# Department of Mathematics
# Graduate Student Handbook

This is written *for* graduate students *by* graduate students, and should not be interpreted as a statement of official department policy.

Version 2.3.1

August 19, 2013

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# Chapter 1

# Foreword

This guide has been prepared to assist graduate students in the Department of Mathematics. It is not a statement of official department policy, and should not be interpreted as such. The intent of this document is to provide a general outline of department policies and to answer frequently asked questions. In the event of confusion or uncertainty, specific inquiry should be made with the appropriate office or individual.

Students are also encouraged to consult the following resources:

*General Information On Graduate Programs*
http://www.math.unl.edu/graduate/giogp/

*Graduate Studies Bulletin*
http://www.unl.edu/gradstudies/current

*Master's Degree Deadlines and Forms*
http://www.unl.edu/gradstudies/current/degrees#masters

*Doctoral Degree Deadlines and Forms*
http://www.unl.edu/gradstudies/current/degrees#doctoral

This handbook describes the academic requirements and policies for the mathematics graduate program and offers advice for meeting these requirements and adhering to these policies. Additional information on university-wide policies for graduate students can be found at http://www.unl.edu/gradstudies/current

This handbook also describes the responsibilities of the Graduate Teaching Assistant (GTA) and Graduate Research Assistant (GRA) in the Department of Mathematics.

# Chapter 2

# Department Contacts & Useful Websites

| | | |
|---|---|---|
| Department Chair | Judy Walker | jwalker7@unl.edu |
| Vice Chair | Allan Donsig | adonsig1@unl.edu |
| Graduate Chair | Susan Hermiller | shermiller2@unl.edu |
| Academic Advisor | Lori Mueller | scohn1@unl.edu or tmarley1@unl.edu |
| Faculty Advisor | Tom Marley and Steve Cohn | lmueller2@unl.edu |
| Business Manager | Tom Danaher | tdanaher1@unl.edu |
| Systems Administrator | Rex Dieter | rdieter1@unl.edu |
| Main Office | Elizabeth "Liz" Youroukos | eyouroukos1@unl.edu |
| Graduate and Research Assistant | Marilyn Johnson | mjohnson11@unl.edu |

Table 2.1: Department contacts

| | |
|---|---|
| University of Nebraska–Lincoln | http://www.unl.edu |
| Graduate College | http://www.unl.edu/gradstudies |
| College of Arts and Sciences | http://ascweb.unl.edu |
| Department of Mathematics | http://www.math.unl.edu |
| Office of International Student Affairs | http://www.unl.edu/iaffairs |
| Office of Equal Opportunity | http://www.unl.edu/equity |
| Student Code of Conduct | http://stuafs.unl.edu/ja/code/ |
| Thesis Guidelines | http://www.unl.edu/gradstudies/current |

Table 2.2: Useful websites

| | | |
|---|---|---|
| Counseling & Psychological Services | 472–5000 | http://health.unl.edu/caps |

Table 2.3: University Services

## 2.1 Staff Roles

The department main office is located in Avery Hall 203. The department staff is available to help with many problems and questions that may arise. The following list indicates what areas of responsibility each staff member is in charge of.

- Tom Danaher (tdanaher1@unl.edu) All financial and administrative support, questions connected to payroll, GTA appointments, office assignments, any questions connected to accounts or grants.
- Rex Dieter (rdieter1@unl.edu) Computer systems administrators. All computer related questions.
- Elizabeth "Liz" Youroukos (eyouroukos1@unl.edu) Main receptionist; travel arrangements (purchasing airline tickets, requesting funds, expense vouchers); mail, including FedEx; maintains supply inventory; recommendation letters for employment; room reservations for review sessions/exams; assistance with updating the department web pages; manages coffee and monthly phone billing; copy codes
- Lori Mueller (scohn1@unl.edu or tmarley1@unl.edu) Undergraduate advising; class scheduling; curriculum changes; all class rosters; calculator checkout; final exams (preparations, room assignments); Math Placement Exam (MPE); Math Resource Center (MRC); contact for posters, flyers, brochures; assistance with updating the department web pages.
- Marilyn Johnson (mjohnson11@unl.edu) All questions connected with the Graduate program; grant proposal support/grant submissions; coordinate conferences, seminars, and workshops; assistance with updating the department web pages; main contact for purchasing.

