APPENDIX 3

The Physiology Graduate Programs

A. The Physiological Methods Course, 1970-2000

B. Detailed descriptions of Master Program for the 1974, 1980, and 1994

C. Detailed descriptions of Ph.D. Program for the 1974, 1980, and 1994

APPENDIX 3A

MASTER DEGREE PROGRAM OF THE DEPARTMENT OF PHYSIOLOGY

The program leading to a Master's degree in the department changed very little over the years. In the first year the students almost always took a curriculum that was the same as, or very similar to, the one taken by the Ph.D. students (Table). It was also similar in the second year, although often fewer credits of Advanced Physiology were required so they could devote more time to their thesis research. This approach allowed students to easily transfer from the Master to the Ph.D. program if their academic record was strong enough to justify this program; some students interested in the Ph.D. program with weaker undergraduate records were offered admittance to the Master's program, depending on the availability of stipends (Master's students did not receive financial support in the first year, but were supported in the second year if their mentor had the funds).

Master Program of the Department of Physiology, through mid-1990s

	1970s	1980s	1990s
1st Year			
Fall Semester	Med Phys Biochem Methods Colloquium	Med Phys* Biochem Methods I Stats Colloquium	Med Phys* Biochem Methods Colloquium
Spring Semester	Med Phys Neurophys Colloquium	Med Phys* Neurophys Methods II Grad Seminar Colloquium	Med Phys* Neurophys Research Colloquium
Summer Semester	Electives Lab experience	Electives Research	Stats Research
2nd year			
Both semesters	Adv Phys (4 hrs) Electives Research Colloquium	Adv Phys (6 hrs) Electives Grad Seminar Research Colloquium	Adv Phys (4 hrs) Electives Grad Seminar Research Colloquium

*Referred to as Graduate Physiology when a small group was added to the medical lectures

The two required courses that varied over the years were statistics and biochemistry. The former reflects the on-going departmental problem with finding a good statistical course for its graduate students and also applies to the Ph.D. Program. The same, but to a lesser extent, is true for the Biochemistry course. Over the years, M.S. students have been required to take Biochemistry offered for medical, dental, or agricultural students and one year they were given the choice of one of these. The

electives available to students also varied over the years, depending largely on the research interests of the department.

M.S. students were always expected to do a research based master's dissertation, which was presented to the department and defending to their Thesis Committee, which usually consisted of three faculty members, one of which had to be from outside the department. This often meant that students were unable to complete their Master's work in two years, and usually defended their thesis sometime in their third year in the program. At one time the department even considered a Master program designed for students who were specifically interested for a terminal Master degree when they applied (e.g., were trying to improve their chances of getting into medical school) that required they take dental, not medical, physiology but this option was never adopted. The number of Master's students completing the program was remarkably constant for its first thirty years (Fig. 3 in text), but began to decline in the last decade of the 20th century. The program was terminated when graduate work was centralized by Dr. Saba in the first years of the new century.

Description of the Master of Science Program

Department of Physiology & Biophysics

1974

MASTER OF SCIENCE IN PHYSIOLOGY AND BIOPHYSICS

I. Prerequisites for the Program

The following prerequisites are mandatory for the master's program in Physiology and Biophysics. However, a student may eliminate a limited number of undergraduate course deficiencies during the first year in the program.

A. Calculus (2 semesters, 3 desired)

B. Physics (2 semesters, with Calculus prerequisite)

C. Modern Biology (2 semesters)

D. Physical Chemistry (1 semester)

II. Graduate Course Requirements

All students in this Department must successfully complete the following core of required courses which are designed to provide a firm foundation for future teaching and research endeavors.

GRADUATE CURRICULUM

First Year

FIRST SEMESTER

A. *Required Courses*

Physiol. 344	*Medical Physiology*	*3 hrs*
Physiol. 441	*Physiological Methods*	*4 hrs*
Physiol. 499	*Graduate Colloquium*	*1 hr*
Biochem. 231	*General Biochemistry*	*4 hrs*

B. *Prerequisites*

C. *Electives*

SECOND SEMESTER

A. *Required Courses*

Physiol. 345	*Medical Physiology*	*4 hrs*
Physiol. 346	*Neurophysiology*	*3 hrs*
Physiol. 499	*Graduate Colloquium*	*1 hr*

B. *Electives*

SUMMER

A. *Electives*

B. *Laboratory Experience*

Second Year

A. *Required Courses*

Physiol. 491	*Advanced Physiology*	*4 hrs*
Physiol. 497	*Research*	*6 hrs*
Physiol. 499	*Graduate Colloquium*	*1 hr*

B. *Electives*

C. *Laboratory Experience*

DEPARTMENTAL ELECTIVES

Physiology 248	*Experimental Design*	*3 hrs*
Physiology 347	*Biophysical Analysis*	*4 hrs*
Physiology 399	*Special Topics*	*1-4 hrs*
Physiology 447	*Systems Biophysics*	*4 hrs*
Physiology 490	*Teaching Practicum*	*1-3 hrs*
Physiology 444	*Graduate Seminar*	*2 hrs*

OTHER ELECTIVES

1. *Graduate courses in the life sciences (e.g., Biochemistry, Pharmacology, etc.)*
2. *Physical and Engineering Sciences.*
3. *Mathematics (Statistics is essential for most areas)*

III. Admission to Candidacy

During the first year of training, the student's advisor will be the chairman of the Graduate Studies Committee. At the end of the first year of training the student's academic performance will be carefully reviewed by the Graduate Studies Committee. On the basis of this performance, the sutdent will be admitted to candidacy for the Master of Science degree or dismissed from the program.

IV. Graduate Advisor and Graduate Committee

After admission to candidacy the student should select a graduate advisor. The student and the advisor will invite at least two members of the faculty to comprise the graduate committee, with the advisor serving as chairman. The majority of the members must be full or associate members of the Graduate Faculty.

V. Graduate Research and Final Examination

The student shall undertake a research project under the guidance of the graduate advisor in preparation for the master's thesis and final examination. The investigation should demonstrate a mastery of appropriate techniques and represent a contribution to knowledge. The written thesis shall be presented to the committee at least one month before the end of the semester in which completion of all requirements is expected. The form prescribed under the Graduate School "Regulations Governing the Preparation of Dissertations and Theses" must be followed with the guidance of the graduate advisor. In order for the thesis manuscript to be approved there shall be no more than one unfavorable vote among members of the student's committee.

Following committee approval of the thesis manuscript, the final oral examination will be scheduled. The student should contact all committee members to establish a convient date for the examination. The graduate advisor must notify the Office of the Graduate School at least three weeks in advance of the examination date. The student will defend the thesis in an oral examination before the graduate committee. The student may receive no more than one unfavorable vote on the oral examination. After passing the oral examination, two bound copies in approved type-written form must be delivered to the Office of the Graduate School at least one week before the close of the session in which the degree is expected to be conferred.

Description of the Master of Science Program

The Department of Physiology & Biophysics

1980

MASTER OF SCIENCE PROGRAM

DEPARTMENT OF PHYSIOLOGY AND BIOPHYSICS

I. Criteria for Admission

A. Grade Point Average

The minimal undergraduate GPA for admission required by the Graduate School is 2.5. Generally, 3.0 is required for full, unqualified admission to our program. Students with less than 2.5 will generally not be considered. Students may be admitted with GPA's between 2.5 and 3.0 but only on departmental probation. This probation must be removed at the end of the first semester by the student achieving a GPA of 2.75 taking courses specified by the advisory committee and a minimal grade of "B" in Physiology 344. This departmental probation, and the mechanism for removing it, will be clearly stated in the letter of acceptance to the student.

B. Graduate Record Examination

The verbal, quantitative, analytical, and one advanced GRE scores will be required of all applicants.

C. Letters of Reference

Letters of reference will be requested from three individuals of the applicant's choice. These individuals may either complete the departmental reference forms or write letters of reference if they choose. It will be made clear to these referees that these are to be academic or professional references. We will acknowledge receipt of each letter by sending a postcard to the referee.

D. Personal Interview

This is not required but it is highly desirable.

E. Prerequisites for the Program

Calculus (2 semesters, 3 desirable)

Physics (2 semesters, Calculus-based desirable)

Biology (2 semesters)

Organic Chemistry (1 semester)
(Physical Chemistry desirable)

II. Graduate Course Requirements

A. The Curriculum

All students in the M.S. Program must successfully complete the following core of required courses which are designed to provide a firm foundation for future teaching and research endeavors. Teaching each year is a normal requirement of all students in the M.S. Program.

GRADUATE CURRICULUM

First Year

First Semester

A. Required Courses

Physiol. 344 - Medical Physiology

Physiol. 342 - Physiological Methods (part 1)

Physiol. 499 - Graduate Colloquium

Biochem. 231 - General Biochemistry

Stat. 311 - Statistical Methods

B. Prerequisites

C. Electives

Second Semester

A. Required Courses

Physiol. 345 - Medical Physiology

Physiol. 341 - Physiological Methods (part 2)

Physiol. 346 - Neurophysiology

Physiol. 499 - Graduate Colloquium

Physiol. 444 - Graduate Seminar

Physiol. 399 - Special Topics

B. Electives

* Graduate students will be required to write five abstracts and one full paper during the first year of our graduate program. Material for the abstracts and the paper will come from data obtained during the laboratory exercises in the Physiological Methods course. For this purpose, students will register for Physiology 399 (Special Topics) for one credit hour with the coordinator of the Methods course. The written exercises will be graded by the faculty of the Methods course on an "S-U" basis.

Summer

A. Electives

B. Thesis Research

Second Year

A. Required Courses

Physiol. 444 - Graduate Seminar (one semester)

Physiol. 491 - Advanced Physiology (6 hours)

Physiol. 499 - Graduate Colloquium (both semesters)

B. Electives

C. Thesis Research

Departmental Electives

Conjoined Course 375 - Neurobiology

Physiology 248 - Experimental Design

Physiology 347 - Biophysical Analysis

Physiology 399 - Special Topics

Physiology 447 - Systems Biophysics

Physiology 490 - Teaching Practicum

Physiology 498 - Thesis

Other Electives

1. Graduate courses in the life sciences (e.g., Biochemistry, Pharmacology, etc.)
2. Physical and Engineering Sciences
3. Mathematics

B. Modifications of Curriculum

1. Advanced Standing

Students must petition the Graduate Studies Committee (GSC) to waive any required course or to deviate from the normal sequence of courses.

2. Effects of Curriculum Changes

Whenever a student's curriculum is modified, (e.g., by course addition, drop, withdrawal, or waiver) the GSC must re-specify the course curriculum, (e.g., repetition of the course) re-evaluate seniority, and consider any effects such a change may have on the student's standing in the department. All these factors will be discussed with the student. The student will be notified of all these factors in writing, and a copy will be sent to the Graduate School. All the decisions regarding changes in a student's curriculum or status

in the department will be reported in writing to the student and the Graduate School, included in the student's file, and reported to the graduate faculty at its next meeting.

III. Grade Requirements

In order to remain in good standing, the Department of Physiology and Biophysics requires the following:

1) An overall grade-point average (GPA) of at least 2.75.

2) A GPA of at least 2.75 in required Physiology courses

For the first academic year, grades in Research and Special Topics are excluded from GPA calculations. If the GPA requirements outlined above are not met, the student will be placed on departmental probation. The probation can be resolved if the student can again meet these requirements within one semester (excluding summer sessions) The courses to be taken during the probationary semester will be designed by the student's advisory committee. If probation is not resolved within one semester, the student will be dismissed from the program.

The following are also grade requirements for the M.S. Program and failure to meet them will result in immediate dismissal from the program.

1) No more than one "C" will be allowed in the following courses: medical physiology 344, medical physiology 345, neurophysiology 346, neurobiology 375, and advanced physiology 491.

2) No more than a total of two "C's" will be allowed in the courses listed above in 1., and in biochemistry 231, statistics 311, and any additional courses required by the

student's committee and included in this category by the committee.

3) No grade less than "C" will be allowed in any of the courses listed above in 1. and 2.

The graduate faculty reserves the right to retain a student in the program if special circumstances exist. In this case, the graduate faculty will review the student's record and render its decision by majority vote.

IV. Candidacy Requirements

During the first year of training, the graduate studies committee will act as the student's advisor. At the end of the first year of training the student's academic performance will be carefully reviewed by the Graduate Studies Committee. On the basis of that review, the student will be presented to the Faculty for admission to candidacy for the Master of Science degree or for dismissal from the program. Two-thirds of the Graduate Faculty must approve of each student for candidacy. In case such approval is not given, the Graduate Faculty will recommend a course of action.

V. Graduate Advisor and Thesis Advisory Committee

During the first academic year of this program a student is not committed to any particular area of specilization or a research advisor. During this time, the student is expected to become familiar with the research activities in the various faculty laboratories. However, the student will not be assigned to any such laboratory, nor will financial support be received from any given laboratory during this time. Based on impressions of the research in

these laboratories, and on personal interests, the student will choose a research advisor by the end of the first academic year. The advisor must be a member of the graduate faculty and of the Department of Physiology and Biophysics. After obtaining the chosen advisor's agreement, the student will write to the department chairman (with a copy going to the advisor) requesting that this assignment be made. This letter should contain a brief description of the proposed thesis research project. The agreement between student and advisor will become official upon written approval by the department chairman in consultation with the Graduate Studies Committee. Next, the student and advisor will invite at least two members of the Graduate Faculty to comprise the student's advisory committee, with the advisor serving as chairperson. At least two of the committee members must be members of the Department of Physiology and Biophysics. These assignments also require a written request from the student for approval by the department chairman in consultation with the Graduate Studies Committee. Copies of all such correspondence will be sent to the Graduate School. Until the advisory committee is established, the GSC will act as the student's advisor. The composition of the committee may be altered at any time with the consent of the student, the advisor, the department chairman, and the majority of the original committee members involved.

VI. Graduate Research and Final Examination

The student shall undertake a research project under the guidance of the graduate advisor in preparation for the master's thesis and final examination. The investigation should demonstrate a mastery of appropriate techniques and represent a contribution to knowledge. The written thesis shall be presented to the committee at least one

month before the end of the semester in which completion of all requirements is expected. The form prescribed under the Graduate School "Regulations Governing the Preparation of Dissertations and Theses" must be followed with the guidance of the graduate advisor. In order for the thesis manuscript to be approved there shall be no more than one unfavorable vote among members of the student's committee.

Following committee approval of the thesis manuscript, the final oral examination will be scheduled. The student should contact all committee members to establish a convenient date for the examination. The graduate advisor must notify the Office of the Graduate School at least three weeks in advance of the examination date. The student will defend the thesis in an oral examination before the graduate committee. The student may receive no more than one unfavorable vote on the oral examination. After passing the oral examination two bound copies in approved type-written form must be delivered to the Office of the Graduate School at least one week before the close of the session in which the degree is expected to be conferred.

VII. Support Priorities

A. Departmental stipends will generally be awarded to students according to the following order of priority:

1. continuing Ph.D. students with a GPA $\geq$ 3.0
2. entering Ph.D. students who are not on probation
3. continuing Ph.D. students with a GPA between 2.75 and 3.0
4. continuing M.S. students with a GPA $\geq$ 3.0

Entering M.S. students usually will not be supported. When M.S. students are given stipends, the support will be awarded for one semester at a time.

B. In general, M.S. students will be responsible for their own financial support during their first academic year; they will not be allowed to draw financial support from any departmental laboratory during this year. After the first academic year, such support is permitted on approval by the Graduate Studies Committee. Approval will depend on such factors as academic standing, lack of alternative support, and the understanding that the student is not obligated to stay in that laboratory, as well as any other relevant factors.

C. In general, no more than one student in a given research laboratory may be supported on Departmental stipends.

VIII. Appeal Procedure within the Department

Students may appeal GSC decisions first to the GSC, then to the departmental graduate faculty. Both groups will render their decisions by majority faculty vote.

IX. Vacation and Leave Policy

Participation in this program is considered to be a full-time (12 month) endeavor. The department, however, recognizes the need for periods of relaxation from study and work and thus applies the same guidelines for vacations for graduate students on stipends as those applicable to the faculty. University policy for faculty permits 22 working days of cumulative paid vacation per year in addition to University staff holidays. Authorized vacations and leaves are to be approved by the advisor before departure. Any substantial deviation from this policy must have the prior approval of the research advisor and the Graduate Studies Committee.

Description of the Master of Science Program

Department of Physiology & Biophysics

1980

MASTER OF SCIENCE PROGRAM

DEPARTMENT OF PHYSIOLOGY AND BIOPHYSICS

I. Criteria for Admission

A. Grade Point Average

The minimal undergraduate GPA for admission required by the Graduate School is 2.5. Generally, 3.0 is required for full, unqualified admission to our program. Students with less than 2.5 will generally not be considered. Students may be admitted with GPA's between 2.5 and 3.0 but only on departmental probation. This probation must be removed at the end of the first semester by the student achieving a GPA of 2.75 taking courses specified by the advisory committee and a minimal grade of "B" in Physiology 344. This departmental probation, and the mechanism for removing it, will be clearly stated in the letter of acceptance to the student.

B. Graduate Record Examination

The verbal, quantitative, analytical, and one advanced GRE scores will be required of all applicants.

C. Letters of Reference

Letters of reference will be requested from three individuals of the applicant's choice. These individuals may either complete the departmental reference forms or write letters of reference if they choose. It will be made clear to these referees that these are to be academic or professional references. We will acknowledge receipt of each letter by sending a postcard to the referee.

D. Personal Interview

This is not required but it is highly desirable.

E. Prerequisites for the Program

Calculus (2 semesters, 3 desirable)

Physics (2 semesters, Calculus-based desirable)

Biology (2 semesters)

Organic Chemistry (1 semester)
(Physical Chemistry desirable)

II. Graduate Course Requirements

A. The Curriculum

All students in the M.S. Program must successfully complete the following core of required courses which are designed to provide a firm foundation for future teaching and research endeavors. Teaching each year is a normal requirement of all students in the M.S. Program.

GRADUATE CURRICULUM

First Year

First Semester

A. Required Courses

Physiol. 344 - Medical Physiology

Physiol. 342 - Physiological Methods (part 1)

Physiol. 499 - Graduate Colloquium

Biochem. 231 - General Biochemistry

Stat. 311 - Statistical Methods

B. Prerequisites

C. Electives

Second Semester

A. Required Courses

Physiol. 345 - Medical Physiology

Physiol. 341 - Physiological Methods (part 2)

Physiol. 346 - Neurophysiology

Physiol. 499 - Graduate Colloquium

Physiol. 444 - Graduate Seminar

B. Electives

Summer

A. Electives

B. Thesis Research

Second Year

A. Required Courses

Physiol. 444 - Graduate Seminar (one semester)

Physiol. 491 - Advanced Physiology (6 hours)

Physiol. 499 - Graduate Colloquium (both semesters)

B. Electives

C. Thesis Research

Departmental Electives

Conjoined Course 375 - Neurobiology

Physiology 248 - Experimental Design

Physiology 347 - Biophysical Analysis

Physiology 399 - Special Topics

Physiology 447 - Systems Biophysics

Physiology 490 - Teaching Practicum

Physiology 498 - Thesis

Other Electives

1. Graduate courses in the life sciences (e.g., Biochemistry, Pharmacology, etc.)
2. Physical and Engineering Sciences
3. Mathematics

B. Modifications of Curriculum

1. Advanced Standing

Students must petition the Graduate Studies Committee (GSC) to waive any required course or to deviate from the normal sequence of courses.

2. Effects of Curriculum Changes

Whenever a student's curriculum is modified, (e.g., by course addition, drop, withdrawal, or waiver) the GSC must re-specify the course curriculum, (e.g., repetition of the course) re-evaluate seniority, and consider any effects such a change may have on the student's standing in the department. All these factors will be discussed with the student. The student will be notified of all these factors in writing, and a copy will be sent to the Graduate School. All the decisions regarding changes in a student's curriculum or status in the department will be reported in writing to the student and the Graduate School, included in the student's file, and reported to the graduate faculty at its next meeting.

