent cells. Fundamentals of the description of stress and strain and advanced topics in visco elasticity are considered to describe the normal and diseased state at the tissue, cellular and molecular level. Prerequisites: EMCH 210, ME033 or equivalent.

506 MEDICAL IMAGING (3cr) Medical diagnostic imaging techniques, including generation and detection of ultrasound, X-ray, and nuclear radiation; instrumentation and biological effects. Prerequisite: PHYS 202.

507 BIOENGINEERING APPLICATIONS OF LABORATORY COMPUTERS (3cr) The organization of small laboratory computers and their use in real-time analysis of physiological data. Prerequisites: BIOE 402, CMPSC 201.

508 (MATSE 508) **BIOMEDICAL MATERIALS** (3cr) Properties and methods of producing metallic, ceramic, and polymeric materials used for biomedical applications. Prerequisites: None

510 Bio MEMS (3cr) Build basic foundations for understanding electrical, mechanical and chemical transducers in biomedical applications through learning BioMEMS fabrication, design and analysis.

512 Cell and BioMolecular Engineering (3cr) Graduate level cell and molecular biology course for for engineers emphasizing molecular mechanisms.

515 CELL MECHANICS AND BIOPHYSICS (3cr) Advanced topics and recent developments in cellular engineering; applications of engineering science to cell biology. Prerequisite: BIOE 505

516 ULTRASONIC IMAGING (3cr) Advanced topics and recent developments in ultrasonic imaging will be discussed. Prerequisite: BIOE 506 or equivalent.

517 (MATSE 517) **Biomaterials Surface Science** (3cr) Special properties of surfaces as an important causative and mediating agent in the biological response to materials. Prerequisite: None.

519 ARTIFICIAL ORGAN DESIGN (3cr) Basic techniques and principles of a multidiscipline approach to artificial organs design. Prerequisites: None.

552 (EMCH 552, IE 552) **MECHANICS OF THE MUSCULOSKELETAL SYSTEM** (3cr) Structure and Biomechanics of bone, cartilage, and skeletal muscle; dynamics and control of musculoskeletal system models. Prerequisite: consent of program. Prerequisite or concurrent: BIOL 472

553 (IE 553) **ENGINEERING OF HUMAN WORK** (3cr) Physics and physiology of humans at work; models of muscle strength; dynamic movements; neural control; physical work capacity; rest allocation. Prerequisite: BIOL 041 or 472.

570 Topics in Biomedical Instrumentation (1cr) Physiological basis, theory of operations, and practical aspects of clinical instrumentation. Prerequisite: None

576 BIOENGINEERING OF THE CARDIOVASCULAR SYSTEM (3cr) Experimental and analytical studies of network branching patterns, regional blood flow, rheology and mechanics of blood cells and vessels as they affect physiological function. Prerequisite: BIOL 472.

580 BIOENGINEERING INTERNSHIP (3-6cr) Supervised experience at the Milton S. Hershey Medical Center, including rotation through services and work on a minor project. Prerequisite: BIOE 402; 3 credits in Bioengineering at the 500 level.

590 BIOENGINEERING COLLOQUIUM (1cr) Weekly series of seminars by speakers from outside and within Penn State University on new and developing research areas in bioengineering, and presentations by registered students on their thesis research. All students are required to attend; M.S. degree students must register at least once and Ph.D. students must register at least twice during their thesis research.

596 INDIVIDUAL STUDIES (1-9cr) Opportunity for advanced graduate students to study independently in consultation with a faculty advisor.

597 SPECIAL TOPICS (1-9cr) This designation is assigned to new or developing graduate courses covering specialized areas of interest in bioengineering. Past offerings have focused on topics such as advanced studies of cardiovascular function, advanced topics in artificial organ design and cellular biomechanics.

Ph.D. Thesis Proposal Guidelines
Bioengineering Program

Introduction

Each Ph.D. student is required to submit a written thesis proposal to their Ph.D. advisory committee. The proposal is usually submitted at the time of scheduling the comprehensive examination, and serves as the focus of discussion during this examination. According to the guidelines of the Graduate School, the Comprehensive examination must be taken at least three months prior to the final thesis defense. It is usually taken after one year of study and research following successful completion of the Ph.D. Candidacy Examination.

The objective of the thesis proposal is three-fold. First, the proposal itself serves to outline the course of the student's proposed research program with sufficient detail so that the student's advisor and members of the thesis committee may provide useful guidance and input into design and execution of the proposed research plan. Secondly, the act of writing the proposal serves as a vehicle that enables the student to map out a clear course of research activities for the future that facilitates a logical and methodical approach to the research. And third, writing the proposal serves as a training exercise that will be of use to the student in the preparation of future applications for research funding.