# Chapter 3

# Introduction

The Department of Mathematics offers graduate programs leading to the Master of Science (MS), Master of Arts (MA), Master of Arts for Teachers (MAT), Master of Science for Teachers (MScT), and the Doctor of Philosopy (Ph.D.) in Mathematics, cf. 4. The intent of this guide is to outline the requirements and procedures for each degree program, and to provide a resource to find answers to common questions that arise while a graduate student in the Department of Mathematics at the University of Nebraska–Lincoln. This document is not intended to be a comprehensive resource, and if there is any topic that is not covered in this handbook clarification should be sought from an appropriate person, cf. 2.1

## 3.1 Orientation

Prior to the beginning of each Fall semester, the department offers an orientation program to incoming graduate students. This introduction incorporates university training for teaching assistants, as well as a department program for teaching assistants. There are meetings with course lecturers and conveners at this time, as well as *the mandatory department meeting* for all teaching assistants, and new students are given a general orientation to the department and its facilities.

## 3.2 Advising

Each incoming graduate student will be assigned a faculty adviser. Frequently the department will make an effort to assign a faculty adviser with interests similar to those indicated on the student's application for admission. The faculty adviser will assist the new student in adjusting to the department, as well as with academic planning. Students can change advisers at any time by arrangement with the appropriate faculty members. Marilyn Johnson and Susan Hermiller should be notified of all such changes. Upon selection of a supervisory committee and thesis adviser, the initial faculty adviser will be replaced by the student's research adviser. Students who have not yet formed a supervisory committee must complete Form Epsilon prior to the start of each semester, preferably just before you register for classes.

## 3.3 Graduate Student Advisory Board

The Graduate Student Advisory Board (GSAB) is an elected body of $6 \pm 1$ current graduate students in the department. The members include 1 first year student (elected mid-Fall), 2 second year

students, and 3 students in their third year or beyond. The term for a member consist of 2 years, at which time an election is held to fill the vacant position. Students are allowed to be elected as many times as they wish to be put on the ballot.

The purpose of the GSAB is to serve as a liaison between the department's graduate students and the Department of Mathematics itself. If you have any concerns regarding the faculty, staff, department, or other graduate students which you don't feel comfortable going to the administration of the department with, you can contact a GSAB member or use the anonymous drop box at http://www.math.unl.edu/~gsab/feedback.html and we will present your concern to them for you. The GSAB website can be found at http://www.math.unl.edu/~gsab. Current members are

| | |
|---|---|
| Melanie Devries | s-mdevrie4@math.unl.edu |
| Doug Dailey | ddailey2@math.unl.edu |
| Caitlyn Parmelee | s-cparmel1@math.unl.edu |
| Lauren Keough | s-lkeough1@math.unl.edu |
| Charles Tomlinson | ctomlinson2@math.unl.edu |
| Alex Kunin | alex.kunin@huskers.unl.edu |

Table 3.1: GSAB Members

The Department Chair often uses the GSAB to help identify concerns the graduate students may have, and to solicit nomination for department committees. In addition to these duties, the GSAB plans at least one department function and/or one graduate student function each semester. In past years these functions have included a winter talent show and potluck dinner, ice skating, softball, and picnics.

## 3.4 Registration

Students register for classes using MyRed, found at http://myred.unl.edu. Full-time graduate students are expected to register for at least 9 credit hours per semester, and ordinarily at least six of these credit hours must be taken in mathematics courses. Tuition waivers cover up to 12 hours per semester and up to 12 hours during the summer.

All incoming students must register for the Landscape Seminar (Math 896) during the spring semester of their first year. This seminar meets once per week and provides an introduction to the mathematical research being done in the department. Selected faculty members will make presentations and be available for questions from students.

Students who feel that their background may be particularly weak in a subject should consult their advisor, as it is possible for incoming graduate students to enroll in some "400-level" courses, if needed to correct this deficiency. Similarly, new students who are particularly strong in a particular area may want to consider taking more advanced classes or reading courses in specific subjects, and should likewise consult with their advisor or with the Graduate Chair.

Reading courses are always available, provided interested faculty can be found to supervise them. They are recommended for students whose interests are unusual or are not frequently addressed in regularly offered courses. Summer reading courses are also recommended, and can provide students with the opportunity to "try out" a particular area of study or to broaden their mathematical horizons.

## 3.5 Full Time Certification

A full-time semester course load consists of nine or more credit hours. A full-time summer session course load consists of six or more credit hours.

Graduate students working on their dissertations may apply for Full Time Certification for a period no longer than twelve months in total (masters students) or twenty-four months in total (doctoral students). Full time certification allows a student to be officially full-time (thus retaining benefits such as use of the rec center and loan deferments) while registered for less than nine credit hours.