III. Grade Requirements

In order to remain in good standing, the Department of Physiology and Biophysics requires the following:

1) An overall grade-point average (GPA) of at least 2.75.

2) A GPA of at least 2.75 in required Physiology courses

For the first academic year, grades in Research and Special Topics are excluded from GPA calculations. If the GPA requirements outlined above are not met, the student will be placed on departmental probation. The probation can be resolved if the student can again meet these requirements within one semester (excluding summer sessions). The courses to be taken during the probationary semester will be designed by the student's advisory committee. If probation is not resolved within one semester, the student will be dismissed from the program.

The following are also grade requirements for the M.S. Program and failure to meet them will result in immediate dismissal from the program.

1) No grade less than "C" will be allowed in required courses.

2) No more than two "C's" will be allowed in required courses.

The graduate faculty reserves the right to retain a student in the program if special circumstances exist. In this case, the graduate faculty will review the student's record and render its decision by majority vote.

IV. Candidacy Requirements

During the first year of training, the graduate studies committee will act as the student's advisor. At the end of the first year of training the student's academic performance will be carefully reviewed by the Graduate Studies Committee. On the basis of that review, the student will be presented to the Faculty for admission to candidacy for the Master of Science degree or for dismissal from the program. Two-thirds of the Graduate Faculty must approve of each student for candidacy. In case such approval is not given, the Graduate Faculty will recommend a course of action.

V. Graduate Advisor and Thesis Advisory Committee

During the first academic year of this program a student is not committed to any particular area of specialization or a research advisor. During this time, the student is expected to become familiar with the research activities in the various faculty laboratories. However, he will not be assigned to any such laboratory, nor will he receive his financial support from any given laboratory during this time. Based on his impressions of the research in these laboratories, and on his own interests, the student will choose a research advisor by the end of the first academic year. The advisor must be a member of the graduate faculty and of the Department of Physiology and Biophysics. After obtaining the chosen advisor's agreement, the student will write to the department chairman (with a copy going to the advisor) requesting that this assignment be made. This letter should contain a brief description of the proposed thesis research project. The agreement between student and advisor will become official upon written approval by the department chairman in consultation with the Graduate Studies Committee. Next, the student and advisor will invite at least two members of the Graduate Faculty to comprise the student's advisory committee, with the advisor serving as chairperson. At least two of the committee members must be members of the Department of Physiology and Biophysics. These assignments also require a written request from the student for approval by the department chairman in consultation with the Graduate Studies Committee. Copies of all such correspondence will be sent to the Graduate School. Until the advisory committee is established, the GSC will act as the student's advisor. The composition of the committee may be altered at any time with the consent of the student, the advisor, the department chairman, and the majority of the original committee members involved.

VI. Graduate Research and Final Examination

The student shall undertake a research project under the guidance of the graduate advisor in preparation for the master's thesis and final examination. The investigation should demonstrate a mastery of appropriate techniques and represent a contribution to knowledge. The written thesis shall be presented to the committee at least one month before the end of the semester in which completion of all requirements is expected. The form prescribed under the Graduate School "Regulations Governing the Preparation of Dissertations and Theses" must be followed with the guidance of the graduate advisor. In order for the thesis manuscript to be approved there shall be no more than one unfavorable vote among members of the student's committee.

Following committee approval of the thesis manuscript, the final oral examination will be scheduled. The student should contact all committee members to establish a convenient date for the examination. The graduate advisor must notify the Office of the Graduate School at least three weeks in advance of the examination date. The student will defend the thesis in an oral examination before the graduate committee. The student may receive no more than one unfavorable vote on the oral examination. After passing the oral examination two bound copies in approved type-written form must be delivered to the Office of the Graduate School at least one week before the close of the session in which the degree is expected to be conferred.

VII. Support Priorities

A. Departmental stipends will generally be awarded to students according to the following order of priority:

1. continuing Ph.D. students with a GPA $\geq$ 3.0

2. entering Ph.D. students who are not on probation

3. continuing Ph.D. students with a GPA between 2.75 and 3.0

4. continuing M.S. students with a GPA $\geq$ 3.0

Entering M.S. students usually will not be supported. When M.S. students are given stipends, the support will be awarded for one semester at a time.

B. In general, M.S. students will be responsible for their own financial support during their first academic year; they will not be allowed to draw financial support from any departmental laboratory during this year. After the first academic year, such support is permitted on approval by the Graduate Studies Committee. Approval will depend on such factors as academic standing, lack of alternative support, and the understanding that the student is not obligated to stay in that laboratory, as well as any other relevant factors.

C. In general, no more than one student in a given research laboratory may be supported on Departmental stipends.

VIII. Appeal Procedure within the Department

Students may appeal GSC decisions first to the GSC, then to the departmental graduate faculty. Both groups will render their decisions by majority faculty vote.

IX. Vacation and Leave Policy

Participation in this program is considered to be a full-time (12 month) endeavor. The department, however, recognizes the need for periods of relaxation from study and work and thus applies the same guidelines for vacations for graduate students on stipends as those applicable to the faculty. University policy for faculty

permits 22 working days of cumulative paid vacation per year in addition to University staff holidays. Authorized vacations and leaves are to be approved by the advisor before departure. Any substantial deviation from this policy must have the prior approval of the research advisor and the Graduate Studies Committee.

Description of the Master of Science Program

Department of Physiology

1994

MASTER OF SCIENCE PROGRAM

Department of Physiology

(Updated April, 1994)

I. CRITERIA FOR ADMISSION

A. Grade Point Average

The minimal undergraduate GPA for admission required by West Virginia University is 2.5. Generally, 3.0 is required for full, unqualified admission to our program. Students with less than 2.5 will generally not be considered. Students may be admitted with GPA's between 2.5 and 3.0 but only on departmental probation. This probation must be removed at the end of the first semester by the student achieving a GPA of 3.0, taking courses specified by the advisory committee, and a minimal grade of "B" in Physiology 344. This departmental probation, and mechanism for removing it, will be clearly stated in the letter of acceptance to the student.

B. Graduate Record Examination (GRE)

GRE scores (verbal, quantitative, and analytical) or MCAT scores are preferred, but not required, for all applicants.

C. Letters of References

Letters of reference will be requested from three individuals of the applicant's choice. These individuals may either complete the departmental reference forms or write letters of reference if they choose. It will be made clear to these referees that these are to be academic or professional references.

D. Personal Interview

This is not required, but is highly desirable.

E. Prerequisites for the Program

Applicants should have a strong background in biology and/or chemistry. In addition to a basic biology course, inorganic and organic chemistry are required. Because several areas of physiology require an understanding of the fundamentals of calculus and physics, introductory courses on these subjects are also essential. It is recommended that applicants have also taken biochemistry, cellular or molecular biology, and an introductory physiology course. Physical chemistry is recommended, but not required.

II. GRADUATE COURSE REQUIREMENTS

A. The Curriculum

All students in the M.S. Program must successfully complete the following core of required courses which are designed to provide a firm foundation in the principles of physiology. In the Physiological Methods course taken during the first year, students undertake laboratory rotations with each faculty member who is a potential thesis advisor. These meetings familiarize students with the research interests and techniques of the Departmental faculty so that they can make a more informed decision on whom to work with.

Effective 8/94

MASTERS CURRICULUM

FIRST YEAR

First Semester

A. Required Courses:

Physiol. 344	Graduate Physiology	5 hrs
Physiol. 499	Graduate Colloquium	1 hr
Physiol. 342	Physiological Methods	4 hrs
Biochem. 399	Graduate Biochemistry	4 hrs

Second Semester

A. Required Courses:

Physiol. 345	Graduate Physiology	5 hrs
Physiol. 346	Neurophysiology	3 hrs
Physiol. 497	Research	4 hrs
Physiol. 499	Graduate Colloquium	1 hr

Summer Session

A. Required Courses:

Physiol. 497	Research	3 hrs
Stat. 311 (if necessary)	Statistics (or Psych 311)	3 hrs

SECOND YEAR

First Semester

A. Required Courses:

Physiol. 491*	Advanced Physiology	2-4 hrs
Physiol. 499	Graduate Colloquium	1 hr
Physiol. 497	Research	3 hrs

Second Semester

A. Required Courses:

Physiol. 491*	Advanced Physiology	2-4 hrs
Physiol. 499	Graduate Colloquium	1 hr
Physiol. 497	Research	3 hrs

Summer Session

Physiol. 497	Research	3 hrs
Physiol. 444	Graduate Seminar	1 hr

* 4 credit hours per year total

Students may take approved electives. Courses must be approved by the appropriate guidance committee (Graduate Studies Committee or dissertation committee).

B. Modifications of Curriculum

1. Advanced Standing

Students must petition the Graduate Studies Committee (GSC) to waive any required course or to deviate from the normal sequence of courses.

2. Effects of Curriculum Changes

Whenever a student's curriculum is modified, (e.g., by course addition, drop, withdrawal, or waiver) the GSC must re-specify the course curriculum (e.g., repetition of the course), re-evaluate seniority, and consider any effects such a change may have on the student's standing in the department. All these factors will be discussed with the student. The student will be notified of all these factors in writing, and a copy will be sent to the Health Sciences Graduate Programs Office. All the decisions regarding changes in a student's curriculum or status in the department will be reported in writing to the student and the Health Sciences Graduate Programs Office, included in the student's file, and reported to the graduate faculty at its next meeting.

III. GRADE REQUIREMENTS

In order to remain in good standing, the Department of Physiology requires the following:

1) An overall grade-point average (GPA) of at least 3.0.

2) A GPA of at least 3.0 in required Physiology courses.

For the first academic year, the grade in Research (Physiol. 497) is excluded from GPA calculations. If the GPA requirements outlined above are not met, the student will be placed on departmental probation. The probation can be lifted if the student can again meet these requirements within one semester (excluding summer sessions). The courses to be taken during the probationary semester will be determined by the student's advisory committee. If probation is not lifted within one semester, the student will be dismissed from the program.

The following are also grade requirements for the M.S. Program and failure to meet them will result in immediate dismissal from the program:

1) No more than one "C" will be allowed in the following courses: medical physiology 344 and 345, neurophysiology 346 or neurobiology 375, and the advanced physiology course taken in the second year.

2) No more than a total of two "C's" will be allowed in the courses listed above in (1), and biochemistry and any additional courses required by the student's committee and included in this category by the committee.

3) No grade less than "C" will be allowed in any of the courses listed above in (1) and (2).

The graduate faculty reserves the right to retain a student in the program if special circumstances exist. In this case, the graduate faculty will review the student's record and render its decision by majority vote.

IV. CANDIDACY REQUIREMENTS

During the first year of training, the Graduate Studies Committee will act as the student's advisor. At the end of the first year of training the student's academic performance will be carefully reviewed by the Graduate Studies Committee. On the basis of that review, the student will be presented to the faculty for admission to candidacy for the Master of Science degree or for dismissal from the program. Two-thirds of the Graduate Faculty must approve of each student for candidacy. In case such approval is not given, the Graduate Faculty will recommend a course of action.

V. GRADUATE ADVISOR AND THESIS ADVISORY COMMITTEE

During the first academic year of this program a student is not committed to any particular area of specialization or a research advisor. During this time, the student is expected to become familiar with the research activities in the various faculty laboratories. However, the student will not be assigned to any such laboratory, nor will financial support be extended from any given laboratory during this time. Based on impressions of the research in these laboratories, and on personal interests, the student will choose a research advisor by the end of the first academic year. The advisor must be a member of the Graduate Faculty and of the Department of Physiology. After obtaining the chosen advisor's agreement, the student will write to the department chairman (with a copy going to the advisor) requesting that this assignment be made. This letter should contain a brief description of the proposed thesis research project. The agreement between student and advisor will become official upon written approval by the department chairman in consultation with the Graduate Studies Committee. Next, the student and advisor will invite at least two other members of the Graduate Faculty to comprise the student's advisory committee, with the advisor serving as chairperson. At least two of the committee members must be members of the Department of Physiology. These assignments also require a written request from the student for approval by the department chairman in consultation with the Graduate Studies Committee. Copies of all such correspondence will be sent to the Health Sciences Graduate Programs Office. Until the advisory committee is established, the GSC will act as the student's advisor. The composition of the

advisory committee may be altered at any time with the consent of the student, the advisor, the department chairman, and the majority of the original committee members involved.

VI. GRADUATE RESEARCH AND FINAL EXAMINATIONS

The student shall undertake a research project under the guidance of the graduate advisor in preparation for the master's thesis and final examination. The investigation should demonstrate a mastery of appropriate techniques and represent a contribution to knowledge. The written thesis shall be presented to the committee at least one month before the end of the semester in which completion of all requirements is expected. The form prescribed under the Health Sciences Graduate Programs "Regulations Governing the Preparation of Dissertations and Theses" must be followed with the guidance of the graduate advisor. In order for the thesis manuscript to be approved there shall be no more than one unfavorable vote among members of the student's committee.

Following committee approval of the thesis manuscript, the final oral examination will be scheduled. The student should contact all committee members to establish a convenient date for the examination. The graduate advisor must notify the Health Sciences Graduate Programs Office at least three weeks in advance of the examination date. The student will defend the thesis in an oral examination before the graduate committee. **Shortly before the examination, the student will present his or her research to the department as part of the departmental seminar series.** The student may receive no more than one unfavorable vote on the oral examination. After passing the oral examination two bound copies in approved type-written form must be delivered to the Health Sciences Graduate Programs Office at least one week before the close of the session in which the degree is expected to be conferred.

VII. SUPPORT PRIORITIES

A. Departmental stipends will generally be awarded to students according to the following order of priority:

1. continuing Ph.D. students with a GPA · 3.0
2. entering Ph.D. students who are not on probation
3. continuing Ph.D. students with a GPA between 2.75 and 3.0
4. continuing M.S. students with a GPA · 3.0

Entering M.S. students usually will not be supported. When M.S. students are given stipends, the support will be awarded for one semester at a time.

B. In general, M.S. students will be responsible for their own financial support during their first academic year; they will not be allowed to draw financial support from any departmental laboratory during this year. After the first academic year, such support is permitted on approval by the Graduate Studies Committee. Approval will depend on such factors as academic standing, lack of alternative support, and the understanding that the student is not obligated to stay in that laboratory, as well as any other relevant factors.

VIII. APPEAL PROCEDURE WITHIN THE DEPARTMENT

Students may appeal GSC decisions first to the GSC, then to the departmental graduate faculty. Both groups will render their decisions by majority faculty vote.

XII. VACATION AND LEAVE POLICY

Participation in this program is considered to be a full-time (12 month) endeavor. The department, however, recognizes the need for periods of relaxation from study and work and thus applies the same guidelines for vacations for graduate students on stipends as those applicable to the faculty. University policy for faculty permits 22 working days of cumulative paid vacation per year in addition to University staff holidays (these do not include semester break at Christmas or spring break). Authorized vacations and leaves are to be approved by the advisor before departure. Any substantial deviation from this policy must have the prior approval of the research advisor and the Graduate Studies Committee.

XIII. GRADUATE SCHOOL REGULATIONS AND GUIDELINES

The following regulations and guidelines have been established by the Health Sciences Graduate Programs Office for all masters candidates submitting dissertations to West Virginia University.

A. A graduate grade-point average of at least 2.75 will be required for graduation from WVU with a graduate degree.

B. During the semester that graduation is anticipated, the student should check at the Health Sciences Graduate Programs Office to see that his/her records show no deficiencies such as those regarding admission to the masters program, meeting of residence requirements, and removal of all incomplete grades, etc. The last date for removal of "I" grades (incompletes) is not later than one week prior to the

close of the summer session, on week prior to the last day of the final examination period at the end of the first semester, or one week prior to Commencement Day at the end of the second semester.

C. At the time of registration for the semester in which all degree requirements are expected to be met, or at the latest within 2 weeks after such registration, each candidate must submit a formal request on a special "Application for Graduation and Diploma" (including a $25 graduate fee) form to the Health Sciences Graduate Programs Office for the conferring of the degree. This form is available from the Health Sciences Graduate Programs Office. The candidate must complete all requirements at least one week before the end of that semester. If the degree is not actually earned during that semester the student must submit a new application at the beginning of the term in which he does expect all requirements will be met.

D. Each graduate student must be registered during the semester or session in which the final examination is to be taken.

E. The last day for the student's advisor to submit a request to the Office of the Graduate School for the final examination is four weeks prior to the end of the final examination period at the end of the first semester, or four weeks prior to Commencement Day at the end of the second semester. This request must be filed at least three weeks before the date of the oral examination defense. No final examination is to be given to a student until clearance is signed by the Health Sciences Graduate Programs Office in the form of receipt of the student's "Shuttle Sheet" from that office by the student's advisor.

F. Results of the final examination, acceptance of the dissertation, and certification of its suitability for immediate microfilming must be reported by the student's graduate advisor or committee chairman to the Health Sciences Graduate Programs Office within 24 hours of the scheduled time of the examination. This shall be no later than one week before the end of the semester or summer session in which the degree is expected to be granted.

G. At least one week prior to the end of the semester in which the degree is expected to be conferred (August, December, or May), the candidate whose committee has approved the dissertation must submit to the Health Sciences Graduate Programs Office <u>two bound copies</u>.

1. Mandatory requirements for acceptability of the dissertation are as follows:

a. <u>All</u> theses, dissertations, forms and fees must be submitted to the Health Sciences Graduate Programs Office. <u>DO NOT</u> take to the Library. The Health Sciences Graduate Programs Office will make delivery of the theses, dissertations, forms, fees and the approval form to the Library.

b. The Health Sciences Graduate Programs Office will review copies of the theses or dissertation before its copied in final form to assure that it meets the guidelines.

c. Bibliography: The bibliography can be typed in the format recommended by his/her school/department committee.

d. Sample of title page with chairperson listed is attached (this is only for the extra copy of the title page that goes with the copyright form).

e. Student should submit extra copies directly to department as required.

f. Thesis guidelines are the same except they do not have any forms to complete and no fees for microfilming and binding. If a thesis student wishes to have the thesis copyrighted they need to contact the Library for information. Two bound copies of the thesis with original signatures in both copies are submitted to the Health Sciences Graduate Programs Office.

GENERAL GUIDELINES GOVERNING THE PREPARATION OF DISSERTATIONS/THESES

Because capacity is very irportant in microfilming and reproducing manuscripts, copies presented to the Health Sciences Graduate Programs Office must be on good quality white, 16 to 20 pound paper. The various trade name "erasable" bonds all smear, and copies printed on recycled paper often fade. Hence, these paper types are not acceptable. Perforated paper used with some computer printers results in ragged edges on the bound manuscript and should be avoided.

Reproduction

Dissertations must be typewritten on only one side of the paper. Either the original and first copy or two copies reproduced by electrostatic copying methods must be presented to the Health Sciences Graduate Programs Office. The copies presented must be clean, clear, uniform, high contrast print. Mimeograph copies are not acceptable. Electrostatic copying methods on the reguired paper can be excellent, but results are unacceptable when the original is poorly typed (ribbon too dark or too light, incomplete erasures and corrections, etc), or the copying machine is poorly set or serviced (splotched, spotted, gray or dirty copies) When a student is in doubt about the acceptability of copies, personnel in the Health Sciences Graduate Programs Office will be happy to inspect a page or two before the whole manuscript is reproduced.

The surest way to prepare acceptable copies is to have the original typed on good quality paper. The student then may make as many copies as are needed for personal or committee use before submitting the required two copies to the Health Sciences Graduate Programs Office.