Format

The format of the Proposal will be similar in style to that required of established investigators applying for ***NIH*** funding, and will consist of the following sections, as outlined below. The proposal should be typed double space on one-sided 8-1/2 x 11 paper, and figures may be either pasted in or printed directly using computer artwork programs. The page limitations given below represent an extreme upper limit. The specific size of each section may vary according to the type of research being conducted and the length of time devoted to preliminary studies prior to submission of the thesis proposal.

1. **Title Page** (see attached sample)

    a. Provide a succinct title for the proposal and the estimated starting and ending dates of the research.
    b. Name of the student.
    c. Name of thesis advisor.
    d. Names of dissertation research committee members.

2. **Summary Description of the Proposal** (400 words maximum)

    State the proposal's broad, long-term objectives and specific aims, making reference to the health relatedness of the project. Describe concisely the research design and methods for achieving these goals. Avoid summaries of past accomplishments and the use of the first person. This abstract is meant to serve as a succinct and accurate description of the proposed work when separated from the proposal. Do not exceed the 400 word limit.

3. Specific Aims

List the broad long-term objectives and describe concisely and realistically what the specific research described in this proposal is intended to accomplish and any hypotheses to be tested. A maximum of two pages is recommended.

4. Background and Significance

Briefly sketch the background to the present proposal, critically evaluate existing knowledge and

specifically identify the gaps, which the project is intended to fill. State concisely the importance of the research described in this proposal by relating the specific aims to the broad long-term objectives and to health relevance. Four to six pages are recommended.

5. Preliminary Studies

Provide a summary description of preliminary studies performed by the candidate leading to this proposal. For students who have performed **MS** thesis research that has led to this proposal, provide a synopsis of these studies. Describe related research studies that have been done subsequent to the completion of the **MS** degree or following initial entry into the **Ph.D**. program. Limit this section to a maximum of 12 to 18 pages.

6. Research Design and Methods

Describe the research design and the procedures to be used to accomplish the specific aims of the project. Include the means by which the data will be collected, analyzed, and interpreted. Describe any new methodology and its advantage over existing methodologies. Discuss the potential difficulties and limitations of the proposed procedures and alternative approaches to achieve the aims. Provide a tentative sequence or timetable for the investigation. Limit this section to a maximum of 40 pages including all figures and tables.

7. Bibliography

Provide a list of all references cited in the above section that is in the format of articles written for major journals, such as the American Journal of Physiology or Journal of Biomechancis. Citations within the text may be made by either author (year) or by number. The references should be listed in alphabetical order and limited in number to less than 200.

Approvals

The thesis proposal must be approved by the thesis advisor and all members of the student's thesis committee. In addition, departmental approval by the Bioengineering Program Chair is also required. The Program Chairman will review the proposal to ensure conformity to these guidelines and Graduate School regulations, and to ensure that adequate facilities and Program commitments are available to facilitate completion of the proposed studies.

[Sample Title Page]

Thesis Proposal for the Ph.D. Degree
in
Bioengineering

Title

Submitted By: Student's Name Date:

Proposed Duration of Studies: Starting: Ending:

Thesis Advisor: Name
Title

Thesis Committee Approval:

Members:	**Approvals:**	
Name #1, Advisor Title	Signature	Date
Name #2 Title	Signature	Date
Name #3 Title	Signature	Date
Name #4 Title	Signature	Date
Name #5 Title	Signature	Date

Departmental Approval

Chairman, Department of Bioengineering
Professor Herbert H. Lipowsky

Signature Date

PENN STATE AMERICAN ENGLISH ORAL COMMUNICATIVE PROFICIENCY TESTING FOR PROSPECTIVE INTERNATIONAL TEACHING ASSISTANTS

International students who plan to be teaching assistants must take the Penn State American English Oral Communicative Proficiency Test. A copy of the various courses are listed on the next page.

Students can pre-register by calling the Linguistics and Applied Language Studies office at 865-7365 or go to Room 305 Sparks Building. To pre-register, students must have their student ID card. Those with a temporary ID card or no ID card should bring their passport with the official letter from the Graduate School.

Graduate School Teaching Certificate

Penn State graduate students wanting recognition of their commitment to college teaching may now earn the Graduate School Teaching Certificate. The Graduate School Teaching Certificate was developed to provide graduate students with an avenue to enhance their teaching skills. The certificate is self-directed and available to all Penn State graduate students who fulfill the following requirements:

- Attend the Schreyer New Instructor Orientation or an equivalent teaching orientation that includes lesson planning, teaching methods and strategies to encourage student participation.
- Complete one semester of SUBJ 602 Supervised Experience in College Teaching under the direction of a mentor.
- Complete the Schreyer Institute Penn State Course in College Teaching or HI ED 546 College Teaching.
- Complete another semester of SUBJ 602, to include either a block of lectures prepared and presented by the student, or total responsibility for a lab or recitation section.
- Develop a website that includes a statement of teaching philosophy and demonstration of the ability to develop a PowerPoint presentation. Assistance with this project may be obtained through Information Technologies Services, which may be accessed from the Penn State home page.