To be eligible for Full Time Certification, a student must have been enrolled for four or more credit hours in the previous academic year, or have been previously Full Time certified. For more information and current requirements, please visit http://bulletin.unl.edu/graduate/Registration. To apply for Full Time Certification, please visit http://www.unl.edu/gradstudies/fulltime.

## 3.6 Department Committees

The department has several standing faculty committees that graduate students may need to consult. The following faculty members are serving as chair of these committees.

- Susan Hermiller (shermiller2@unl.edu) is the Graduate Chair, and is the chair of the Graduate Advisory Committee (GAC). Responsibilities of the Graduate Advisory Committee: Advise the Department about all aspects of the graduate program. In particular, administer the graduate program, administer the graduate exams, recruit graduate students, advise about policy issues concerning the graduate program, advise about curricular issues affecting the graduate program, serve as liaison with the Carnegie Initiative on the Doctorate Committee, administer the GAANN grants, provide recommendations for graduate student awards and scholarships, provide advice on preparing graduate students for the profession.
- Allan Peterson (apeterson1@unl.edu) is the Graduate Exam coordinator. The Graduate Exam coordinator is responsible for scheduling and administration of regularly offered graduate examinations. He is also the principal point of contact for students with graduate exam questions.
- Jim Lewis (wlewis1@unl.edu) is the chair of the Teaching Advisory Committee. Responsibilities of the Teaching Advisory Committee: Advise the Department and act as a resource for the Department about all aspects of teaching. In particular, mentor junior faculty, postdocs, and graduate students in teaching, promote discussions/seminars about teaching, discuss and if needed conduct peer review of teaching, advise faculty about preparation of teaching portfolios, identify nominees for faculty teaching awards.
- Brian Harbourne (bharbourne1@unl.edu) is the chair of the Technology Advisory Committee. Responsibilities of the Technology Advisory Committee: Administer our math lab, oversee the work of our computer support staff, serve as a resource and advise the department on all aspects of use of technology in the classroom and in research, advise the department on issues related to our website, advise the chair on technology resource needs.

The department administers two grants that offer fellowship opportunities for students, the Mentoring Through Critical Transition Points (MCTP) grant, and the Graduate Assistants in Areas of National Need (GAANN) grant.

The steering committees for these fellowship-offering programs are:

**GAANN steering committee:** M. Walker (Chair), L. Bellows (Graduate Studies), R. Rebarber, J. Walker.

**MCTP steering committee:** T. Marley (Chair) A. Donsig, J. Walker,

# Chapter 4

# Degrees

Graduate degree programs in the Department of Mathematics lead to the following degrees: Doctor of Philosophy (PhD), Master of Science (MS), Master of Arts (MA), Master of Arts for Teachers (MAT), and Master of Science for Teachers (MScT). Note that the Department offers both the MS and MA in Mathematics, and that the requirements for these two degrees are identical. Consequently, Master's degree candidates may choose the degree title they prefer at the time they complete their *Memorandum of Courses*.

The MScT and MAT programs are designed for persons who are or will be teaching secondary mathematics. The possession of a valid secondary mathematics teaching certificate is a prerequisite to the award of the degree. For details on the program contact the Chair of the MAT-MScT Committee Jim Lewis (wlewis1@unl.edu).

Particulary capable students who are interested in a joint degree program with the Department of Computer Science are encouraged to contact the Graduate Chair for the details of this program.

Students should note that neither this handbook nor any other publication can substitute for mature, knowledgable advice. All students are encouraged to *see their adviser* if they have any questions. That is what the adviser is there for.

## 4.1 Masters Degree

There are three options for programs leading to a Master's degree. These are:

**Option 1:** Requires a thesis. The program must include 6–10 hours of Math 899 and at least 8 hours of graduate-only coursework. A member of the Graduate Faculty must act as thesis advisor.

**Option 2:** Requires a minor. Students may take a minor in any area offering the Master's Degree outside the Department. Of the 36 hours required, at least 18 must be in Mathematics and at least 9 must be in the minor. The program must include at least 12 hours of graduate-only coursework. This option is not intended for students who expect to pursue a Ph.D.

**Option 3:** May be taken with an area of specialization in Pure Mathematics or Applied Mathematics. The program must include at least 18 hours of graduate-only coursework.

There are no specific course requirements for the Master's degree in general, although all options require a total of 36 hours of coursework. Some of this coursework must be in graduate-only courses, which are defined to be 900-level courses or 800-level courses without a 400-level counterpart. (Generally, these courses are marked with asterisks in the Graduate Studies Bulletin.) All three options allow a minor, and Option 2 requires a minor. The choice of minor area must be approved by the student's advisor.