Students may use word processors (computers) to produce dissertations; however, because of duplicating and microfilming needs, the print must be letter quality with dark black characters that are

consistently clear and dense. Dot matrix printers ara not acceptable. Blue characters are not acceptable. Paper must be 16 to 20 pound paper, and type size should be 10 point or larger. Computer printouts with small and indistinct print become illegible in microform.

Spacing and Margins

All straight text is to be double spaced. Quotations, footnotes, etc , may be single spaced. The placement of the footnotes at the bottom of the paper or at the end of the manuscript is optional but must be consistent throughout. A form acceptable for publications in the discipline is recommended. All paper should have a minimum margin of 1" on all sides of the page.

Pagination

Each and every page in a dissertation, including all blank pages, is to be assigned a number with no duplications in the numbering system. The preliminary (table of contents, list of tables, etc) are to be numbered with small Roman numerals (i, ii, iii, iv, etc , in the upper right-hand corner). The title page counts as page i, but the number does not appear The remainder of the text should be numbered consecutively in Arabic numerals centered at the top or bottom of the page within the 1" margin. Avoid the use of letter suffixes as 10a, 10b, etc If there are more volumes than one, they should be identified as Volume I, II, etc., and numbering may either follow consecutively or begin again with Arabic 1. Multiple volumes should each contain a title page.

Illustrations and Charts

All illustrations and charts must be drawn in dark, opaque ink and be of sufficient size to be readable. Remember that microfilming and duplicating are black and white photographic processes and colors will appear in varying shades of gray. Thus, cross-hatching and labels are essential. If a title or description of an illustration or graph is too long to be placed on the same page, it should be placed on the previous page. Some disciplines prefer the title or description to face the illustration or graph. If this is done, be sure to number the blank side of the page (see pagination)

Oversize pages complicate duplicating procedures and should be avoided Often a different layout or the use of photographic reduction will resolve the problem . If oversized maps or charts are used, they should be folded as few times as possible, but in such a way as to give 1/4 inch minimum

clearance on front, right hand edge of book. A binding tab should be provided before the manuscript is presented to the binder. Maps or charts to be inserted in a pocket of the inside back cover are to be folded to a size not larger than 6 1/2 inches x 10 1/2 inches. The Health Sciences Graduate Programs Office will provide information about the acceptability of illustrative material if given the opportunity to examine it before submission of the manuscript. Photocopies and reduced text must be readable when reproduced, if in doubt bring example to Health Sciences Graduate Programs Office for appraisal.

Photographs

Photographs in a dissertation should be in black and white rather than color. Maximum clarity for microfilming and duplicating is attained when there is good black and white contrast. Color photographs should only be used when they are absolutely essential for understanding the methods or results of the research. If color photographs are used, appropriate labels must be provided to assist the readers of reproduced copies. Photographs are to be firmly affixed to pages with Kodak (or equivalent) Dry Mounting Tissue to insure permanent mounting.

Signatures

Both copies of a dissertation presented to the Health Sciences Graduate Programs Office must have original signatures of committee members on the approval page. The names of the student's committee members must be typed out below their signatures with the chairperson listed last and so identified. Reproductions are not acceptable. A sample signature page is attached.

Title

As Library retrieval Systems use words in the title to locate manuscripts, it is essential that titles provide a brief description of the contents of the work. Words should be substituted for formulas, symbols, Greek letters, and so on. In cases where the title is excessively long, the author must provide the Health Sciences Graduate Programs Office with an abbreviated title of not more than 55 spaces; i.e., a maximum of 55 printed characters and spaces between words.

Aqreement Form

A completed "Doctoral Dissertation Aareement Form must be presented to the Health Sciences Graduate Programs Office when the two (2) copies of the dissertation are delivered.

Abstract

The purpose of the abstract is to give a concise presentation so that the reader will be able to determine whether it is advisable to read the complete manuscript. The maximum length of the abstract is 350 words. The following parts are found in an abstract, although not identified with subheadings.

a. Statement of Problem
b. Procedures or Methods
c. Results
d. Conclusions

For publication purposes, a separate copy of the abstract must also be submitted. This is in addition to the abstract in the two unbound copies of the dissertation. This separate copy of the abstract must have centered at the top of the first page the exact full title of the dissertation, followed on the next line by the full name of the candidate, and on the next line by the word ABSTRACT. Paaes should not be numbered. The title on the abstract and on the "Agreement Form" must be the same, word for word, as on the title page of the dissertation.

The abstract will appear in Dissertation Abstracts, published by University Microfilms International. The original of the candidate's dissertation will be submitted on loan to University Microfilms International for complete microfilming. The resulting copy or copies will be available for purchase by all who request them.

The cost of publishinq the abstract and for microfilming the dissertation is $50.00 (subject to change). This is payable by certified check, money order to West Virginia University or cash. This check is presented to the Health Sciences Graduate Programs Office at the time of delivery of the two copies of the dissertation.

Organization of Manuscript

Proper arrangement and construction of the parts of a dissertation will likely vary according to the styles adopted by different disciplines. The suggestions concerning the organization of the dissertation that follow may be taken as a norm from which deviations may be made under the guidance of the student's advisor or committee. A dissertation should consist of the following parts:

1. Title page
2. Notice of copyright, if appropriate
3. Acknowledgments
4. Table of Contents
5. List of Tables and Illustrations
6. Introduction
7. Review of Literature
8. Text of Investigation
9. Bibliography
10. Appendix
11. Abstract
12. Curriculum vitae (optional)
13. Signature Page

Deadline Dates

Copies of the typewritten draft of the dissertation should be presented to all committee members at least one month before the final examination.

CHECK LIST FOR ITEMS BEING DEPOSITED IN HEALTH SCIENCES GRADUATE PROGRAMS OFFICE

1. Theses (2 Bound manuscripts)
   a. Signature Sheet with original signatures of Committee members (2 copies)
   b. Acceptable Margins and double spaced
   c. Pages and Exhibits numbered consecutively
   d. *Copyright statement must appear in manuscript

e. Clear and legible copies. The use of color and dot matrix print must have prior approval.

f. 16-20# weight paper (no erasable bond, recycled paper or perforated computer paper.

2. Separate Abstract (Pages numbered, 350 word maximum, double spaced, including title and student's name
3. Copyright Agreement Form (Completed and signed)
4. *$35.00 for Copyright (Certified Check/Money Order payable to University Microfilm, Inc.).
5. Extra title page with name of Chairperson.
6. Survey of Earned Doctorates Form (Completed and sianed)
7. $50.00 Check for Dissertation Fee (Certified Check/Money Order payable to WVU Library or cash.
8. Shortened Title if the title exceeds 55 character limit (includes spaces).

*Optional

Approval Form

If the dissertation is in acceptable form, all appropriate forms have been completed and payment has been received, the Health Sciences Graduate Programs Office personnel will complete and sign an approval form indicating that all obligations regarding submission of the dissertation to the Health Sciences Graduate Programs Office have been fulfilled. The original of the form will be given to the student to return to the appropriate office in the college from which the degree is being granted.

The dissertation will be microfilmed and both copies bound, catalogued and added to the Library collection.

Example of Title Page

ISOMETRIC TENSION DEVELOPMENT
IN THE HYPERTROPHIED HEART

DISSERTATION
Submitted to the School of Medicine
of
West Virginia University
In Partial Fulfillment of the Requirements for
The Degree of Doctor of Philosophy (Master of Science, etc.)

by

Frank Love Pollock, A.B.

Morgantown
West Virginia
1991

(SAMPLE SIGNATURE PAGE)

APPROVAL OF EXAMINING COMMITTEE

Donald G. Baker, Ph.D.

Thomas Anderson, M.D.

Harold M. Jones, Ed.D.

Daniel M. Worthington, Ph.D., Chair

Date

APPENDIX 3B

Physiological Methods Course, 1970-2000

Unlike many other graduate courses required by the department that evolved gradually as new information was incorporated into the material presented (e.g., medical physiology), this course changed significantly several times from the 1970s to the late 1990s, which is the time span on which we have detailed information about the course. These changes reflected the shifts in the research interests of department faculty and the technical approaches they used in their research over this quarter century.

From 1970 to 1975 this was a one-semester course focused largely on electronics and instruments for biological measurements (see course content from 1974), which reflected the emphasis on biophysics during the Wilson years. In the 1976-77 academic year it was expanded to a two-semester course as modules on animal surgery, subcellular physiological methods, and use of computers were added (see course outline for the 1977-1978 academic year). These changes likely reflected the addition of Drs. Brown, Colby, and Morgan to the department since they had expertise in these techniques and would want potential graduate students to be exposed to them early in their academic career.

The course changed again shortly after Dr. Hedge became chair to focus more on experimental approaches to subdisciplines within physiology. In the revised course several of the modules were retained including introduction to animal surgery, electrophysiology, use of computers, radioiosotopes (previous called compartmental analysis), and assessment of cardiovascular function (part of "Monitoring physiological parameters"). Modules in the second semester included consideration of cellular physiology, and respiratory, renal, and endocrine functions (see Spring schedule for 1979). The course during this period and up to the mid-1980s made use of both rats and dogs as animal models for these experimental circumstances. However, the use of dogs was phased out in 1987 as concern for animal welfare and animals rights activists built in the 1980s (a university Animal Care and Use Committee was created in 1986). Starting around 1990, the focus of some modules also shifted toward regulatory compliance issues with less emphasis on experimental techniques. This also allowed the incorporation of lab rotations into the methods course, which occurred in 1989. Thus the fall semester of the course in 1990 include modules on computer use (4 weeks), animal care and use (2 weeks), radiation biology (2 weeks), in vitro experiments on the neuromuscular junction (3 weeks), and four lab

rotations. The spring of that academic year had models on the endocrine system, nerves and muscles, the renal and cardiovascular systems, and cell and respiratory physiology. As that decade progressed, these modules covering different systems were eliminated and the course reverted to one semester. Eventually, it was discontinued completely when the new graduate program with a common first-year curriculum was introduced by Dr. Saba.

Physiological Methods (Physiology & Biophysics 441), offered in the Fall Semester of 1974

Week 1:	Review of basic electrical principles
Week 2:	Solid state electronic devices and circuits
Week 3:	Solid state devices and circuits
Week 4:	Operational amplifiers
Week 5:	Fundamentals of digital electronics
Week 6:	Biopotential electrodes and amplifiers
Week 7:	Biological stimulator methods
Week 8:	Cardiovascular instrumentation
Week 9:	Cardiovascular instrumentation
Week 10:	Isotope methods in biological research
Week 11:	Isotope methods in biological research
Week 12:	Respiratory instrumentation and function tests
Week 13:	Biological temperature measurement and control
Week 14:	Radiotelemetry of biological data
Week 15:	Gas tension and pH instrumentation

Physiological Methods-Physiology and Biophysics 441-Fall Semester 1974-75

Instructors- W. Morton Caldwell, John L. Hankinson, and Thomas R. Ebeling

Textbooks- Principles of Applied Biomedical Instrumentation, Geddes and Baker
Biophysical Measurements, Strong

COURSE CONTENT

Week 1 - REVIEW OF BASIC ELECTRICAL PRINCIPLES

1. Electrical charge, electron transfer, generation of static electrical charge, definition of coulomb and volt, force of electrostatic field, Coulombs law. Capacitance, practical capacitors in series and parallel, dielectric constant.

2. Biological aspects of early electrical experimentation, discovery of bio-electricity by Galvani, resultant application by Volta to generate constant electrical current from chemical cell.

3. Definition of electrical current and resistance, resistivity of various materials, conductors and insulators, temperature effect on resistance, practical resistors, resistance linearity.

4. Ohms law, resistances in series and parallel, resistance power dissipation, definition of watt, derivation of electrical power from basic work rate units.

5. IR voltage drop, voltage divider, practical voltage drop problems, voltage divider loading, current division law, superposition principle, Kirchhoffs law, nodal and loop analysis of simple DC circuits. Current and voltage source concepts, Thevenin and Norton theorems.

6. Steady state current and time-varying current. Basic AC waveforms , RMS, peak, and average values of sinusoidal, square, and triangular waveforms. Frequency and period relationship. Inductance, Amperes law, electromagnetic field, transformers, inductive reactance. Form, generation, and distribution of commercial electrical power.

7. Series resistance-capacitance circuits, capacitive reactance, current flow through RC circuit, response to step, ramp, and sine inputs. Review of basic derivative and integral concepts, RC differentiator and integrator circuits. RC phase shift networks, AC vector notation, impedance of RC, RL, and RCL series and parallel circuits.

Laboratory - Experiment with laboratory electronic instruments-voltohmeter, VTVM, DC power supply, function generator, and oscilloscope. Measurement of voltage, current, resistance and waveform frequency, period , and amplitude. Exploration of instrument accuracy and agreement. Measurement of voltage from high and low source resistance circuits using high and low input impedance instruments.

WEEK 2 - SOLID STATE ELECTRONIC DEVICES AND CIRCUITS

1. Semiconductor material, crystal lattice structure, silicon and germanium doping to make P and N semiconductor material, electrons and holes in covalent bonds, P-N junction formation, depletion region. Model of P-N junction, electrical behavior, forward and reverse bias current flow, junction capacitance, use as polarity-sensitive resistor element, I-V characteristics of P-N diodes.

WEEK 2 CONTD

2. Diode circuits- power rectifier, signal clipper, and constant voltage element. Half and full wave rectifier circuits, RC and LC ripple filters, power supply regulation. Zener diodes and voltage regulator uses, light emitting diodes, photodiodes, tunnel diodes. P-N diode as log element.

3. Concept of signal amplification by active device, modulation of power with active device by input control signal, nerve-muscle analogy. PNP transistor power amplification by transfer of current from low resistance input to high resistance output circuit. Transistor as current-controlled device, biasing of base-collector and base-emitter junctions.

4. Elementary common-base, emitter, and collector circuits, current and voltage gains, input and output resistances. Basic transistor parameters, forward current gain, leakage, frequency limitations, h-parameter analysis.

5. Practical bipolar transistor amplifiers- load line design methods, class A, B, C uses and efficiency, biasing methods and effect on stability, gain, input impedance and frequency response. AC and DC common emitter amplifiers, series and shunt switches, current sources. Emitter follower circuit, input and output impedances, biasing, use in biopotential measurement.

6. Field effect transistor (FET) circuits- basic FET theory, voltage-controlled amplification, input resistance and capacity, current source I-V characteristics, common source voltage amplifier biasing methods. Insulated gate FET, enhancement and depletion types.

7. Transistor application and selection- voltage and current ratings, specification sheet information, heat sinking, lead connections, cost and availability.

Laboratory- The following circuits are constructed and analyzed.

Circuit	Analysis
DC source-resistor-silicon and germanium diode series circuit	Verification of Ohms law, summation of voltage drops, forward and reverse bias diode current, diode forward voltage drop and temperature effects.
Half and full wave diode rectifier circuit	Conversion of AC to DC, filtering of AC ripple, RMS and peak voltage relationship
Silicon diode clipper	Clipping of input sine wave to diode forward voltage
RC differentiator-positive spike generator	Time constant measurement of generated spikes, diode shunting of negative spikes
Zener diode voltage regulator	Regulation of output with variable input voltage and load current, maximum zener power dissipation, calculation of circuit component values
Double zener clipper	Positive and negative limiting of output at zener value
Bipolar NPN transistor series switch-amplifier DC input	Control of collector current by base current, current and voltage gain, cutoff and saturation collector current and voltage

WEEK 2 LABORATORY CONTD

Circuit	Analysis
NPN transistor common emitter AC amplifier	Bias current injection for proper class A Q-point, voltage gain, phase inversion, input impedance
NPN transistor current source	Load line analysis of collector current stability with variable collector load resistances. Collector voltage variations.
Common emitter NPN amplifier with three biasing methods- (1) current injection (2) collector feedback (3) base divider-emitter resistance	Voltage gain, base, emitter, and collector voltage calculation and verification, design of bias circuit, calculation of component values, effect of variations in transistor parameters and temperature, input impedance calculation and verification, frequency response.
Emitter follower	Voltage and current gain, impedances, phase inversion

WEEK 3 - SOLID STATE DEVICES AND CIRCUITS

1. Oscillator circuits- gain and positive feedback , RC phase shift oscillators, LC resonant feedback circuits, relaxation methods, unijunction transistors, other breakdown devices.

2. Multivibrators- Analysis of bistable multivibrator, input triggering circuits, waveform shaping and frequency divider, computer memory applications. Monostable multivibrator- RC control of output pulse duration, input triggering, applications in uniform pulse generation, time delay, and analog frequency measurement. Astable multivibrator- analysis of periodic oscillation mechanism, frequency control and stability, uses as square wave oscillator. Study of 555 integrated circuit as monostable and astable, 555 current source circuit for generation of linear ramp waveform.

3. Schmitt trigger circuit- analysis of positive feedback mechanism, hysteresis, design for specific trigger voltage level.

4. Differerential amplifiers- need for detection and amplification of difference in two signals, development by biological researchers, concept of dual inputs, basic long-tail pair circuit, derivation of differential gain expression, common mode and differential signal definition, common mode rejection ratio, current source emitter resistance circuit, common mode and differential input impedances. Input reference point considerations . DC differential circuits, push-pull class B pairs, complementary symmetry amplifiers.

Laboratory - The following circuits are constructed and analyzed.

Circuit	Analysis
External bias FET Amplifier	Gate cutoff voltage, off and on drain voltage, voltage gain, input impedance, capacity coupling.
Self-biased FET amplifier	Generation of gate-source bias voltage by source resistance, voltage gain, negative feedback by source R.

WEEK 3 LABORATORY CONTD

Circuit	Analysis
Series FET switch	Switching of audio signals by FET gate voltage control
Bistable, Monostable, and Astable multivibrators	Measurement of bistable on and off collector voltages, monostable period RC control, astable frequency.
Schmitt trigger	Trigger voltage level and hysteresis
555 timer integrated circuit	Operation as astable and monostable, verification of specification sheet equations and parameters.

WEEK 4- OPERATIONAL AMPLIFIERS

1. Definition of operational amplifier and connection of input and feedback elements. Application as inverting amplifier, input and feedback current, summing point, virtual ground, derivation of inverting amplifier transfer function, voltage at + and - inputs, output impedance.

2. Operational amplifier parameters- open loop gain, offset and bias current. offset voltage, output voltage and current limits, stability, input impedance. Modular, IC, FET, and power operational amplifiers, cost, and choice of amplifiers for specific applications.

3. Inverting amplifier as summing circuit, addition or subtraction of inputs, Methods for reduction or cancellation of offset current and voltage, error calculation due to offsets. Power supply requirements.

4. Voltage follower and noninverting amplifier circuits- gain calculation, input impedance, biopotential applications.

5. Operational amplifier differential amplifier circuits- gain, input impedance, common mode rejection ratio, offset problems. Instrumentation amplifiers. Differential applications to biopotential measurement and transducer outputs. Bridge circuits.

6. Operational amplifier current to voltage and voltage to current converters. Use of summing point as input current sink, output voltage vs input current. Current source circuits with grounded and floating loads.

7. Analog computing circuits- derivation of integrator and differentiator functions. Integration of biological waveforms, area under curve, summation of events, time to voltage conversion, staircase generators, automatic reset integrators, voltage controlled oscillators, period to frequency converters, solving of differential equations. Rate of change measurement and noise problems, biological signal differentiation.

8. Nonlinear circuits- diodes and nonlinear resistances as input and feedback elements, precision rectifiers, linearizing, curve fitting, log amplifiers, multiplication and division.

WEEK 4 CONTD

Laboratory- The following circuits are constructed and analyzed.