It is recommended that the Penn State Course in College Teaching precede the second semester of SUBJ 602. A grade of “B” or higher is required.

In order for the certificate to be issued, the program chair or department head, in consultation with the student's advisor, must verify completion of the requirements in a letter to the Graduate School. Notice of completion of the Graduate School Teaching Certificate will not appear on the student's transcript.

Graduate students wanting recognition of their commitment to college teaching are encouraged to speak to their advisors about this opportunity. Questions about the program should be directed to Barbara W. Pennypacker, Assistant Dean of the Graduate School, at p1q@psu.edu. Please note that this is not a Teacher certification program. For more information, visit:

http://www.gradsch.psu.edu/gradinit/tacert.html

ADDENDUM TO THESIS GUIDE

Change to be implemented Summer 2003

A signed signatory page will no longer be included in the thesis. A committee page (shown below) should be placed in the thesis instead of the signatory page. A signed signatory page must still be submitted to the Thesis Office and will remain on file there.

Change to be implemented Fall 2003

The processing fee for a doctoral thesis submitted *on paper* will increase to $85. The fee for an electronic thesis (eTD) will remain at $70 (refunds will not be given for overpayment if a change of submission type is made). The fee for a master's thesis will remain at $17.

Sample committee page

The thesis of John Doe has been reviewed and approved* by the following:

name of professor
title
thesis adviser

name of professor
title

name of professor
title

name of professor
title

name of department head or program chair
title

*Signatures are on file in the Graduate School.

B I O E N G I N E E R I N G - FACULTY AND THEIR RESEARCH

Harry R. Allcock, Ph.D., Evan Pugh Professor of Chemistry. Application of chemical synthesis to polymer chemistry, materials science, and biomedicine; and the chemical synthesis of new materials to generate useful combinations of properties.
Abdellaziz Ben-Jebria, Ph.D., professor of chemical engineering. Inhalation toxicology, pulmonary transport and uptake of chemical, airway reactivity and smooth muscle contractility.
James G. Brasseur, Ph.D., professor of mechanical engineering. Biofluid mechanics, neuromuscular mechanics, turbulent flows, graphical imaging.
Paul Brown, Ph.D., professor of materials science and engineering. Biomedical materials, chemical routes to ceramics and composites, multicomponent phase equilibria, reaction kinetics.
Peter J. Butler, Ph.D., assistant professor of bioengineering. Membrane biophysics, cell mechanotransduction, vascular physiology; use of quantitative light microscopy to investigate the molecular bases of vascular function.
Wen-Wu Cao, Ph.D., professor of mathematics and materials science. Computer modeling and design of composite transducers for medical ultrasonic imaging.
Ryan Clement, Ph.D., assistant professor of bioengineering. Neural engineering, development of neuroprosthetic and brain machine interfacing technology.
Christopher Collins, Ph.D., assistant professor of Radiology.
Wayne R. Curtis, Ph.D., professor of chemical engineering. Biotechnology, plant biology pharmaceutical production using plants.
Cheng Dong, Ph.D., professor of bioengineering. Biomechanics, cellular mechanics, cell motility, cell deformation and cell adhesion in the microcirculation, computer modeling.
Steven Deutsch, Ph.D., senior scientist, Applied Research Laboratory, professor of bioengineering. Biofluid mechanics.
Henry J. Donahue, Ph.D., professor of orthopedics and cellular and molecular physiology. Bone and cartilage cell biology, mechanotransduction, fluid flow, gap junctions, ca^{2+} imaging, orthopedic biomaterials and cancer.
Michael Eppihimer, Ph.D., associate professor of bioengineering. Pathogenis of thrombosis. T-helper cell recruitment.
Arnold A. Fontaine, Ph.D., research associate, Applied Research Laboratory. Biofluid dynamics, turbulence, drag reduction.
Andris Freivalds, Ph.D., professor of industrial engineering. Industrial ergonomics, cumulative trauma disorders, biomechanics, work physiology.
Roger P. Gaumond, D.Sc., associate professor of bioengineering. Electrophysiology of the auditory brain stem and of myocardium, energy sources of implants.
David B. Geselowitz, Ph.D., professor emeritus of bioengineering and medicine. Theoretical cardiac electrophysiology and electrocardiography, artificial hearts and cardiac-assist devices.
William O. Hancock, Ph.D., assistant professor of bioengineering. Motor proteins, cytoskeletal mechanics, quantitative cell biology.
Ahmed Heikal, Ph.D., associate professor of bioengineering. Biological processes on a molecular level using state-of-the art laser spectroscopy and microscopy techniques.
William E. Higgins, Ph.D., professor of electrical engineering. 3-D/4-D medical imaging analysis and visualization and virtual endoscopy.
Kane M. High, M.D., associate professor of anesthesia. Anesthesia management and respiratory assist devices.
Edward S. Kenney, Ph.D., professor emeritus of nuclear engineering. Industrial and medical radiation imaging, nuclear instrumentation, nuclear reactor control.
Herbert H. Lipowsky, Ph.D., professor and department head. Pressure and flow relationships in the microcirculation, in vivo rheology of blood flow in sickle-cell disease and other hematological disorders.
Tao Lu Lowe, Ph.D., assistant professor surgery, bioengineering and materials science and engineering.
Biodegradable and bioresponsive polymers for controlled drug delivery, hydrogels, dendrimers, polymer-protein-cell interactions, transport across the blood-brain barrier, Alzheimer's disease, tissue engineering and nanotechnology.
Keefe Manning, PhD., assistant professor of bioengineering. Hemodynamics, pediatric heart defects, blood rheology and cardiovascular prosthetics.
Stephen J. Piazza, Ph.D., assistant professor of kinesiology, mechanical engineering, orthopedics and rehabilitation and bioengineering. Orthopedic biomechanics, mechanics of locomotion, mechanics of orthopedic surgery, joint biomechanics, computer simulations of normal and pathological movement.
William S. Pierce, M.D., Evan Pugh Professor Emeritus of Surgery. Artificial heart and mechanical circulatory assistance.
Joseph L. Rose, Ph.D., Paul Morrow Professor in Engineering Design and Manufacturing. Development of ultrasound imaging and guided wave devices.
Gerson Rosenberg, Ph.D., Jane A. Fetter Professor of Bioengineering and research professor of surgery. Mechanical circulatory assistance, the electric artificial heart, artificial organs.
James Runt, Ph.D., professor of polymer science. Polymers/biomaterials for use in medical devices.
Robert Sainburg, Ph.D., assistant professor of kinesiology. Neural mechanisms underlying control of multi-joint arm movements in humans.
Jeffrey Schiano, Ph.D., assistant professor of electrical engineering. Control systems and nuclear resonance sensors.
Neil A. Sharkey, Ph.D., professor of kinesiology. Human biomechanics.
Christopher A. Siedlecki, Ph.D., assistant professor of surgery and bioengineering. Cardiovascular biomaterials, structure/function, relationships of proteins and surfaces, protein and cellular interactions and implanted biomaterials, surface modification and characteri-