The *Memorandum of Courses* must be filed in the Graduate College before completion of eighteen hours of graduate credit. The form is required for candidacy and should be completed in consultation with the student's advisor. This form can be found online at
http://www.unl.edu/gradstudies/current/degrees#masters,
and should be filed before half of the anticipated program of studies is complete.

The *Application for a Masters Degree* must be filed at the Graduation Services Office (Canfield Administration Building 109) at the outset of the semester or session in which graduation is planned. It is found at http://www.unl.edu/gradstudies/current/degrees#masters The Masters Exam cannot be completed more than 24 months prior to receipt of the degree. The student and the advisor should jointly determine the appropriate time to take the written exam. The Final Exam Report must be filed in the Graduate Office four weeks prior to the deadline for filing the final report for the degree.

## 4.2 Doctoral Degree

The Ph.D. program requires a Qualifying Exam, a Ph.D. Comprehensive Exam, and a Final Oral Exam. The Ph.D. requires 90 hours of graduate credit, including a dissertation. At least 45 hours must be completed at UNL after the filing of the program of studies. The Ph.D. program will normally include at least 12 hours and at most 55 hours of dissertation research. (In Mathematics, 20 to 25 hours is typical.)

The Mathematics Department does not have specific course requirements beyond those imposed by the Graduate College. However, students are required to consult with their advisor each semester until a supervisory committee is formed. The Supervisory Committee may, at its discretion, include other requirements in the student's Ph.D. program. This includes, but is not limited to, additional 6 courses in mathematics or another subject, additional readings, or a language exam. Each student should consult with their Supervisory Committee about this and other details of their program.

Before a student has earned 45 credit hours, the student forms a Ph.D. Supervisory Committee. The student must choose an Advisor, who will chair the Supervisory Committee and direct the dissertation. A form listing the Ph.D. Supervisory Committee must be filed with the Graduate Studies Office. This form is at http://www.unl.edu/gradstudies/current/degrees#doctoral

A *Program of Studies* must be filed with Graduate Studies within the same semester of approval of the Supervisory Committee; this form is completed with the advice and consent of the student's Supervisory Committee, and is at http://www.unl.edu/gradstudies/current/degrees#doctoral

Once a student has passed the Ph.D. Comprehensive Exam and satisfied any other requirements specified by their supervisory committee, the student must file the *Admission to Candidacy* form with Graduate Studies. Located at http://www.unl.edu/gradstudies/current/degrees#doctoral, this form must be filed no later than seven months prior to graduation. The completed form should be filed with the Office of Graduate Studies.

There must be an oral defense of the thesis, which takes place once the dissertation is written and approved by the student's committee chair and the two designated readers. The timing of the defense will be determined by the Supervisory Committee, and the *Application for Final Oral Examination* must be filed at least three weeks prior to the defense. This form is at http://www.unl.edu/gradstudies/current/degrees#doctoral

## 4.3 Degree Timelines

This section contains information concerning timelines and task sequences that must be completed for the various degree programs.

| | Task | When |
|---|---|---|
| 1 | File *Memorandum of Courses* | while > 50% of program remains |
| 2 | File *Application for Advanced Degree* | start of final semester |
| 3 | File *Final Examination Report for the Masters Degree* | six weeks from graduation |

Table 4.1: Master's Degree Tasks

| Year | Minimal Progress | Normal Progress | Optimal Progress |
|---|---|---|---|
| 1 | | | Qualifying Exam |
| 2 | | Qualifying Exam | Comprehensive Exam |
| 3 | Qualifying Exam (5 semesters) | Comprehensive Exam | |
| 4 | Comprehensive Exam | | |

Table 4.2: Ph.D. Graduate Exam Completion Goals

| | Task | When |
|---|---|---|
| 1 | Form/file Doctoral Supervisory Committee | prior to taking Comprehensive exams[a] |
| 2 | File *memorandum of courses* | while > 50% of program remains |
| 3 | Complete other requirements specified by supervisory committee | at least 1 year prior to graduation |
| 4 | File *Admission to Candidacy* form | 7 months prior to graduation |
| 5 | File *Application for Advanced degree* | Final semester (see deadline) |
| 6 | File *Application for Final Oral Examination or Waiver* | three weeks prior to defense |

[a] if the committee has not been formed prior to taking Comprehensive exams, the GAC will serveas the committee.