Circuit	Analysis
Inverting Amplifier	Gain as function of input and feedback resistances, summation of three input waveforms, maximum output voltage, frequency response, input offsets, phase inversion.
Voltage follower	Gain, input impedance, phase inversion.
Noninverting amplifier	Gain, input impedance.
Differential amplifier	Gain, common mode rejection ratio, differential signals
Integrator	Integration of DC and pulse inputs, staircase generation input balance, reset methods.
Electronic reset integrator	FET as switch to reset integrator with external pulse, sawtooth generation, time to voltage generation, biological event timing.

WEEK 5- FUNDAMENTALS OF DIGITAL ELECTRONICS - Tom Ebeling

1. Boolean algebra, basic logic concepts, AND and OR functions, truth tables, NOT concept, commutation, absorption, DeMorgan, association, and distribution theorems. Binary addition, exclusive-or. Binary counting, binary codes.

2. Binary gate circuits, inverters , transistor and integrated circuit gates, logic levels, multivibrators, flip-flops, memory circuits.

3. Counters, registers, and readouts- BCD counters and decimal converters, readout and display devices, shift registers, binary decoding.

4. Analog-to-digital and digital-to-analog converters, computer interface, digital instrumentation in biological research.

Laboratory- The following circuits were constructed/connected and analyzed.

Circuit	Analysis
IC NAND gate	Generation of truth table from observed response, TTL operational precautions
IC NAND and NOR gates	Use of NAND and NOR gates for AND and OR function generation
Digital counter	Use of NAND, NOR and J-K flip-flops to count to 16, 10, and 5.
Digital counter with LED 7-segment display	Characteristics of IC binary decoder/driver and LED numerical displays.

WEEK 6- BIOPOTENTIAL ELECTRODES AND AMPLIFIERS

1. Electrode-electrolyte interface, ion exchange, electrical double layer, Nernst potential, Warburg electrode interface RC model, impedance-frequency characteristics of electrodes, current density problems in model design, electrode impedance and half-cell potential effects on biopotental recording.

2. Electrode design- electrode materials, Ag-AgCl ,platinization, electrode pastes, capacitance electrodes, electrode polarization. Practical electrodes- plate, recessed, needle, microelectrodes, wick, carbon .

3. Biopotential amplifiers-requirements for high input impedance, CMRR, low noise, and correct frequency response. Input impedance effects on reduction of signal and frequency range. Review of input impedance of basic transistor amplifiers, methods for increasing impedance, emitter resistance, bootstrapping, followers. Operational amplifier circuits, input impedance, followers and neutralized (negative C) amplifiers. FET and IGFET amplifiers

4. Differential amplifiers- CMRR enhancement, interference sources, 60 Hz problems, coupling of interference to amplifier, amplifier input reference and ground designs, ground isolation methods, transformer isolation, optical coupling, signal and power grounds, shielding and guarding, ground loops, interference as function of amplifier input inpedance, floating inputs, source impedance balance, interference sampling. Instrumentation amplifiers as biopotential amplifiers, electrical stability, chopper amplifiers. Practical amplifiers for measurement of ECG, EEG, EMG,intercellular potentials. Survey of commercial amplifiers.

5. Single-ended input amplifiers as biopotential amplifiers, method of interference rejection, ground isolation by transformer, optical, or telemetry coupling to readout.

6. Sources of noise- Johnson noise, shot noise, flicker noise, computation of noise figure from amplifier test data, correct methods for noise tests, variation of amplifier noise figure with source impedance, "input shorted" methods, derivation of noise figure expression from signal to noise ratios and input equivalent-Johnson noise calculations. Noise frequency considerations, necessary amplifier response, frequency restriction, design of high, low, and bandpass filters. Comparison of noise specifications of several commercial amplifiers.

Laboratory - The 60 Hz interference pickup of a Tektronix 502A oscilloscope is investigated as a function of single-ended vs differential input, 60 Hz balanced input amplitudes, bare vs shielded wire, source impedance, electrostatic and electromagnetic sources, and subject grounding.

A lead II ECG is obtained on the oscilloscope using single-ended, differential floating, and differential grounded input configurations and the amount of 60 Hz interference noted. A lead II ECG is also obtained on the Grass polygraph and the effect of the polygraph time constant, notch, and low pass filter settings are studied.

The equivalent input noise of the oscilloscope is also explored with respect to source impedances and observations made about the validity of this test.

WEEK 7- BIOLOGICAL STIMULATION METHODS

1. Electrical stimulation- Early methods, inductorium, static machines. Stimulation parameters, strength duration curve, current vs time, choice of stimulus waveform, advantages of square wave. Constant current and constant voltage concepts, electrical models of biological subject, series and parallel stimulus impedances, measurement of stimulus current, stimulus losses in shunt paths, stimulating electrode problems.

2. Electronic stimulators-Relaxation oscillator, multivibrators for square wave generation. Astable-monostable chains for frequency, duration, and delay control. Stimulus pulse train generators, pulse pairs. Analog integrators for stimulus timing. Digital divider methods. Response-controlled stimulation.

3. Stimulus artifact problem- isolation methods to remove stimulator from amplifier ground reference- transformer, radio frequency, optical, battery operation. Detailed analysis of stimulator-subject-amplifier ground situation. Passive stimulus-powered RF isolators vs balanced modulator isolator. Measurement of isolated stimulus amplitude.

4. Stimulator output circuit design- constant current and constant voltage output, power requirements, constant current isolation problems.

5. Mechanical stimulation- force and displacement generators, linear actuators, motors, moving coil electrodynamic transducers, loudspeaker applications, positioning servomechanism, displacement and velocity feedback, power amplifers, mechanical noise, frequency response, displacement transducers.

5. Audio stimulation- generation of acoustic energy, conventional and electrostatic loudspeakers, modulated tone bursts, audio power amplifiers, distortion.

6. Conditioning stimulation- psychological conditioning current levels, perception currents, AC vs DC, frequency effects, burst modulation, reaction current amplitude, skin resistance. Current amplitudes to produce muscle deactivation, respiratory arrest, cardiac arrest, ventricular fibrillation. Microshock, ground faults.

Laboratory - Demonstration of inductorium, various commercial square wave stimulators, transformer isolation, self-powered RF isolator, linear modulator isolator, stimulus artifact, linear motion generator, tone burst generator, radiotelemetry conditioning stimulator. Evaluation of commercial stimulators.

WEEK 8- CARDIOVASCULAR INSTRUMENTATION

1. Blood flow measurement-Importance of cardiac output measurement. Averaging methods- Fick, dilution, isotope, glass beads, paddlewheel. Instantaneous data needed for cardiac dynamics studies- invasive methods such as heated thermistor. Noninvasive methods- electromagnetic flowmeter principle, voltage generated by blood flowing through magnetic field, Kolins first EM flowmeter, DC magnetic drive, electrode polarization, amplitude of flow signal, AC magnet excitation, transformer potential interference and solution. Square wave AC flowmeter, modern designs, flow transducer problems, chronic implantation. Sites and range of flow measurement, accuracy, calibration, zero flow determination, design of square wave electromagnetic blood flowmeter with operational amplifiers. Evaluation of current commercial models.

WEEK 8- CARDIOVASCULAR INSTRUMENTATION CONTD

Ultrasonic blood flow measurement- Transit time flowmeter developed by Franklin, measures time sound burst travels downstream, used in early Rushmer chronic research, replaced by Franklins doppler shift flowmeter. Principle of doppler flowmeter, advantages of lightweight transducer and automatic zero determination, May be used externally to measure flow velocity in veins and arteries close to skin surface. Frequency output proportional to blood velocity, low power consumption compared to electromagnetic meter. Calibration problems due to power spectrum of output signal, development of pulsed doppler flowmeter, flow measurement at specific distance from transducer. Laminar flow patterns. Directional flow measurements by EM, transit time, doppler, and pulsed doppler.

Cardiovascular pressure measurement- pressure information combined with flow data to compute resistance, hydraulic analogy to Ohms law. Pressure technics- principle of external cuff method. Concept of bending diaphram pressure transducer, methods to detect diaphram bending, strain gauge, LVDT, variable capacitor. Bridge circuits for strain gauges, gauge factor, wire and semiconductor strain gauges, bridge linearity. LVDT demodulators, operational amplifier capacitor gauge linearizing methods. Conventional, catheter, and implantable pressure gauges. Transistor, IC, and magnetostrictive gauges. Dynamic problems in pressure measurement, damping, catheter length, volumetric displacement, resonant frequency, overshoot, principles of damped resonant systems and transducer system corrections for desired response. Testing pressure transducers. Temperature sensitivity, linearity, long-term stability. Evaluation of several commercial pressure transducers. Noninvasive pressure measurement problem.

3. Cardiovascular dimension measurements- used to study ventricular mechanical activity and to develop geometric models. Heart volume measured in acute experiments by rubber bag around heart, circumference by mercury-in-rubber gauge around heart in chronic work. Ventricular width measured by internal variable inductor. Width also measured by ultrasonic pulse transit time, transducers on inside or outside of ventricle, linear but has alignment problems. Two coil method for width or length, simple circuit, linearity problem and solutions. Multichannel inductance coil method, measurement of internal left ventricular width, wall thickness, other organ dimensions. Impedance and X-ray dimension methods. Stroke volume calculation by geometric model assumption, comparison with integrated flow waveform.

4. Computation of other cardiovascular parameters- Rushmer analysis of left ventricular function from three basic parameters, derivation of stroke volume, flow acceleration, pressure rate of change, systolic duration, heart rate, power, stroke work, and total work by analog computation. Application of operational amplifiers integrators to compute stroke volume and duration of cardiac events. Practical analog multipliers. Design of beat-by-beat linear heart rate circuits, conversion of period to frequency, sample-and-hold circuits,

Laboratory- Demonstration of gated sine wave, square wave, and doppler blood flowmeters, conventional and intraventricular pressure transducers, heart ratemeter, and dimension coil system.

WEEK 9- CARDIOVASCULAR INSTRUMENTATION

1. Timing and recording of cardiovascular events, application of automatic reset analog integrator, timing from event 1 to event 2, generation of voltage proportional to elapsed time, use in atrioventricular conduction studies.

WEEK 9- CARDIOVASCULAR INSTRUMENTATION CONTD

Strip chart recorders, galvometric and servo writing methods, curvilinear, rectilinear, knife edge writing accuracy, digital electrostatic methods, ink writers, heat, electric, and optical writing. Chart recorder frequency response. Tape recorders, FM and direct methods, IRIG specifications, noise, speed stability.

2. Implanted cardiovascular instrumentation- problems of tissue reaction, lead breakage, fluid seepage, connecting wires, power sources, interference with natural function due to size and weight, long-term reliability, calibration. Cardiac pacemakers, circuit design, demmand pacemakers, power sources, electrodes, fluid leakage problems.

Laboratory- Class divided into two groups for implantation of ventricular dimension coils, aortic electromagnetic flow probe, and intraventricular pressure transducer in acute dog experiment. Each student responsible for specific parameter, installation of gauge,and calibration of readout. Arterial pressure is also measured by femoral catheter and pressure transducer, and heart rate computed by cardiotachometer. All five parameters are displayed on a strip chart recorder simultaneously and analyzed by each student.

WEEK 10 - ISOTOPE METHODS IN BIOLOGICAL RESEARCH

Taught by John Hankinson

WEEK 11- ISOTOPE METHODS IN BIOLOGICAL RESEARCH

Taught by John Hankinson

WEEK 12- RESPIRATORY INSTRUMENTATION AND FUNCTION TESTS

Taught by John Hankinson

WEEK 13- BIOLOGICAL TEMPERATURE MEASUREMENT AND CONTROL

1. Areas of temperature measurement, temperature transducers, thermoresistive, temperature coefficients of metals, thermistor characteristics, posistors, bridge and operational amplifier circuits for thermistors, self heating, linearizing methods, accuracy, thermistor time constant. Thermocouples, Seebeck effect, voltage output, reference junction, thermocouple amplifiers, use of thermistors and thermocouples in measurement of blood flow.

2. Temperature controllers, negative feedback, on-off type, proportional control, set point, error signal, accuracy, hunting, operational amplifier proportional control circuits, power amplifiers for heater driving, SCR and triac circuits for AC proportional control, AC interference, optical coupling of feedback signal. Peltier effect semiconductor coolers, uses for cooling, heat pump, liquid heat extraction methods, nerve blocking. Commercial temperature controllers, heaters, and coolers.

Laboratory- Demonstration of DC proportional controllers for animal heating, thermistor and thermocouple temperature measurement circuits, operational power amplifier DC proportional controller, AC on-off control system, triac high power AC proportional system, semiconductor cooler control system.

WEEK 14- RADIOTELEMETRY OF BIOLOGICAL DATA

1. Electromagnetic spectrum and radiation characteristics, frequency and wavelength, frequency allocations to various services, government regulations, broadcasting and communications frequencies, radio propagation in free space and atmosphere, frequencies used for biotelemetry.

2. Generation of radio signals, oscillator circuits, colpitts, hartley, and crystal oscillators, resonant circuits, RF amplifiers and frequency multipliers, amplitude, frequency, and pulse modulation, sidebands, carrier, frequency range of modulation vs carrier frequency, modulation circuits, amplifier power , antennas.

3. Biopotential transmitters, simple AM systems, interference problems, blocking oscillator transmitter, AM-FM systems, FM-FM subcarrier systems, subcarrier demodulation. Multichannel FM, PWM, and pulse interval methods.

4. Conversion of entertainment equipment for biotelemetry, commercial FM tuners, amateur, CB, and radiocontrol equipment modification. Availability and specifications of commercial biotelemetry systems, build or buy decisions, special telemetry receivers.

5. Telemetry of specific biological parameters, ECG, EMG, EEG, nerve spikes, temperature, flow, pressure. Transducer-transmitter interface circuits. Frequency response required. DC response. Implanted telemetry, packaging, use of integrated circuits, power sources, miniature batteries , power transmission into animal for battery charging . Micropower operational amplifiers. Passive transmitters.

Laboratory- An FM-FM temperature transmitter is constructed. Temperature is measured by thermistor which controls the frequency of a UJT oscillator that modulates a 100 MHz FM single-transistor oscillator stage. The signal is received on a conventional FM radio and demodulated into a DC level proportional to temperature by a clipper-monostable-RC integrator frequency to voltage converter. Calibrations of temperature vs subcarrier frequency and frequency to voltage converter output are made. An external audio oscillator is also used to modulate the transmitter to investigate the frequency response of the system. This demonstrates that while the transmitter has a DC response, the receiver is restricted to the low audio range. A special DC-500 KHz bandpass telemetry receiver is demonstrated.

The UJT subcarrier circuit is removed and a two stage FET input amplifier is constructed for direct frequency modulation of the oscillator. An EMG input is supplied, and the receiver output is displayed on the oscilloscope. The quality of this transmission by direct FM is analyzed.

WEEK 15- GAS TENSION AND PH INSTRUMENTATION

Taught by John Hankinson

WEEK 10 - ISOTOPE METHODS IN BIOLOGICAL RESEARCH

1. Basic isotope concepts, types of radiation, radiation's interaction with matter, half-life, specific activity, units of radiation, mass absorption coefficient, decay schemes of isotopes.

2. Instrumentation - Ionization chamber, geiger-muller detector, solid scintillation detector, liquid scintillation detector, efficiency of detectors, collimators, and the importance of geometry.

3. Uses of Isotopes - chemical tracers, double isotope labeling, dilution techniques, isotope scans (thyroid and lung scans used as examples).

Laboratory - Demonstration of gamma ray spectroscopy using a solid scintillation detector, 2048 channel pulse height analyzer, and television display. Students also practice the setting of the discriminator and window using several different isotopes.

WEEK 11 - ISOTOPE METHODS IN BIOLOGICAL RESEARCH

1. Biological effects of radiation - acute effects, relative sensitivity of different cells, relationship with DNA synthesis, relationship with incidence of cancer.

2. Relative hazard of isotopes - effective half-life, energy and types of particles, ease of ingestion, target organs, chemical form, etc.

3. Radioisotope Laboratory Safety Rules - handling of isotopes, spills, film badges, disposal problems, storage problems, shielding necesaary, records required, other safety considerations.

4. Considerations in the Design of a Radiotracer Experiment - availability of isotope, limits of detection, evaluation of the hazard, activity requirements, physical and chemical form, evaluation of instrumentation.

Laboratory - determination of undnown volume by dilution technique, procedures for safe usage of isotopes, effects of geometry, wash-in and wash-out of a single compartment model simulated using glass ware and a solid scintillation detector with two detectors for both wash-in and wash-out monitoring.

WEEK 12 - RESPIRATORY INSTRUMENTATION AND FUNCTION TESTS

1. Definition of various lung volumes, measurement of lung volumes, pneumotachograph, spirometers, helium dilution technique, nitrogen wash-out technique, volume and pressure body plethysmograph.

2. Measurement of: CO diffusion capacity, ventilation and perfusion ratio, anatomical dead space, and closing volumes. prediction formulas and standard error of estimation.

Laboratory - Demonstration of the measurement of closing volumes, CO diffusion capacity, and TLC measurement using a pressure body plethysmograph. Students perform simple spirometry, nitrogen wash-out technique and make necessary calculations to determine TLC and RV.

WEEK 15 - GAS TENSION AND PH INSTRUMENTATION

1. Measurement of pH, P_{CO_2}, and P_{O_2}: pH hydrogen electrode, pH glass electrodes, different reference electrodes, bridge solutions, and amplifier considerations. P_{CO_2} and P_{O_2} electrode principles, Henderson-Hasselbalch equation, sample preparation, temperature effects.

Laboratory - Demonstration of pH, P_{CO_2}, and P_{O_2} measurements using a Corning Blood Gas Analyzer.

Physiological Methods (Physiology & Biophysics 441 and 442), offered in the 1977-1978 academic year

Fall 1977: Monday, Wednesday, and Friday (442)

Weeks 1-2: Physiological parameter monitoring

Weeks 3-6: Principles of Modeling

Weeks 7-10: Electrophysiology

Weeks 11-15: Subcellular physiological methods

Spring 1978: Tuesday and Thursday (441)

Weeks 1-4: Animal surgery

Weeks 5-6: Computer methods

Weeks: 7-12: Physiological instrumentation

Weeks 13-15: Compartment analysis

WEST VIRGINIA UNIVERSITY SCHOOL OF MEDICINE

DEPARTMENT OF PHYSIOLOGY AND BIOPHYSICS

PHYSIOLOGICAL METHODS

Physiology and Biophysics 442 (Fall)
Physiology and Biophysics 441 (Spring)

Scope - Research techniques and strategies for physiology and biophysics are presented in a two semester variable-credit sequential series of eight modules. Topics for Fall semester 1977 (442) are:

Subcellular Physiological Methods (1 credit, 4 weeks)

Principles of Modelling (1 credit, 4 weeks)

Electrophysiology (1 credit, 4 weeks)

Physiological Parameter Monitoring (1 credit, 3 weeks)

Topics for Spring semester (441) are:

Animal Surgery (1 credit, 3 weeks)

Computer Methods (1 credit, 3 weeks)

Physiological Instrumentation (2 credits, 6 weeks)

Compartmental Analysis (1 credit, 3 weeks)

Graduate and upper-division undergraduate students may selectively enroll in any modules which will benefit their particular field of interest.

Prerequisites & Grading - Physiology, Calculus, Statistics, or consent of instructor. Each module will be graded separately and course grade will be the average of all sections taken.