zation, scanning probe microscopy.
Michael B. Smith, Ph.D., professor of radiology. Magnetic resonance imaging.
Nadine Barrie Smith, Ph.D., assistant professor of bioengineering. Noninvasive focused ultrasound surgery and hyperthermia; magnetic resonance thermometry.
Alan J. Snyder, Ph.D., professor of bioengineering and senior research associate in surgery. Artificial heart, circulatory assist, electronic design for implantable devices.
James S. Ultman, Ph.D., professor of chemical engineering and bioengineering. Biomass and heat transfer, pulmonary physiology, health effects of air pollutants.
Akif Undar, PhD., Associate Professor of Pediatrics, Associate Professor of Bioengineering.
Erwin A. Vogler, Ph.D., associate professor of materials science and engineering. Surfaces and the biological response to materials, the mediating role of water, mechanisms of water wetting, and thin-film phenomena.
Andrew Webb, Ph.D, professor of bioengineering. Studies functional magnetic resonance imaging and MRI spectroscopy.
William Weiss, Ph.D., associate professor of bioengineering and research associate in surgery. Implantable circulatory support devices, electromechanics, transcutaneous energy transmission.
Qing X. Yang, Ph.D. assistant professor of radiology. Ultra-fast imaging, pulse sequence and k-space sampling method developments; fMRI; high field MRI/NMR (susceptibility effects, dielectric effects); RF coil design.
Jun You, PhD., Assistant Professor of Orthopedics and Rehabilitation
Jeffrey D. Zahn, Ph.D., assistant professor of bioengineering. BioMEMS, microfabrication technology in biomedical device design; microfluidic devices for chemical sensing, biochemical separations, and drug delivery.
Conrad Zapanta, Ph.D., assistant professor surgery and bioengineering. Cardiac assist devices, total artificial hearts, prosthetic heart valves.

Graduate Office
Kern Building
865-2516

Office of International Students and Scholars (OISS)
410 Boucke Building
Phone and email advising 865-6348 8:30-5:00 or email OISS-Adviser@ip.psu.edu
Walk-in hours: Mon., Tues: 1:30-4:30, Thur.-Fri. 8:30-11:30 a.m.

Student Insurance Office
208 Boucke Building
865-7467

Bioengineering Dept. Main Office
205 Hallowell Building
865-1407 or 863-6614