Course outlines attached

PHYSIOLOGICAL METHODS

COURSE OUTLINE (442) Fall, 1977

Lectures & Laboratories: Monday, Wednesday & Friday, 2-4:00 p.m., Rm 3051 BS

IYSIOLOGICAL PARAMETER MONITORING	Aug. 24(W), 26(F), 29(M), 31(W):	Cardiovascular measurements: EKG & derived measures, blood flow, pressure wave forms, heart mechanical events (Caldwell)
1 cr. hr.)	Sept. 2(F):	Temperature measurement and control (Caldwell)
	Sept. 7(W), 9(F):	Measurement of respiratory parameters (Frazer)

	Sept. 12(M), 14(W), 16(F):	Linearity, impulse response, Fourier analysis (Franz)
RINCIPLES OF ODELLING	Sept. 19(M), 21(W), 23(F):	Laplace transforms, transfer functions (Franz)
1 cr. hr.)	Sept. 26(M), 28(W), 30(F):	Stochastic processes (Brown)
	Oct. 3(M), 5(W), 7(F):	Hypothesis test models, modelling from experimental data (Frazer)

	Oct. 10(M), 12(W), 14(F):	Stereotaxis and neurohistology (Gladfelter)
ECTRO- YSIOLOGY	Oct. 17(M), 19(W), 21(F):	Extracellular and intracellular recording methods (Millecchia, Brown)
cr. hr.)	Oct. 24(M), 26(W), 28(F):	Electrical stimulation, iontophoretic injection, voltage clamp (Brown, Franz)
	Oct. 31(M), Nov. 2(W):	Neurophysiological data processing (Brown, Millecchia)

	Nov. 4(F), 7(M):	Cell fractionation, ultracentrifugation (Lee)
	Nov. 9(W), 11(F), 14(M):	Enzyme kinetics (Canady)
CELLULAR IOLOGICAL ETHODS	Nov. 16(W), 18(F), 21(M):	Spectroscopy, chromatography, diffraction (Colby)
cr. hr.)	Nov. 28(M), 30(W), Dec. 2(F):	Perm-selective membranes, measurement of ionic concentrations (Miles
	Dec. 5(M), 7(W), 9(F):	In vitro techniques: fluorescent markers membrane markers, in vitro organelle labelling methods (Miles)

PHYSIOLOGICAL METHODS

COURSE OUTLINE (441) Spring, 1978

Lectures & Laboratories: Tuesday 10-12 Noon & 2-5:00 p.m., and Thursday 9-12 Noon

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NIMAL URGERY 1 cr. hr.)	Jan. 5(Th), 10(Tu), 12(Th), 17(Tu), 19(Th), 24(Tu): Animal handling and medication, anesthesia, surgical techniques: intubation, catheterization, thoracic surgery, sterile techniques, postoperative maintenance (Morgan, Sherwood)

OMPUTER ETHODS	Jan. 26(Th), 31(Tu): Introduction to the PDP-12, SCROLL, RUNOFF (McIntyre)
1 cr. hr.)	Feb. 9(Th), 14(Tu), 16(Th), 21(Tu): Introduction to programming in BASIC (Brown)

	Feb. 23(Th), Mar. 7(Tu), 9(Th): Ohm's Law, Kirchhoff's Rules (Caldwell)
	Mar. 14(Tu), 16(Th): Complex impedances, passive networks, semiconductors (Caldwell)
SIOLOGICAL TRUMENTATION	Mar. 21(Tu): Operational amplifiers and analog signal processing (Brown)
cr. hrs.)	Mar. 23(Th), 28(Tu): Physiological instrumentation: oscilloscope, polygraph, tape recorder, multimeter (Caldwell)
	Mar. 30(Th): Digital electronics (Brown)
	Apr. 4(Tu), Apr. 6(Th): Troubleshooting (Caldwell)

	Apr. 11(Tu), 13(Th): Isotope concepts and instrumentation. Tracers and dilution (Hankinson)
PARTMENTAL LYSIS	Apr. 18(Tu), 20(Th): Compartmental analysis of washout curves (Franz)
cr. hr.)	Apr. 25(Tu), 27(Th): Application of compartmental analysis to membrane transport (Miles)

PHYSIOLOGICAL METHODS 341

Spring 1979 Schedule

1-4 p.m. Thursdays

Experiment			Room	Instructor
I.	Mechanical Properties of Tissues			Klabunde
	January 11	Demonstration and Experiment	BS 3050	
	January 18	Quiz (10% of Grade)	BS 3050	
II.	Mechanical Properties of Lungs and Chest Wall			Frazer
	January 25	Introduction and Demonstration	ALOSH 203	
	February 1	Experiment	ALOSH 203	
	February 8	Data Analysis and Discussion	ALOSH 203	
	February 15	Quiz (30% of Grade)	ALOSH 203	
III.	Vasopressin-induced Water Movement in the Kidney			Irish
	February 22	Introduction	BS 3050	
	March 1	SPRING RECESS		
	March 8	Experiment	BS 3048	
	March 15	Data Analysis and Discussion	BS 3050	
	March 22	Quiz (30% of Grade)	BS 3050	
IV.	Regulation of Endocrine Function			Hedge
	March 29	Introduction and Surgery	BS 3054	
	April 5	Complete Experiment	BS 3054	
	April 12	Hormone Assays	BS 3054	
	April 19	Data Analysis and Discussion	BS 3050	
	April 26	Quiz (30% of Grade)	BS 3050	

APPENDIX 4C

REPRESENTATIVE DESCRIPTIONS OF THE DOCTORAL PROGRAM FOR

THE 1970s (1973), 1980s (1980), and 1990s (1994)

Description of the Doctoral Program

Department of Physiology & Biophysics

1973

DOCTORAL PROGRAM

DEPARTMENT OF PHYSIOLOGY AND BIOPHYSICS
WEST VIRGINIA UNIVERSITY

TABLE OF CONTENTS

Revised 12/7/73

I. Prerequisites for the Program

The following prerequisites are mandatory for the doctoral program in Physiology and Biophysics. However, a student may eliminate a limited number of undergraduate course deficiencies during his first year in the program.

A. Calculus (2 semesters, 3 desired)

B. Physics (2 semesters, with Calculus prerequisite)

C. Modern Biology (2 semesters)

D. Physical Chemistry (1 semester)

II. Graduate Course Requirements

All students in this Department must successfully complete the following core of required courses which are designed to provide a firm foundation for future teaching and research endeavors.

EFFECTIVE DATE - FALL, 1974

GRADUATE CURRICULUM

First Year

FIRST SEMESTER

A. *Required Courses*

Physiol. 344	*Medical Physiology*	*3 hrs*
Physiol. 441	*Physiological Methods*	*4 hrs*
Physiol. 499	*Graduate Colloquium*	*1 hr*
Biochem. 231	*General Biochemistry*	*4 hrs*

B. *Prerequisites*

C. *Electives*

SECOND SEMESTER

A. *Required Courses*

Physiol. 345	*Medical Physiology*	*4 hrs*
Physiol. 346	*Neurophysiology*	*3 hrs*
Physiol. 499	*Graduate Colloquium*	*1 hr*

B. *Electives*

SUMMER

A. *Electives*

B. *Laboratory Experience*

Second Year

FIRST SEMESTER

A. Required Courses

Physiol. 444	Graduate Seminar	2 hrs
Physiol. 491	Advanced Physiology	6 hrs
Physiol. 499	Graduate Colloquium	1 hr

B. Electives

C. Laboratory Experience

SECOND SEMESTER

A. Required Courses

Physiol. 444	Graduate Seminar	2 hrs
Physiol. 491	Advanced Physiology	6 hrs
Physiol. 499	Graduate Colloquium	1 hr

B. Electives

C. Laboratory Experience

SUMMER

A. Electives

B. Laboratory Experience

Final Years

FIRST AND SECOND SEMESTERS

A. Required Courses

Physiol. 497	Research	1-15 hrs
Physiol. 499	Graduate Colloquium	1 hr

B. Electives

SUMMERS

A. Required Courses

Physiol. 497	Research	1-15 hrs

B. Electives

DEPARTMENTAL ELECTIVES

Physiology 248	Experimental Design	3 hrs
Physiology 347	Biophysical Analysis	4 hrs
Physiology 399	Special Topics	1-4 hrs
Physiology 447	Systems Biophysics	4 hrs
Physiology 490	Teaching Practicum	1-3 hrs
Physiology 498	Thesis	2-4 hrs

OTHER ELECTIVES

1. Graduate courses in the life sciences (e.g., Biochemistry, Pharmacology, etc.)
2. Physical and Engineering Sciences.
3. Mathematics (Statistics is essential for most areas)

III. Candidacy Requirements

Admission to the Graduate School and enrollment in graduate courses does not of itself guarantee acceptance of the student as a candidate for a Ph.D. degree. To qualify as a doctoral candidate a student must demonstrate his ability to do work of graduate caliber by satisfactorily passing the departmental qualifying examination.

IV. Graduate Advisor and Graduate Committee

After the first year and before the end of the second year of graduate work the student should select a graduate advisor. The student and his advisor will invite at least four members of the faculty to comprise his graduate committee, with the advisor serving as chairman. The committee shall serve both as the qualifying examination committee and as the doctoral dissertation committee. The composition of the committee may be altered at any time with the consent of the advisor and of the committee member(s) involved, however, when the committee is serving as the doctoral dissertation committee it shall be comprised of no fewer than five members, the majority of which must be members of the Graduate Faculty, with at least one member of a department other than Physiology and Biophysics.

V. Prerequisites for the Qualifying Examination

The following prerequisites are required for advancement to the qualifying examination.

A. Satisfactory completion of the first two years of course requirements, with attainment of an average grade of "B" or better in Advanced Physiology.

B. Faculty approval.

VI. Qualifying Examination

The qualifying examination should be taken at the end of the first two years of didactic course work, but must be taken before the end of the third year. It is an opportunity to demonstrate a grasp of the important concepts and problems of the field of physiology and biophysics and the ability to employ rationally the instruments of research that have been developed in the field. This is accomplished by writing three research design papers followed by an oral examination according to the following rules and guidelines.

A. Aspects of the qualifying examination pertaining to the student.

1. On the first day of the examination the student will be presented with a choice of at least five research questions covering at least four different areas of Physiology and Biophysics.
2. The student will be given the following charge concerning the questions.
   a. "Select three questions and write a research design paper for each topic chosen. You will have a total of three weeks for the written part of the examination. You may use all books, journals and other library materials available. If you are in doubt about the exact nature of a question, ask your advisor for clarification."
   b. "General content and form of your papers": (1) Review the major pieces of experimental evidence and discuss them critically. (2) Formulate the main hypothesis presently offered for the particular problem. State your own hypothesis if you consider the published opinion inadequate or if no unifying hypothesis exists. (3) Design a 'crucial' experiment or set of experiments with the purpose of

resolving the issues in question. (Research proposal).

(4) The papers should be prefaced by an outline indicating a clear and logical development of your literature review (not exhaustive, but limited to the key publications), formulation of the main hypotheses, and research design. Groups of paragraphs should be headed by appropriate titles, thus organizing the paper into coherent parts and indicating the nature of the point discussed. The complete answer should be internally consistent.

c. "The committee will evaluate your performance in terms of demonstrated knowledge of the field, understanding of the issues in question, and quality of the research design."

3. At the end of the three week time allotment, the student must duplicate and distribute the three papers to all members of his examining committee. At this time he should also schedule the oral examination within the following two weeks, barring any conflicting commitments of the members of the committee.

4. During the oral examination, the committee will question the student on the major arguments and details of the papers and in other areas of Physiology and Biophysics. At the completion of the oral examination, the student will be advised as to whether he has passed or failed the qualifying examination, the decision being based on all three written answers and the performance during the oral examination.

B. Aspects of the qualifying examination pertaining to the faculty.

1. It is the responsibility of the advisor to see that the student is presented with a sufficient number of suitable questions for the written portion of the examination. The primary source of these questions should be the student's examining committee.

All questions should first be submitted to the advisor who will screen them for clarity, quality, appropriateness, and diversity. In general, the exam questions should not refer to research expected to be performed for the doctoral dissertation.

2. The advisor is responsible for seeing that all rules and guidelines concerning time limits, general procedures, etc. are followed.
3. The advisor should preside at the oral examination, directing the order of questioning and limiting the discussion to that information pertinent to ascertaining the qualification of the student. He should have the student's academic record present at the time. The scheduling and results of the examination must be reported to the Graduate School by the advisor.

VII. Graduate Research

After achieving candidacy for the Ph.D. by passing the qualifying examination, the student shall pursue an individual research endeavor of his choice under the supervision and guidance of his advisor in preparation for the doctoral dissertation and final oral examination. His investigation should demonstrate a mastery of research techniques and represent a definite contribution to knowledge.

VIII. Doctoral Dissertation and Final Oral Examination

The following guidelines have been established as the minimum requirements of this Department for satisfactory completion of the doctoral dissertation and final oral examination. These guidelines in no way indicate that every student will complete his requirements during these time limits. In fact most students will require more time. Therefore it

is strongly recommended that the student expand the timetable considerably to allow time for major revisions.

A. Doctoral dissertation

1. After a doctoral candidate has prepared a concise dissertation outline and completed his preliminary experiments, he must meet with his graduate committee to evaluate the scientific merit of the proposed research. The format of the meeting should be a brief public seminar presented by the candidate followed by a closed discussion between the candidate, committee members and any interested faculty members. At this time the student is expected to defend the goals, experimental design, procedures and possible conclusions of the proposed research. This meeting should be scheduled a minimum of six months prior to the anticipated time of graduation.
2. A dissertation draft which is acceptable to both the student and his advisor should be duplicated and distributed to all members of the doctoral committee at least 11 weeks prior to the anticipated date of graduation. The committee members have three weeks in which to evaluate the manuscript.
3. Conflicts concerning the scientific content of the dissertation draft should be resolved by a meeting of the student, the advisor, and the committee member(s). All committee members should be appraised of any significant proposed changes. Editorial decisions concerning the language, form, data presentation, etc. of the dissertation should be primarily the responsibility of the advisor. Committee approval of the dissertation should be obtained a minimum of 8 weeks before

the expected time of graduation. In order for the dissertation to be approved there shall be no more than one unfavorable vote among members of the committee.

B. Final Oral Examination

1. Following committee approval of the manuscript, the final oral examination should be scheduled. The student should contact all committee members to establish a convenient date for the examination. The student's advisor must notify the Office of the Graduate School at least three weeks in advance of the examination date. The first part of the oral examination is an open presentation and defense of the dissertation and requires public notification to the University community. The second part of the examination is a closed discussion between the candidate and his committee.

2. To successfully defend his dissertation during the oral examination, the student must receive no more than one unfavorable vote among members of the committee.

3. After passing his oral examination, the student who has followed this timetable will have at least 3 weeks to prepare, type and duplicate the final copies of the manuscript. Two accepted copies in approved type-written form must be delivered to the Office of the Graduate School at least 1 week before the close of the session in which the degree is expected to be conferred.

IX. Graduate School Regulations and Guidelines

The following regulations and guidelines have been established by the Graduate School for all doctoral candidates submitting dissertations to West Virginia University.

A. All requirements for the Doctor of Philosophy must be completed within a period of 7 years starting at the initial enrollment into the graduate program.

B. A graduate grade-point average of at least 2.75 will be required for graduation from WVU with a graduate degree.

C. During the semester the student anticipates to graduate, he should check at the Office of the Graduate School to see that his records show no deficiencies such as those regarding admission to the Graduate School and doctoral program, establishment of candidacy through qualifying or comprehensive examinations, meeting of residence requirements and the regulation for completion of the program within 7 years, removal of all incomplete grades, etc. The last date for removal of "I" grades (incompletes) is not later than one week prior to the close of the summer session, one week prior to the last day of the final examination period at the end of the first semester, or one week prior to Commencement Day at the end of the second semester.

D. At the time of registration for the semester in which all degree requirements are expected to be met, or at the latest within 2 weeks after such registration, each candidate must submit a formal request on a special "Application for Graduation and Diploma" form to the Dean of the Graduate School for the conferring of the degree. This form is available from the Registrar's Office of the Graduate School. The candidate must complete all requirements at least

one week before the end of that semester. If the degree is not actually earned during that semester the student must submit a new application at the beginning of the term in which he does expect to meet all requirements.

E. A $10 graduation fee must be paid at Admissions and Records, Medical Center at the beginning of the semester in which the candidate expects to receive his degree.

F. Each graduate student must be registered during the semester or session in which he takes the final examination.

G. The last day for the student's advisor to submit a request to the Office of the Graduate School for the final examination is four weeks prior to the end of the final examination period at the end of the first semester, or four weeks prior to Commencement Day at the end of the second semester. This request must be filed at least three weeks prior to the date of the examination. No final examination is to be given to a student until his clearance is signified by the Office of the Graduate School in the form of receipt of the student's "Shuttle Sheet" from that office by the student's advisor.

H. Results of the final examination, acceptance of the dissertation, and certification of its suitability for immediate microfilming must be reported by the student's graduate advisor or committee chairman to the Office of the Graduate School within 24 hours of the scheduled time of the examination. This shall be no later than one week before the end of the semester or summer session in which the degree is expected to be granted.

I. At least one week prior to the end of the semester in which the degree is expected to be conferred (August, December, or May), the candidate whose committee has approved his dissertation must submit to the Graduate School Office the typewritten unbound original and first carbon copy (or two acceptable copies reproduced by multilith or electrostatic copying methods such as Xerox).

1. Mandatory requirements for acceptability of the dissertation.

a. Paper. The original and the first copy must be typed or reproduced on 100% rag content, 16# or heavier non-erasable white Bond paper. The various trade-named "erasable" bonds are not acceptable.

b. Reproduction. The dissertation may be typewritten or reproduced by multilith or electrostatic copying methods such as Xerox, as long as the result is a stable, clear, clean, high contrast print, uniform throughout the paper and acceptable to the Office of the Graduate School. Mimeograph or reproduction of this type is not acceptable. The WVU Office of Publications provides service to graduate students in the preparation of multiple copies of doctoral dissertations. Students must furnish a neatly typewritten manuscript of the text with all pages numbered and collated in conformity with the regulations of the Graduate School. Normal lead time for completion of the work is three weeks and work which must be completed in less than three weeks will not be accepted. One of the most persistent reasons why dissertations presented for deposit with the Office of the Graduate School are not accepted is that there is a

poor copy produced by the method of reproduction used. When a student is in doubt about the acceptability of copy, he should bring a page or two to the Graduate School for inspection before the whole production is run. Uniformity of copy throughout the manuscript is very important. There are other causes of rejection that should be cautioned against. Paper must be uniform throughout with the obvious exception of photographs. Photographs should be firmly affixed to the page with Kodak (or equivalent) Dry Mounting Tissue. Graphs and tables must normally be on the same paper as the text. Print-outs on computer paper must not be used. The same type and make of type must of course be used throughout the dissertation.

c. Spacing and Margins. All straight text must be double spaced. Quotations, footnotes, etc., may be single spaced. The placement of the footnotes at the bottom of the page or at the end of the dissertation is optional but must be consistent throughout the manuscript in a form generally acceptable in publications. All pages should have the following minimum margins:

Left ..... 1½ inches

Right, Top and Bottom ..... 1¼ inches

d. Pagination. Each and every page in a dissertation or thesis except the blank page following the title page must be assigned a number with no blanks or duplications in the numbering system. The preliminaries (title page, table of contents, etc.) must be numbered with small Roman numerals

(i,ii, iii, iv, etc either centered at the bottom of the page or in the upper right-hand corner as in the rest). The remainder of the text should be numbered consecutively in Arabic in the upper right-hand corner of the page, spaced $^3/_4$ of an inch from the top and side.

e. Illustrations. Oversized maps or charts should be folded and provided with a binding tab before presenting to binder, in such a way as to give ¼ inch minimum clearance on front (right-hand edge) of book. Maps or charts to be inserted in pocket inside back cover are to be folded to a size not larger than 6½ x 10½ inches.

2. Organization of Dissertation.

The suggestions concerning the organization of the dissertation that follow may be taken as a norm from which deviations may be under the guidance of the student's advisor or committee.

A dissertation should be divided into the following parts:

a. Title Page - This should have the format of the example given on the next page of this handout.

b. Acknowledgments

c. Table of Contents

d. Lists of Tables and Illustrations

e. Introduction (Significance of the problem)

f. Literature review

g. Statement of the problem (if not done in the introduction)

h. Methods

i. Results

j. Discussion

k. Conclusions

l. References

m. Appendix

n. Abstract - The purpose of the abstract is to give a concise presentation of the dissertation so that the reader will be able to determine whether it is advisable for him to read the complete dissertation. Although the maximum length of the abstract is 600 words, all but a very few should be shorter. The following parts are found in an abstract, although not indentified with subheadings: (1) Statement of Problem, (2) Procedure and Methods, (3) Results, and (4) Conclusions. Note: Dissertations also require one additional separate copy of the abstract especially prepared on an unnumbered sheet. See page 16.

o. Vita

p. Approval Page - The names of the students' committee must be typed below their signatures with the Chairman identified. Both copies must have original signatures (not reproductions).

Example of Title Page

ISOMETRIC TENSION DEVELOPMENT

IN THE HYPERTROPHIED HEART

DISSERTATION

Submitted to the Graduate School
of
West Virginia University
In Partial Fulfillment of the Requirements for
The Degree of Doctor of Philosophy

by

Barbara Baugh Krames

Morgantown
West Virginia
1964

J. Submit to the Office of the Graduate School one separate copy of the abstract consisting of no more than 600 words. This copy must be in addition to that in the unbound dissertations. The full title of the dissertation must be centered at the top of the first page, followed on the next line by the full name of the candidate, and on the next line by the word "ABSTRACT". It must not have any page number on it. The abstract will appear in "Dissertation Abstracts", published by University Microfilms, Ann Arbor, Michigan.

K. At the time of delivery of the two copies of the dissertation, an "Agreement Form" with University Microfilms, Inc. must be filled out and signed.

L. The title and author's name in full must be exactly the same on the title page of the dissertation, the separate abstract, and the "Agreement Form".

M. The student must pay a fee of $30.00 at the Office of the Graduate School to cover the cost of microfilming the dissertation and publication of the abstract in "Dissertation Abstracts" a bi-monthly journal which receives wide distribution. Checks must be made out to "Dissertation Service". No other form of publication will be required, but publication elsewhere is permitted and encouraged. The original of the candidate's dissertation will be submitted on loan to University Microfilms for complete microfilming, the resulting copy or copies to be available for purchase by all who request them. Available at the Office of the Graduate School is a helpful leaflet "Suggestions for the Preparation of Doctoral Dissertations for Microfilming". The original copy will be returned by University Microfilms to the Library, where it will be bound. The first unbound

carbon copy will be sent by the Graduate School to the student's department. The preparation and binding of the first carbon and any other copies for personal use, departmental use, or other purposes are the responsibility of the student.

N. Copyrights may be secured by the author through the University Microfilms, Inc. or through independent means. The student should inform himself of his legal rights under the copyright laws. Information pertaining to copyrights can be found in the Graduate School publication "A Review of Copyright Matters Related to Graduate Theses and Dissertations" available in the Department of Physiology and Biophysics Office. If copyright service is desired this must be indicated on the contract form. It can be provided through the Office of the Graduate School upon receipt of a certified check for $10.00 made payable to "University Microfilms". If the dissertation is to be copyrighted an additional page must be inserted immediately following the title page in each copy of the dissertation with the typed inscription centered below the middle as follows:

Copyright by John Arthur Brown 1971	(Full legal name of author as on dissertation and contract form.) (Date of publication on film. On December submittals use next year.)

O. The student must report the full title of his dissertation to the Office of the Graduate School at least three weeks before Commencement unless dissertation copies were deposited previous to that date.

P. The student must complete the form provided at the Office of the Graduate School which incorporates his pre-doctoral program and post-doctoral plans into the "Survey of Earned Doctorates Awarded in the United States".

Q. Also he must complete the form provided at the Office of the Graduate School which provides similar information as in O above for the NEA Biennial study of the occupations which attract doctor's degree graduates.

R. Attendance at the spring Commencement is voluntary. If the student does not plan to attend, he must leave the complete mailing address to where he wants his diploma mailed at the Dean's Office of the Graduate School.

S. Checklist. One week prior to the end of the semester in which the degree is expected the Office of the Graduate School must have received:

1. Report of Final Examination.
2. Approved original unbound copy of dissertation, first carbon.
3. Contract of Agreement form for dissertation microfilming services; and copyright if desired.
4. Payment for the above.
5. Completed form "Survey of Eaned Doctorates".
6. Completed form for NEA Biennial study.
7. Participation in Commencement or leave mailing address at Dean's Office of the Graduate School.

T. For further information see Graduate and Professional Catalog.

Summary of Deletions From Old Doctoral Program Guidelines in Revised Copy

p.1 II Graduate Course Requirements

Deleted "All formal course requirements and the qualifying examination must be completed within a maximum of three years."

p.2 III Candidacy Requirements

Deleted ". . . . and meeting the Ph.D. foreign language requirements."

p.2 IV Prerequisites for the Qualifying Examination

Deleted B. "Satisfactory completion of the foreign language requirements as indicated in the Graduate Catalog."

p.7 VIII Graduate School Regulations and Guidelines

Deleted "This must include a minimum of 2 semesters of residence in full-time graduate study at WVU."

p.8 VIII Graduate School Regulations and Guidelines

F. Each graduate student must be registered during the semester or session in which he takes the final examination. Deleted "This requirement may be met by registering specifically for the examination at the Registrar's office and then paying a $1 fee at the Comptroller's office prior to the final examination."

p.16 VIII Graduate School Regulations and Guidelines

Deleted "All doctoral candidates are required to participate in the exercises of Commencement Day unless they request in writing to be excused with the reasons therefore and their request is approved by the Dean of the Graduate School. Notification as to participation should be given to the Office of the Graduate School at the time the student deposits copies of his dissertation."

Description of the Doctoral Program

Department of Physiology & Biophysics

1980

DOCTORAL PROGRAM

DEPARTMENT OF PHYSIOLOGY AND BIOPHYSICS

I. Criteria for Admission

A. Grade Point Average

The minimal GPA for admission required by the Graduate School is 2.5. Generally, 3.0 is required for full, unqualified admission to our program. Students with less than 2.5 will generally not be considered. Students may be admitted with GPA's between 2.5 and 3.0 but only on departmental probation. This probation must be removed at the end of the first semester by the student achieving a GPA of 3.0 taking courses specified by the advisory committee and a minimal grade of "B" in Physiology 344. This departmental probation, and the mechanism for removing it, will be clearly stated in the letter of acceptance to the student.

B. Graduate Record Examination

The verbal, quantitative, analytical, and one advanced GRE scores will be required of all applicants.

C. Letters of Reference

Letters of reference will be requested from three individuals of the applicant's choice. These individuals may either complete the departmental reference forms or write letters of reference if they choose. It will be made clear to these referees that these are to be academic or professional references. We will acknowledge receipt of each letter by sending a postcard to the referee.

D. Personal Interview

This is not required but it is highly desirable.

E. Prerequisites for the Program

Calculus (2 semesters, 3 desirable)

Physics (2 semesters, Calculus - based desirable)

Biology (2 semesters)

Organic Chemistry (1 semester) (Physical Chemistry, desirable)

II. Graduate Course Requirements

A. The Curriculum

All students in the Department must successfully complete the following core of required courses which are designed to provide a firm foundation for future teaching and research endeavors. A student's first summer session is devoted to gaining research experience in laboratories and/or making up deficiencies in prerequisite course work. Teaching each year is a normal requirement of all students in the Ph.D. program.

GRADUATE CURRICULUM

First Year*

First Semester

A. Required Courses

Physiol. 344--Medical Physiology

Physiol. 342--Physiological Methods (part 1)

Physiol. 499--Graduate Colloquium

Biochem. 231--General Biochemistry

Stat. 311--Statistical Methods

B. Prerequisites

C. Electives

Second Semester

A. Required Courses

Physiol. 345--Medical Physiology

Physiol. 341--Physiological Methods (part 2)

Physiol. 346--Neurophysiology

Physiol. 499--Graduate Colloquium

Physiol. 444--Graduate Seminar

Physiol. 399--Special Topics

B. Electives

* Graduate students will be required to write five abstracts and one full paper

during the first year of our graduate program. Material for the abstracts and the paper will come from data obtained during the laboratory exercises in the Physiological Methods course. For this purpose, students will register for Physiology 399 (Special Topics) for one credit hour with the coordinator of the Methods course. The written exercises will be graded by the faculty of the Methods course on an "S-U" basis.

Summer

A. Electives

B. Laboratory Experience

Second Year

First Semester

A. Required Courses

Physiol. 444--Graduate seminar

Physiol. 491--Advanced Physiology

Physiol. 499--Graduate Colloquium

B. Electives

C. Laboratory Experience

Second Semester

A. Required Courses

Physiol. 444--Graduate Seminar

Physiol. 491--Advanced Physiology

Physiol. 499--Graduate Colloquium

B. Electives

C. Laboratory Experience

Summer

A. Electives

B. Laboratory Experience

QUALIFYING EXAMINATION

Final Years*

First and Second Semesters

A. Required Courses

Physiol. 497--Research

Physiol. 499--Graduate Colloquium

B. Electives

Summer

A. Required Courses

Physiol. 497--Research

**one colloquium or seminar presentation per year is required after the second year.*

Departmental Electives

Conjoined Course 375--Neurobiology

Physiology 248--Experimental Design

Physiology 347--Biophysical Analysis

Physiology 399--Special Topics

Physiology 447--Systems Biophysics

Physiology 490--Teaching Practicum

Physiology 498--Thesis

Other Electives

1. Graduate courses in the life sciences (e.g., Biochemistry, Pharmacology, etc.)
2. Physical and Engineering Sciences
3. Mathematics

B. Modifications of Curriculum

1. Advanced Standing

Students must petition the Graduate Studies Committee (GSC) to waive any required course or to deviate from the normal sequence of courses.

2. Effects of Curriculum Changes

Whenever a student's curriculum is modified, (e.g., by course addition, drop, withdrawal, or waiver) the GSC must re-specify the course curriculum (e.g., repetition of the course), re-evaluate seniority, and consider any effects such a change may have on the student's standing in the department. All these factors will be discussed with the student. The student will be notified of all these factors in writing, and a copy will be sent to the Graduate School. All decisions regarding changes in a student's curriculum or status in the department will be reported in writing to the student and the Graduate School, included in the student's file, and reported to the graduate faculty at its next meeting.

III. Grade Requirements

In order to remain in good standing, the Department of Physiology and Biophysics requires the following:

1) An overall grade-point average (GPA) of at least 3.0

2) A GPA of at least 3.0 in required Physiology courses.

Before admission to candidacy, grades in Research and Special Topics are excluded from GPA calculations. If the GPA requirements outlined above are not met, the student will be placed on departmental probation. The probation can be resolved if the student can again meet these requirements within one semester (excluding summer sessions). The courses to be taken during the probationary semester will be designated by the student's advisory committee. If probation is not resolved within one semester, the student will be dismissed from the program.

The following are also grade requirements for the Ph.D. Program and failure to meet them will result in immediate dismissal from the program.

1) No more than one "C" will be allowed in the following courses:

medical physiology 344, medical physiology 345, neurophysiology 346, neurobiology 375, and advanced physiology 491.

2) No more than a total of two "C's" will be allowed in the courses listed above in 1., and in biochemistry 231, statistics 311, and any additional courses required by the student's committee and included in this category by the committee.

3) No grade less than "C" will be allowed in any of the courses listed above in 1. and 2.

The graduate faculty reserves the right to retain a student in the program if special circumstances exist. In this case, the graduate faculty will review the student's record and render its decision by majority vote.

IV. Candidacy Requirements

Admission to the Graduate School and enrollment in graduate courses does not of itself guarantee acceptance of the student as a candidate for a Ph.D. degree. To qualify as a doctoral candidate a student must demonstrate the ability to do work of graduate caliber by satisfactorily passing the departmental qualifying examination.

V. Prerequisites for the Qualifying Examination

The following are prerequisites for advancement to the qualifying examination.

1. The student must be in good standing as defined in the Ph.D. Program and have satisfactorily completed the first two years of course requirements (including those specified by the student's advisory committee) with at least six credit hours (or equivalent) of laboratory research experience.
2. The student must have an average grade of "B" or better in Advanced Physiology.
3. The student must have a dissertation advisor.
4. Two-thirds of the graduate faculty must approve each student for candidacy. In case such approval is not given, the graduate faculty will recommend a course of action.

VI. Qualifying Examination

The qualifying examination consists of two parts, a comprehensive part and a research design part.

A. Comprehensive Part

1. Scheduling of examination

In general, all students will take this examination following the completion of the first two years of the Ph.D. Program. The examination will be scheduled for all eligible students during the first two weeks of June.

2. Type of examination

The comprehensive part is a written examination.

3. Content of the examination

The student must answer questions from each of the following major areas of physiology: cell, nervous system, endocrine, organ system I (cardiovascular physiology), organ system II (renal physiology), and organ system III physiology (pulmonary physiology). Physiology of muscle, the GI tract, body fluids, and acid-base balance will be included in the organ system blocks where appropriate. There will be a choice of questions within each of the major areas.

4. Participating faculty

All graduate faculty in the Department will participate in the planning of this examination. The faculty will participate as groups, based on the major areas of physiology. Each group will provide questions written by some or all members of the group, at their discretion.

5. Duration of examination

The examination will be given on a Monday, Wednesday and Friday of one week. The examination will begin at 8:00 a.m. each day and

and terminate at 12:00 p.m. However, the student will have the option of writing answers until 3:00 p.m. each day. (Two of the major areas of physiology will be examined on each day.)

6. Grading of examination

Each question will be graded by the author of that question. One week will be allowed for grading. Each question will be given a numerical score (0 - 100%). In order to pass the examination, the student must obtain a score of 70% or above in each of the six major areas of physiology.

7. Course of action for students who fail

a. If the overall examination average is less than 70%, the entire examination must be repeated.

b. If the overall examination average is greater than 70% but the score(s) in one or two areas is (are) below 70%, only the question(s) in that (those) area(s) must be repeated.

c. If the overall examination average is greater than 70% but the scores in three or more areas are below 70%, the entire examination must be repeated.

If a portion of the examination or the entire examination must be retaken, the student must do this within a period of one month after failure of the original examination. The examination or a portion of the examination may be retaken only once. The criteria of VI. A. 6 will apply to this examination.

B. Research Design Part

1. Scheduling of examination

In general, students will be individually scheduled to take the research design examination within a period of six months after passing the comprehensive part of the examination.

2. Type of examination

The research design portion of the examination will consist of both a written and an oral part.

3. Content of the examination

The student will be presented with two research design questions. The student will answer only one of these questions. The questions may not be based on the student's dissertation project. The student's answer to the question should contain the following sections: background, rationale, objectives, methods, anticipated results, discussion, and references.

4. Participating faculty

The student's dissertation committee will administer this examination.

5. Duration of examination

The student will have a period of two weeks to complete a written answer to the question. The oral portion of the examination will be given approximately two weeks after the written part of the examination has been completed. In general, the oral examination will last from one to four hours.

6. Grading of examination

Both the written and oral parts of the examination will be graded on a pass-fail basis by the dissertation committee.

7. Course of action for students who fail

If the research design part of the qualifying examination is failed, the student may retake the entire research design portion of the examination, but only once.

VII. Graduate Advisor and Dissertation Advisory Committee

During the first full year of this program a student is not committed to any particular area of specialization or a research advisor. During this time, the student is expected to become familiar with the research activities in the various faculty laboratories. However, there will be no formal assignment to any such laboratory, nor will financial support be extended from any given laboratory during this time. Based on impressions of the research in these laboratories, and on personal interests, the student will choose a research advisor early in the second year in the program. The advisor must be a member of the graduate faculty and of the Department of Physiology and Biophysics. After obtaining the chosen advisor's agreement, the student will write to the department chairman (with a copy going to the advisor) requesting that this assignment be made. This letter should contain a brief description of the proposed dissertation research project. The agreement between student and advisor will become official upon written approval by the department chairman in consultation with the Graduate Studies Committee. Normally there will not be more than two Ph.D. students per faculty advisor at any given time. Next, the student and advisor will invite at least four members of the graduate faculty to comprise the student's advisory committee, with the advisor serving as chairperson. At least three of the committee members must be members of the Department of Physiology and Biophysics. These assignments also require a written request from the student for approval by the department chairman in consultation with the Graduate Studies Committee. Copies of all such correspondence will be sent to the Graduate School. Until the advisory committee is established, the GSC will act as the student's advisor. The composition of the committee may be altered at any time with the consent of the student, the advisor, the department chairman, and the majority of the original committee members involved.

The student must meet at least twice with the dissertation advisory committee before preparing the written dissertation. The objectives of the first meeting, to be held shortly after completion of the qualifying examination, will be to evaluate the scientific merit of the research proposal. At this time the student will be expected to defend the goals, experimental design, procedures, and possible significance of the proposed research. Another meeting should be scheduled near the time of completion of the research but before the dissertation is written. At this meeting the student will be expected to defend the data which have been collected and obtain approval to begin writing the dissertation. Additional meetings may be scheduled at any time at the request of the student or the advisor.

VIII. Graduate Research

After achieving candidacy for the Ph.D. by passing the qualifying examination, the student shall pursue an individual research endeavor of the student's choice under the supervision and guidance of the advisor in preparation for the doctoral dissertation and final oral examination. The investigation should demonstrate a mastery of research techniques and represent a definite contribution to knowledge.

IX. Doctoral Dissertation and Final Oral Examination

The following guidelines have been established as the minimum requirements of this Department for satisfactory completion of the doctoral dissertation and final oral examination. These guidelines in no way indicate that every student will complete all requirements during these time limits. In fact most students will require more time. Therefore it is strongly recommended that the student expand the timetable considerably to allow time for major revisions.

A. Doctoral Dissertation

1. After obtaining approval to write the dissertation, a dissertation draft which is acceptable to both the student and the advisor should be duplicated and distributed to all members of the doctoral committee at least 11 weeks before the anticipated date of graduation. The committee members must have at least three weeks in which to evaluate the manuscript.

2. Conflicts concerning the scientific content of the dissertation draft should be resolved by a meeting of the student, the advisor, and the committee member(s). All committee members should be appraised of any significant proposed changes. Editorial decisions concerning the language, form, data presentation, etc. of the dissertation should be primarily the responsibility of the advisor. Committee approval of the dissertation for defense should be obtained a minimum of 8 weeks before the expected time of graduation. In order for the dissertation to be approved for defense, there shall be no more than one unfavorable vote among members of the committee.

B. Final Oral Examination

1. Following committee approval of the manuscript, the final oral examination should be scheduled. The student should contact all committee members to establish a convenient date for the examination. The student's advisor must notify the Office of the Graduate School at least three weeks in advance of the examination date. The first part of the oral examination is an open presentation and defense of the dissertation and requires public notification to the University community. The second part of the examination is a closed discussion between the candidate and the committee.

2. Questions asked during the final exam should be confined to the dissertation and general knowledge of the field. The exam should be chaired by the advisor who will rule on the relevance of questions.
3. To successfully defend the dissertation during the oral examination, the student must receive no more than one unfavorable vote among members of the committee.
4. After passing the oral examination, the student who has followed this timetable will have at least 3 weeks to prepare, type and duplicate the final copies of the manuscript. Two accepted copies in approved typewritten form must be delivered to the Office of the Graduate School at least 1 week before the close of the session in which the degree is expected to be conferred.

X. Support Priorities

A. Departmental stipends will generally be awarded to students according to the following order of priority:

1. continuing Ph.D. students with a GPA $\geq$ 3.0
2. entering Ph.D. students who are not on probation
3. continuing Ph.D. students with a GPA between 2.75 and 3.0
4. continuing M.S. students with a GPA $\geq$ 3.0

Entering M.S. students and entering Ph.D. students on probation usually will not be supported.

Departmental stipends will be awarded to Ph.D. students for a period of 12 months or until the end of the current academic year. However, if the student's GPA falls below 2.75 during the first semester of this 12 month period, the support will be withdrawn at the end of that semester. When M.S. students are given stipends, the support will be awarded for one semester at a time.

Priority for Departmental stipends will also be based on seniority (more senior students will have higher priority). After the first year, students should be supported with money other than departmental stipends whenever possible.

B. The number of new admissions will be partly determined by the number of departmental stipends expected to be available at matriculation, and partly by resources available for training.

C. In general, no more than one or two unsupported Ph.D. students will be admitted per year. Such students must understand that they are responsible for their own financial support during their first year; they would not be allowed to draw financial support from any departmental laboratory during this year. After this first year, such support is permitted on approval by the Graduate Studies Committee. Approval would depend on such factors as academic standing, lack of alternative support, and the understanding that the student is not obligated to stay in that laboratory, as well as any other relevant factors.

D. In general, no more than one student in a given research laboratory may be supported on Departmental stipends.

E. The GSC will choose students to be submitted for competitive external support requiring faculty nomination. Students awarded competitive external support will not be eligible for concurrent departmental stipends.

XI. Appeal Procedure

Students may appeal GSC decisions first to the GSC, then to the departmental graduate faculty. Both groups will render their decisions by majority faculty vote. If this decision is not satisfactory to the student, he may further appeal may be made to the Graduate School, President's Office, and Board of Regents.

XII. Vacation and Leave Policy

Participation in this program is considered to be a full-time (12 month) endeavor. The department, however, recognizes the need for periods of relaxation from study and work and thus applies the same guidelines for vacations for graduate students on stipends as those applicable to the faculty. University policy for faculty permits 22 working days of cumulative paid vacation per year in addition to University staff holidays. Authorized vacations and leaves are to be approved by the advisor before departure. Any substantial deviation from this policy must have the prior approval of the research advisor and the Graduate Studies Committee.

XIII. Graduate School Regulations and Guidelines

The following regulations and guidelines have been established by the Graduate School for all doctoral candidates submitting dissertations to West Virginia University.

A. All requirements for the Doctor of Philosophy must be completed within a period of 7 years starting at the initial enrollment into the graduate program.

B. A graduate grade-point average of at least 2.75 will be required for graduation from WVU with a graduate degree.

C. During the semester that graduation is anticipated, the student should check at the Office of the Graduate School to see that the his records show no deficiencies such as those regarding admission to the Graduate School and doctoral program, establishment of candidacy through qualifying or comprehensive examinations, meeting of residence requirements and the regulation for completion of the program within 7 years, removal of all incomplete grades, etc. The last date for removal of "I" grades (incompletes) is

not later than one week prior to the close of the summer session, one week prior to the last day of the final examination period at the end of the first semester, or one week prior to Commencement Day at the end of the second semester.

D. At the time of registration for the semester in which all degree requirements are expected to be met, or at the latest within 2 weeks after such registration, each candidate must submit a formal request on a special "Application for Graduation and Diploma" form to the Dean of the Graduate School for the conferring of the degree. This form is available from the Office of the Graduate School. The candidate must complete all requirements at least one week before the end of that semester. If the degree is not actually earned during that semester the student must submit a new application at the beginning of the term in which he does expect to meet all requirements will be met.

E. A $10 graduation fee must be paid at Admissions and Records, Medical Center at the beginning of the semester in which the candidate expects to receive the degree.

F. Each graduate student must be registered during the semester or session in which the final examination is to be taken.

G. The last day for the student's advisor to submit a request to the Office of the Graduate School for the final examination is four weeks prior to the end of the final examination period at the end of the first semester, or four weeks prior to Commencement Day at the end of the second semester. This request must be filed at least 3 wks before the date of the oral examination defense. No

final examination is to be given to a student until clearance is signified by the Office of the Graduate School in the form of receipt of the student's "Shuttle Sheet" from that office by the student's advisor.

H. Results of the final examination, acceptance of the dissertation, and certification of its suitability for immediate microfilming must be reported by the student's graduate advisor or committee chairman to the Office of the Graduate School within 24 hours of the scheduled time of the examination. This shall be no later than one week before the end of the semester or summer session in which the degree is expected to be granted.

I. At least one week prior to the end of the semester in which the degree is expected to be conferred (August, December, or May), the candidate whose committee has approved the dissertation must submit to the Graduate School Office the typewritten unbound original and first carbon copy (or two acceptable copies reproduced by multilith or electrostatic copying methods such as Xerox).

1. Mandatory requirements for acceptability of the dissertation.

   a. Paper. The original and the first copy must be typed or reproduced on 16 to 20 pound white bond paper. The various tradenamed "erasable" bonds are not acceptable.

   b. Reproduction. The dissertation may be typewritten or reproduced by multilith or electrostatic copying methods such as Xerox, as long as the result is a stable, clear, clean, high contrast print, uniform throughout the paper and acceptable to the Office of the Graduate School. Mimeograph or reproduction of this type is not acceptable. The WVU

Office of Publications provides service to graduate students in the preparation of multiple copies of doctoral dissertations. Students must furnish a neatly typewritten manuscript of the text with all pages numbered and collated in conformity with the regulations of the Graduate School. Normal lead time for completion of the work is three weeks and work which must be completed in less than three weeks will not be accepted. One of the most persistent reasons why dissertations presented for deposit with the Office of the Graduate School are not accepted is that there is a poor copy produced by the method of reproduction used. When there is doubt about the acceptability of copy, the student should bring a page or two to the Graduate School for inspection before the whole production is run. Uniformity of copy throughout the manuscript is very important. There are other causes of rejection that should be cautioned against. Paper must be uniform throughout with the obvious exception of photographs. Photographs should be firmly affixed to the page with Kodak (or equivalent) Dry Mounting Tissue. Graphs and tables must normally be on the same paper as the text. Print-outs on computer paper must not be used. The same type and make of type must of course be used throughout the dissertation.

c. Spacing and Margins. All straight text must be double spaced. Quotations, footnotes, etc., may be single spaced. The placement of the footnotes at the bottom of the page or at the end of the dissertation is optional but must be consistent throughout the manuscript in a form generally

acceptable in publications. All pages should have the following minimum margins:

Left ..... 1½ inches

Right, Top and Bottom ..... 1¼ inches

d. Pagination. Each and every page in a dissertation or thesis except the blank page following the title page must be assigned a number with no blanks or duplications in the numbering system. The preliminaries (title page, table of contents, etc.) must be numbered with small Roman numerals (i, ii, iii, iv, etc. in the upper right-hand corner as in the rest). The remainder of the text should be numbered consecutively in Arabic in the upper right-hand corner of the page, spaced 3/4 inch from the top and side.

e. Illustrations. Oversized maps or charts should be folded and provided with a binding tab before presenting to binder, in such a way as to give ¼ inch minimum clearance on front (right-hand edge) of book. Maps or charts to be inserted in pocket inside back cover are to be folded to a size not larger than 6½ x 10½ inches.

2. Organization of Dissertation.

The suggestions concerning the organization of the dissertation that follow may be taken as a norm from which deviations may be under the guidance of the student's advisor or committee.

A dissertation should be divided into the following parts:

a. Title Page - This should have the format of the example on page 21 of this program description.

b. Acknowledgments

c. Table of Contents

d. Lists of Tables and Illustrations

e. Introduction (Significance of the Problem)

f. Literature review

g. Statement of the problem (if not done in the introduction)

h. Methods

i. Results

j. Discussion

k. Conclusions

l. References

m. Appendix

n. Abstract - The purpose of the abstract is to give a concise presentation of the dissertation so that the reader will be able to determine whether it is advisable to read the complete dissertation. Although the maximum length of the abstract is 600 words, all but a very few should be shorter. The following parts are found in an abstract, although not indentified with subheadings: (1) Statement of Problem, (2) Procedure and Methods, (3) Results, and (4) Conclusions. Note: Dissertations also require one additional separate copy of the abstract especially prepared on an unnumbered sheet. See page 22.

o. Curriculum Vitae

p. Approval Page - The names of the students' committee members must be typed below their signatures with the Chairman identified. Both copies must have original signatures (not reproductions).

Example of Title Page

ISOMETRIC TENSION DEVELOPMENT IN THE HYPERTROPHIED HEART

DISSERTATION

Submitted to the Graduate School
of
West Virginia University
In Partial Fulfillment of the Requirements for
The Degree of Doctor of Philosophy

by

Barbara Baugh Krames

Morgantown
West Virginia

J. Submit to the Office of the Graduate School one separate copy of the abstract consisting of no more than 600 words. This copy must be in addition to that in the unbound dissertations. The full title of the dissertation must be centered at the top of the first page, followed on the next line by the full name of the candidate, and on the next line by the word "ABSTRACT". It must not have any page number on it. The abstract will appear in "Dissertation Abstracts", published by University Microfilms, Ann Arbor, Michigan.

K. At the time of delivery of the two copies of the dissertation, an "Agreement Form" with University Microfilms, Inc. must be filled out and signed.

L. The title and author's name in full must be exactly the same on the title page of the dissertation, the separate abstract, and the "Agreement Form".

M. The student must pay a fee of $30.00 at the Office of the Graduate School to cover the cost of microfilming the dissertation and publication of the abstract in "Dissertation Abstracts" a bi-monthly journal which receives wide distribution. Certified check must be made out to West Virginia Univ. No other form of publication will be required, but publication elsewhere is permitted and encouraged. The original of the candidate's dissertation will be submitted on loan to University Microfilms for complete microfilming, the resulting copy or copies to be available for purchase by all who request them. Available at the Office of the Graduate School is a helpful leaflet "Suggestions for the Preparation of Doctoral Dissertations for Microfilming". The original copy will be returned by University Microfilms to the Library, where it will be bound. The first unbound

carbon copy will be sent by the Graduate School to the student's department. The preparation and binding of the first carbon and any other copies for personal use, departmental use, or other purposes are the responsibility of the student.

N. Copyrights may be secured by the author through University Microfilms, Inc. or through independent means. The student should become aware of legal rights afforded under copyright laws. Information pertaining to copyrights can be found in the Graduate School publication "A Review of Copyright Matters Related to Graduate Theses and Dissertations" available in the Department of Physiology and Biophysics Office. If copyright service is desired this must be indicated on the contract form. It can be provided through the Office of the Graduate School upon receipt of a certified check for $15.00 made payable to "University Microfilms". If the dissertation is to be copyrighted an additional page must be inserted immediately following the title page in each copy of the dissertation with the typed inscription centered below the middle as follows:

Copyright by John Arthur Brown 1971	(Full legal name of author as on dissertation and contract form.) (Date of publication on film. On December submittals use next year.)

O. The student must report the full title of the dissertation to the Office of the Graduate School at least three weeks before Commencement unless dissertation copies were deposited previous to that date.

P. The student must complete the form provided at the Office of the Graduate School which incorporates the pre-doctoral program and post-doctoral plans into the "Survey of Earned Doctorates Awarded in the United States".

Q. Attendance at the spring Commencement is voluntary. If the student does not plan to attend, the complete mailing address to where the student wants the diploma mailed must be left at the Dean's Office of the Graduate School.

R. Checklist. One week before the end of the semester which the degree is expected the Office of the Graduate School must have received:

1. Report of Final Examination.
2. Approved, original, unbound copy of dissertation, first carbon.
3. Contract of Agreement form for dissertation microfilming services; and copyright if desired.
4. Payment for the above.
5. Completed form "Survey of Earned Doctorates."
6. Participation in Commencement or mailing address left at Dean's Office of the Graduate School.

S. For further information see the West Virginia University Graduate Catalog.

Description of the Doctoral Program

Department of Physiology

1994

DOCTORAL PROGRAM

Department of Physiology

(Updated April, 1994)

I. CRITERIA FOR ADMISSION

A. Grade Point Average

The minimal undergraduate GPA for admission required by West Virginia University is 2.5. Generally, 3.0 is required for full, unqualified admission to our program. Students with less than 2.5 will generally not be considered. Students may be admitted with GPA's between 2.5 and 3.0 but only on departmental probation. This probation must be lifted at the end of the first semester by the student achieving a GPA of 3.0, taking courses specified by the advisory committee, and a minimal grade of "B" in Physiology 344. This departmental probation, and the mechanism for removing it, will be clearly stated in the letter of acceptance to the student.

B. Graduate Record Examination

The verbal, quantitative, and analytical scores are required of all applicants.

C. Letters of References

Letters of reference will be requested from three individuals of the applicant's choice. These individuals may either complete the departmental reference forms or write letters of reference if they choose. It will be made clear to these referees that these are to be academic or professional references.

D. Personal Interview

This is not required, but is highly desirable.

E. Prerequisites for the Program

Applicants should have a strong background in biology and/or chemistry. In addition to a basic biology course, inorganic and organic chemistry are required. Because several areas of physiology require an understanding of the fundamentals of calculus and physics, introductory courses on these subjects are also essential. It is recommended that applicants have also taken biochemistry, cellular or molecular biology, and an introductory physiology course. Physical chemistry is recommended, but not required.

II. GRADUATE COURSE REQUIREMENTS

A. The Curriculum

All students in the Department must successfully complete the following core of required courses which are designed to provide a firm foundation for future teaching and research endeavors. In the Physiological Methods course taken during the first year, students undertake laboratory rotations with each faculty member who is a potential thesis advisor. These meetings familiarize students with the research

interests and techniques of the Departmental faculty so that they can make a more informed decision on whom to work with. A student's first summer session is spent working in one or two laboratories as a preliminary to his/her thesis research. Students are strongly urged to pick a thesis advisor early in their second year so they can begin work on their thesis research during the first and second semesters of that year. Beginning with the second year, teaching is a normal requirement each year for all students in the Ph.D. program.

Effective 8/94

DOCTORAL CURRICULUM

FIRST YEAR

First Semester

A. Required Courses:

Physiol. 344	Medical Physiology	5 hrs
Physiol. 499	Graduate Colloquium	1 hr
Physiol. 342	Physiological Methods	4 hrs
Biochem. 399	Graduate Biochemistry	4 hrs

Second Semester

A. Required Courses:

Physiol. 345	Medical Physiology	5 hrs
Physiol. 346	Neurophysiology	3 hrs
Physiol. 444	Graduate Seminar	1 hr
Physiol. 499	Graduate Colloquium	1 hr
Biochem. 399	Graduate Biochemistry	3 hrs

Summer Session

A. Required Courses:

Physiol. 497	Research	3 hrs
Stat. 311	Statistics (or Psych 311)	3 hrs

SECOND YEAR

First Semester

A. Required Courses:

Physiol. 491	Advanced Physiology	6 hrs
Physiol. 499	Graduate Colloquium	1 hr
Physiol. 497	Research	6 hrs
Physiol. 444	Graduate Seminar	1 hr
Physiol. 490	Teaching Practicum	1 hr

Second Semester

A. Required Courses:

Physiol. 491	Advanced Physiology	6 hrs
Physiol. 490	Teaching Practicum	1 hr
Physiol. 499	Graduate Colloquium	1 hr
Physiol. 497	Research	3 hrs
Biochem. 491d	Cell Biology	3 hrs

Students may take approved electives. Courses must be approved by the appropriate guidance committee (Graduate Studies Committee or dissertation committee).

B. Modifications of Curriculum

1. Advanced Standing

Students must petition the Graduate Studies Committee (GSC) to waive any required course or to deviate from the normal sequence of courses.

2. Effects of Curriculum Changes

Whenever a student's curriculum is modified, (e.g., by course addition, drop, withdrawal, or waiver) the GSC must re-specify the course curriculum (e.g., repetition of the course), re-evaluate seniority, and consider any effects such a change may have on the student's standing in the department. All these factors will be discussed with the student. The student will be notified of all these factors in writing, and a copy will be sent to the Health Sciences Graduate Programs Office. All the decisions regarding changes in a student's curriculum or status in the department will be reported in writing to the student and the Health Sciences Graduate Programs Office, included in the student's file, and reported to the graduate faculty at its next meeting.

III. GRADE REQUIREMENTS

In order to remain in good standing, the Department of Physiology requires the following:

1) An overall grade-point average (GPA) of at least 3.0.

2) A GPA of at least 3.0 in required Physiology courses.

For the first academic year, the grade in Research (Physiol. 497) is excluded from GPA calculations. If the GPA requirements outlined above are not met, the student will be placed on departmental probation. The probation can be lifted if the student can again meet these requirements within one semester (excluding summer sessions). The courses to be taken during the probationary semester will be determined by the student's advisory committee. If probation is not lifted within one semester, the student will be dismissed from the program.

The following are also grade requirements for the Ph.D. Program and failure to meet them will result in immediate dismissal from the program:

1) No more than one "C" will be allowed in the following courses: medical physiology 344 and 345, neurophysiology 346 or neurobiology 375, and advanced physiology 491.

2) No more than a total of two "C's" will be allowed in the courses listed above in (1), and biochemistry 399, statistics 311, and any additional courses required by the student's committee and included in this category by the committee.

3) No grade less than "C" will be allowed in any of the courses listed above in (1) and (2).

The graduate faculty reserves the right to retain a student in the program if special circum-

stances exist. In this case, the graduate faculty will review the student's record and render its decision by majority vote.

IV. CANDIDACY REQUIREMENTS

Admission to the doctoral program in Physiology and enrollment in graduate courses does not of itself guarantee acceptance of the student as a candidate for a Ph.D. degree. To qualify as a doctoral candidate a student must demonstrate the ability to do work of graduate caliber by satisfactorily passing the departmental qualifying examination.

V. PREREQUISITES FOR THE QUALIFYING EXAMINATION

The following are prerequisites for advancement to the qualifying examination:

1) The student must have a dissertation advisor and a dissertation committee.
2) The student must be in good academic standing as defined in the Ph.D. Program and have satisfactorily completed the first two years of course requirements (including those specified by the student's advisory committee) with at least six credit hours (or equivalent) of laboratory research experience.
3) The student must have a final grade of "B" or better in Advanced Physiology.
4) Two-thirds of the graduate faculty must approve each student for candidacy. In case such approval is not given, the graduate faculty will recommend a course of action.

VI. QUALIFYING EXAMINATION

The qualifying examination consists of two parts, a comprehensive part and a research design part.

A. Comprehensive Part

1. Scheduling of examination

In general, all students will take this examination following the completion of the first two years of the Ph.D. Program. The examination will be scheduled for all eligible students during the month of June.

2. Type of examination

The comprehensive part is a written examination.

3. Content of the examination

The student must answer questions from each of the following major areas of physiology: gastrointestinal and cellular, neural, endocrine, cardiovascular, renal and pulmonary physiology. Physiology of the muscle, body fluids, and acid-base balance will be included in the organ system blocks where appropriate. There will be a choice of questions within each of the major areas.

4. Participating faculty

All graduate faculty in the Department will participate in the planning of this examination. The faculty will participate as groups, based on the major areas of physiology. Each group will provide questions written by some or all members of the group, at their discretion.

5. Duration of examination

The examination will be given on a Monday, Wednesday and Friday of one week. The examination will begin at 8:00 a.m. each day and terminate at 4:30 p.m. However, the student will have the option of writing answers until 5:00 p.m. each day. Two of the major areas of physiology will be examined on each day.

6. Grading of examination

Each question will be graded by the author of that question. One week will be allowed for grading. Each question will be given a numerical score (0-100%). In order to pass the examination, the student must obtain a score of 70% or above in each of the six major areas of physiology.

7. Course of action for students who fail

a. If the overall examination average is less than 70%, the entire examination must be repeated.

b. If the overall examination average is greater than 70%, but the score(s) in one or two areas is (are) below 70%, only the question(s) in that (those) area(s) must be repeated.

c. If the overall examination average is greater than 70%, but the scores in three or more areas are below 70%, the entire examination must be repeated.

If a portion of the examination or the entire examination must be retaken, the student must do this within a period of one month after failure of the original examination. The examination or a portion of the examination may be retaken only once. The criteria of Section VI-A will apply to this examination.

B. Research Design Part

1. Scheduling of examination

In general, students will be individually schedule to take the research design examination within a period of six months after passing the comprehensive part of the examination.

2. Type of examination

The research design portion of the examination will consist of both a written and an oral part.

3. Content of the examination

The student will be presented with two research design questions. The student will answer only one of these questions. The questions may not be based on the student's dissertation project. The student's answer to the question should contain the following sections: background, rationale, objectives, methods, anticipated results, discussion, and references.

4. Participating faculty

The student's dissertation committee will administer this examination.

5. Duration of examination

The student will have a period of two weeks to complete a written answer to the question. The oral portion of the examination will be given approximately two weeks after the written part of the examination has been completed. In general, the oral examination will last from one to four hours.

6. Grading of examination

Both the written and oral parts of the examination will be graded on a pass-fail basis by the dissertation committee.

7. Course of action for students who fail

If the research design part of the qualifying examination is failed, the student may retake the entire research design portion of the examination, but only once.

VII. GRADUATE ADVISOR AND DISSERTATION COMMITTEE

During the first full year of this program a student is not committed to any particular area of specialization or a research advisor. During this time, the student is expected to become familiar with the research activities in the various faculty laboratories. However, there will be no formal assignment to any such laboratory, nor will financial support be extended from any given laboratory during this time. Based on impressions of the research in these laboratories, and on personal interests, the student will choose a research advisor <u>early</u> in the second year in the program. The advisor must be a member of the Graduate Faculty and of the Department of Physiology. After obtaining the chosen advisor's agreement, the student will write to the department chairman (with a copy going to the advisor) requesting that this assignment be made. This letter should contain a brief description of the proposed dissertation research project. The agreement between student and advisor will become official upon written approval by the department chairman in consultation with the Graduate Studies Committee. Normally there will not be more than two Ph.D. students per faculty advisor at any given time. Next, the

student and advisor will invite at least four members of the Graduate Faculty to comprise the student's advisory committee, with the advisor serving as chairperson. At least three of the committee members must be members of the Graduate Faculty of the Department of Physiology and at least one member must be a Graduate Faculty member outside of the department. These assignments also require a written request from the student for approval by the department chairman in consultation with the Graduate Studies Committee. Copies of all such correspondence will be sent to the Health Sciences Graduate Programs Office. Until the advisory committee is established, the GSC will act as the student's advisor. The composition of the advisory committee may be altered at any time with the consent of the student, the advisor, the department chairman, and the majority of the original committee members involved.

The student must meet at least twice with the dissertation advisory committee before preparing the written dissertation. The objectives of the first meeting, to be held shortly after completion of the qualifying examination, will be to evaluate the scientific merit of the research proposal. At this time the student will be expected to defend the goals, experimental design, procedures, and possible significance of the proposed research. Another meeting should be scheduled near the time of completion of the research but before the dissertation is written. At this meeting the student will be expected to defend the data which have been collected and obtain approval to begin writing the dissertation. Additional meetings may be scheduled at any time at the request of the student or the advisor.

VIII. GRADUATE RESEARCH

After achieving candidacy for the Ph.D. by passing the qualifying examination, the student shall pursue an individual research endeavor of the student's choice under the supervision and guidance of the advisor in preparation for the doctoral dissertation and final oral examination. The investigation should demonstrate a mastery of research techniques and represent an original contribution to knowledge.

A. Doctoral Dissertation

1. After obtaining approval to write the dissertation, a dissertation draft which is acceptable to both the student and the advisor should be duplicated and distributed to all members of the doctoral committee at least 11 weeks before the anticipated date of graduation. The committee members must have at least three weeks in which to evaluate the manuscript.

2. Conflicts concerning the scientific content of the dissertation draft should be resolved by a meeting of the student, the advisor, and the committee member(s). All committee members should be appraised of any significant proposed changes. Editorial decisions concerning the language, form,

data presentation, etc. of the dissertation should be primarily the responsibility of the advisor. Committee approval of the dissertation for defense should be obtained a minimum of 8 weeks before the expected time of graduation. In order for the dissertation to be approved for defense, there shall be no more than one unfavorable vote among members of the committee.

B. Final Oral Examination

1. Following committee approval of the manuscript, the final oral examination should be scheduled. The student should contact all committee members to establish a convenient date for the examination. The student's advisor must notify the Health Sciences Graduate Programs Office at least three weeks in advance of the examination date. The first part of the oral examination is an open presentation and defense of the dissertation and requires public notification to the University community. The second part of the examination is a closed discussion between the candidate and the committee.

2. Shortly before the examination, the student will present his/her research to the department as part of the departmental seminar series.

3. Questions asked during the final examination should be confined to the dissertation and general knowledge of the field. The exam should be chaired by the advisor who may rule on the relevance of questions.

4. To successfully defend the dissertation during the oral examination, the student must receive no more than one unfavorable vote among members of the committee.

5. After passing the oral examination, the student who has followed this timetable will have at least 3 weeks to prepare, type and duplicate the final copies of the manuscript. Two accepted copies in approved typewritten form must be delivered to the Health Sciences Graduate Programs Office at least 1 week before the close of the session in which the degree is expected to be conferred.

IX. SUPPORT PRIORITIES

A. Departmental stipends will generally be awarded to students according to the following order of priority:

1. continuing Ph.D. students with a GPA above 3.0
2. entering Ph.D. student who are not on probation
3. continuing Ph.D. students with a GPA between 2.75 and 3.0

X. APPEAL PROCEDURE

Students may appeal GSC decisions first to the GSC, then to the departmental graduate faculty. Both groups will render their decisions by majority faculty vote. If this decision is not satisfactory to the student, a further appeal may be made to the Graduate School, President's Office, and Board of

Regents.

XI. VACATION AND LEAVE POLICY

Participation in this program is considered to be a full-time (12 month) endeavor. The department, however, recognizes the need for periods of relaxation from study and work and thus applies the same guidelines for vacations for graduate students on stipends as those applicable to the faculty. University policy for faculty permits 22 working days of cumulative paid vacation per year in addition to University staff holidays (these do not include semester break at Christmas or spring break). All authorized vacations and leaves must be approved by the advisor or GSC before departure. Any substantial deviation from this policy must have the prior approval of the research advisor and the Graduate Studies Committee.

XIII. GRADUATE REGULATIONS AND GUIDELINES FOR PREPARATION OF DISSERTATIONS

The following regulations and guidelines have been established by the Health Sciences Graduate Programs Office for all doctoral candidates submitting dissertations to West Virginia University.

A. All requirements for the Doctor of Philosophy must be completed within a period of 8 years starting at the initial enrollment into the graduate program.

B. A graduate grade-point average of at least 2.75 will be required for graduation from WVU with a graduate degree.

C. During the semester that graduation is anticipated, the student should check at the Health Sciences Graduate Programs Office to see that his/her records show no deficiencies such as those regarding admission to the doctoral program, establishment of candidacy through qualifying or comprehensive examinations, meeting of residence requirements, the regulation for completion of the program within 8 years, and removal of all incomplete grades, etc. The last date for removal of "I" grades (incompletes) is not later than one week prior to the close of the summer session, on week prior to the last day of the final examination period at the end of the first semester, or one week prior to Commencement Day at the end of the second semester.

D. At the time of registration for the semester in which all degree requirements are expected to be met, or at the latest within 2 weeks after such registration, each candidate must submit a formal request on a special "Application for Graduation and Diploma" (including a $25 graduate fee) form to the Health Sciences Graduate Programs Office for the conferring of the degree. This form is available from the Health Sciences Graduate Programs Office. The candidate must complete all requirements at least one week before the end of that semester. If the degree is not actually earned during that semester the

student must submit a new application at the beginning of the term in which he does expect all requirements will be met.

E. Each graduate student must be registered during the semester or session in which the final examination is to be taken.

F. The last day for the student's advisor to submit a request to the Office of the Graduate School for the final examination is four weeks prior to the end of the final examination period at the end of the first semester, or four weeks prior to Commencement Day at the end of the second semester. This request must be filed at least three weeks before the date of the oral examination defense. No final examination is to be given to a student until clearance is signed by the Health Sciences Graduate Programs Office in the form of receipt of the student's "Shuttle Sheet" from that office by the student's advisor.

G. Results of the final examination, acceptance of the dissertation, and certification of its suitability for immediate microfilming must be reported by the student's graduate advisor or committee chairman to the Health Sciences Graduate Programs Office within 24 hours of the scheduled time of the examination. This shall be no later than one week before the end of the semester or summer session in which the degree is expected to be granted.

H. At least one week prior to the end of the semester in which the degree is expected to be conferred (August, December, or May), the candidate whose committee has approved the dissertation must submit to the Health Sciences Graduate Programs Office <u>two typewritten (or computer produced) unbound original</u> copies (or two acceptable Xerox copies).

1. Mandatory requirements for acceptability of the dissertation are as follows:

a. <u>All</u> theses, dissertations, forms and fees must be submitted to the Health Sciences Graduate Programs Office. <u>DO NOT</u> take to the Library. The Health Sciences Graduate Programs Office will make delivery of the theses, dissertations, forms, fees and the approval form to the Library.

b. The Health Sciences Graduate Programs Office will review copies of the theses or dissertation before its copied in final form to assure that it meets the guidelines.

c. Bibliography: The bibliography can be typed in the format recommended by his/her school/department committee.

d. Sample of title page with chairperson listed is attached (this is only for the extra copy of the title page that goes with the copyright form).

e. Student should submit extra copies directly to department as required.

RULES AND FEES FOR SUBMISSION OF DISSERTATIONS TO LIBRARY

1. Copyright Fee Is Now $35.00 Effective January 1, 1991 Payable To University Microfilms, Inc. By Certified Check Or Money Order Only. Copyright Form Must Be Completed And Submitted With ALL Dissertations, If Copyright Is Desired Or Not.

2. An Extra Copy Of Title Page With Name Of Chairperson On Bottom Is Now Required To Accompany The Copyright Form.

3. Fee For Submission Of Dissertation To Library Is $50.00 Payable To West Virginia University Library By Certified Check, Money Order Or Cash.

4. If Title Is Over 55 Spaces, A Shortened Title Must Be Submitted On A Separate Sheet Of Paper.

5. Survey Of Earned Doctorate Form Must Be Completed And Submitted With Dissertation.

GENERAL GUIDELINES GOVERNING THE PREPARATION OF DISSERTATIONS

Because capacity is very irportant in microfilming and reproducing manuscripts, copies presented to the Health Sciences Graduate Programs Office must be on good quality white, 16 to 20 pound paper. The various trade name "erasable" bonds all smear, and copies printed on recycled paper often fade. Hence, these paper types are not acceptable. Perforated paper used with some computer printers results in ragged edges on the bound manuscript and should be avoided.

Reproduction

Dissertations must be typewritten on only one side of the paper. Either the original and first copy or two copies reproduced by electrostatic copying methods must be presented to the Health Sciences Graduate Programs Office. The copies presented must be clean, clear, uniform, high contrast print. Mimeograph copies are not acceptable. Electrostatic copying methods on the reguired paper can be excellent, but results are unacceptable when the original is poorly typed (ribbon too dark or too light, incomplete erasures and corrections, etc), or the copying machine is poorly set or serviced (splotched, spotted, gray or dirty copies) When a student is in doubt about the acceptability of copies, personnel in the Health Sciences Graduate Programs Office will be happy to inspect a page or two before the whole manuscript is reproduced.

The surest way to prepare acceptable copies is to have the original typed on good quality paper. The student then may make as many copies as are needed for personal or committee use before submitting the required two copies to the Health Sciences Graduate Programs Office.

Students may use word processors (computers) to produce dissertations; however, because of duplicating and microfilming needs, the print must be letter quality with dark black characters that are consistently clear and dense. Dot matrix printers ara not acceptable. Blue characters are not acceptable. Paper must be 16 to 20 pound paper, and type size should be 10 point or larger. Computer printouts with small and indistinct print become illegible in microform.

Spacing and Margins

All straight text is to be double spaced. Quotations, footnotes, etc , may be single spaced. The placement of the footnotes at the bottom of the paper or at the end of the manuscript is optional but must be consistent throughout. A form acceptable for publications in the discipline is recommended. All paper should have a minimum margin of 1" on all sides of the page.

Pagination

Each and every page in a dissertation, including all blank pages, is to be assigned a number with no duplications in the numbering system. The preliminary (table of contents, list of tables, etc) are to be numbered with small Roman numerals (i, ii, iii, iv, etc , in the upper right-hand corner). The title page counts as page i, but the number does not appear The remainder of the text should be numbered consecutively in Arabic numerals centered at the top or bottom of the page within the 1" margin. Avoid the use of letter suffixes as 10a, 10b, etc If there are more volumes than one, they should be identified as Volume I, II, etc., and numbering may either follow consecutively or begin again with Arabic 1. Multiple volumes should each contain a title page.

Illustrations and Charts

All illustrations and charts must be drawn in dark, opaque ink and be of sufficient size to be readable. Remember that microfilming and duplicating are black and white photographic processes and colors will appear in varying shades of gray. Thus, cross-hatching and labels are essential. If a title or description of an illustration or graph is too long to be placed on the same page, it should be placed on the previous page. Some disciplines prefer the title or description to face the illustration or graph. If this is done, be sure to number the blank side of the page (see pagination)

Oversize pages complicate duplicating procedures and should be avoided Often a different

layout or the use of photographic reduction will resolve the problem . If oversized maps or charts are used, they should be folded as few times as possible, but in such a way as to give 1/4 inch minimum clearance on front, right hand edge of book. A binding tab should be provided before the manuscript is presented to the binder. Maps or charts to be inserted in a pocket of the inside back cover are to be folded to a size not larger than 6 1/2 inches x 10 1/2 inches. The Health Sciences Graduate Programs Office will provide information about the acceptability of illustrative material if given the opportunity to examine it before submission of the manuscript. Photocopies and reduced text must be readable when reproduced, if in doubt bring example to Health Sciences Graduate Programs Office for appraisal.

Photographs

Photographs in a dissertation should be in black and white rather than color. Maximum clarity for microfilming and duplicating is attained when there is good black and white contrast. Color photographs should only be used when they are absolutely essential for understanding the methods or results of the research. If color photographs are used, appropriate labels must be provided to assist the readers of reproduced copies. Photographs are to be firmly affixed to pages with Kodak (or equivalent) Dry Mounting Tissue to insure permanent mounting.

Signatures

Both copies of a dissertation presented to the Health Sciences Graduate Programs Office must have original signatures of committee members on the approval page. The names of the student's committee members must be typed out below their signatures with the chairperson listed last and so identified. Reproductions are not acceptable. A sample signature page is attached.

Title

As Library retrieval Systems use words in the title to locate manuscripts, it is essential that titles provide a brief description of the contents of the work. Words should be substituted for formulas, symbols, Greek letters, and so on. In cases where the title is excessively long, the author must provide the Health Sciences Graduate Programs Office with an abbreviated title of not more than 55 spaces; i.e., a maximum of 55 printed characters and spaces between words.

Aggreement Form

A completed "Doctoral Dissertation Aareement Form must be presented to the Health Sciences Graduate Programs Office when the two (2) copies of the dissertation are delivered.

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Extra Title Page

If statutory copyright is claimed, an extra copy of your title page with the name of your Chairperson, must be submitted.

Abstract

The purpose of the abstract is to give a concise presentation so that the reader will be able to determine whether it is advisable to read the complete manuscript. The maximum length of the abstract is 350 words. The following parts are found in an abstract, although not identified with subheadings.

a. Statement of Problem
b. Procedures or Methods
c. Results
d. Conclusions

For publication purposes, a separate copy of the abstract must also be submitted. This is in addition to the abstract in the two unbound copies of the dissertation. This separate copy of the abstract must have centered at the top of the first page the exact full title of the dissertation, followed on the next line by the full name of the candidate, and on the next line by the word ABSTRACT. Paaes

should not be numbered. The title on the abstract and on the "Agreement Form" must be the same, word for word, as on the title page of the dissertation.

The abstract will appear in Dissertation Abstracts, published by University Microfilms International. The original of the candidate's dissertation will be submitted on loan to University Microfilms International for complete microfilming. The resulting copy or copies will be available for purchase by all who request them.

The cost of publishing the abstract and for microfilming the dissertation is $50.00 (subject to change). This is payable by certified check, money order to West Virginia University or cash. This check is presented to the Health Sciences Graduate Programs Office at the time of delivery of the two copies of the dissertation.

Survey of Earned Doctorates

A completed questionnaire entitled "Survey of Earned Doctorates" must be presented to the Health Sciences Graduate Programs Office when the two (2) copies of the dissertation are delivered.

Organization of Manuscript

Proper arrangement and construction of the parts of a dissertation will likely vary according to the styles adopted by different disciplines. The suggestions concerning the organization of the dissertation that follow may be taken as a norm from which deviations may be made under the guidance of the student's advisor or committee. A dissertation should consist of the following parts:

1. Title page
2. Notice of copyright, if appropriate
3. Acknowledgments
4. Table of Contents
5. List of Tables and Illustrations
6. Introduction
7. Review of Literature
8. Text of Investigation
9. Bibliography
10. Appendix

11. Abstract
12. Curriculum vitae (optional)
13. Signature Page

Deadline Dates

Copies of the typewritten draft of the dissertation should be presented to all committee members at least one month before the final examination.

CHECK LIST FOR ITEMS BEING DEPOSITED IN HEALTH SCIENCES GRADUATE PROGRAMS OFFICE

1. Dissertation (2 Unbound manuscripts)
   a. Signature Sheet with original signatures of Committee members (2 copies)
   b. Acceptable Margins and double spaced
   c. Pages and Exhibits numbered consecutively
   d. *Copyright statement must appear in manuscript
   e. Clear and legible copies. The use of color and dot matrix print must have prior approval.
   f. 16-20# weight paper (no erasable bond, recycled paper or perforated computer paper.
2. Separate Abstract (Pages numbered, 350 word maximum, double spaced, including title and student's name
3. Copyright Agreement Form (Completed and signed)
4. *$35.00 for Copyright (Certified Check/Money Order payable to University Microfilm, Inc.).
5. Extra title page with name of Chairperson.
6. Survey of Earned Doctorates Form (Completed and signed)
7. $50.00 Check for Dissertation Fee (Certified Check/Money Order payable to WVU Library or cash.
8. Shortened Title if the title exceeds 55 character limit (includes spaces).

*Optional

Approval Form

If the dissertation is in acceptable form, all appropriate forms have been completed and payment has been received, the Health Sciences Graduate Programs Office personnel will complete

and sign an approval form indicating that all obligations regarding submission of the dissertation to the Health Sciences Graduate Programs Office have been fulfilled. The original of the form will be given to the student to return to the appropriate office in the college from which the degree is being granted.

The dissertation will be microfilmed and both copies bound, catalogued and added to the Library collection.

Example of Title Page

ISOMETRIC TENSION DEVELOPMENT
IN THE HYPERTROPHIED HEART

DISSERTATION
Submitted to the School of Medicine
of
West Virginia University
In Partial Fulfillment of the Requirements for
The Degree of Doctor of Philosophy (Master of Science, etc.)

by

Frank Love Pollock, A.B.

Morgantown
West Virginia
1991

(SAMPLE SIGNATURE PAGE)

APPROVAL OF EXAMINING COMMITTEE

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Donald G. Baker, Ph.D.

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Thomas Anderson, M.D.

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Harold M. Jones, Ed.D.

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Daniel M. Worthington, Ph.D., Chair

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Date