Table 4.3: Doctoral Degree Tasks

For doctoral students, it is imperative that the GAC be kept aware of student progress. The Graduate Chair should be regularly informed of changes. Note that *Form π* is a means of keeping the GAC aware of progress toward completion of the Comprehensive Exam. It is located at http://www.math.unl.edu/graduate/forms/form_pi-19970811.pdf, and should be submitted by the adviser at appropriate times, with copies to the Graduate Chair and the student.

# Chapter 5

# Exams and Course Offerings

The requirements for qualification for the Ph.D. program were changed in April 2011 by a vote of the graduate faculty. Students entering the program in August 2011 or earlier may choose between the new rules and the old rules, as described in the GIOGP dated August 31, 2010. Students entering the program after August 2011 must follow these rules.

## 5.1 Course Requirements

Each student must complete, with grades of B or better, at least three two-course sequences. At least one of the sequences must be from Group A below and at least one must be from Group B below. **Group A**

- Math 825-826 (analysis)
- Math 830-831 (differential equations)
- Math 842-843 (applied mathematics)

**Group B**

- Math 817-818 (algebra)
- Math 850-852 (discrete mathematics)
- Math 871-872 (topology)

## 5.2 Course Offerings

The following table gives the typical scheduling for regularly-offered graduate courses. Other courses are offered on an irregular basis based partly on student and faculty interest.

Other courses that have recently been offered with some frequency include Algebraic Geometry, Combinatorics, Commutative Algebra, Graph Theory, Group Theory, Mathematical Biology, Numerical Analysis and Partial Differential Equations.

| Course Number & Topic | Offered |
|---|---|
| 817–818 Introduction Algebra | Yearly |
| 825–826 Mathematical Analysis | Yearly |
| 830–831 ODE | Odd years |
| 842–843 Applied Math | Yearly |
| 901–092 Algebra | Yearly |
| 921–922 Real Analysis | Yearly |
| 924–925 Complex Analysis | Even years |
| 928–929 Functional Analysis | Odd years |
| 932–933 Advanced ODE | Even years |
| 935–936 Advanced Applied Math | Even years |
| 871–872 Topology | Yearly |

Table 5.1: Typical Course Offerings

## 5.3 Qualifying Exams

Entrance into the Department's Ph.D. program is determined by the Ph.D. Qualifying Exam and by successful completion of the course requirements. Each student must pass, at the qualifying (Q) level, two subject exams. Normally each exam should be over the material covered in two courses that form a single coherent body of work. Examples of such course pairs are: algebra (817-818), analysis (825-826), differential equations (830-831), applied mathematics (842-843), combinatorics/graph theory (850-852) or topology (871-872). *One of the the two exams must be either Math 817-818 (algebra) or Math 825-826 (analysis). The other exam may be chosen from any of the remaining five options.* If a student expresses interest in pursuing a Ph.D. in an area that will require a substantial body of knowledge in another discipline, the GAC may approve taking the "third area exam" in a discipline outside the department.

During any examination period the student may take one or more parts of the Ph.D. Qualifying Exam. Scores on parts of the Ph.D. Qualifying Exam are valid for two years; a student need not retake a part of the Exam on which he or she earned a qualifying (Q) score, subject to the two-year limitation. A student is expected to complete the Ph.D. Qualifying Exam during at most five consecutive exam periods (a span of two years). Exceptions may occasionally be granted by approval of the GAC.

The qualifying exams are written and graded by a faculty committee. Each exam problem is typically graded by two independent graders, and then the scores are sent to the GAC with a recommendation regarding failing, passing, and qualifying cutoff scores. The final decision as to whether the student has failed, passed, or qualified is made by the GAC. This decision is based upon exam performance, prior exam performance, and performance in exam cognate coursework, though the GAC is free to consider additional circumstances in rendering its decision. The GAC is to inform the candidate, within a period of three weeks from the last day of the exam, of its decision. For students transferring to UNL from other graduate programs, the GAC has the authority to accept exams taken at other universities.

Students can request to see their exams after grading in order to find out what they did well/poorly on. Students who wish to see their exam for purpose of contesting the grading should be advised that there will be a *very* strong burden of proof needed to sustain a grade appeal on a graduate exam, due to the nature of the exam writing and grading process. Such an appeal is most unlikely to effect any change to the exam result.

The following pages contain a syllabus for the Algebra, Analysis, Applied, Differential Equations, Discrete, and Topology Math Qualifying Exams. For further guidance concerning content of these exams, or content of other exams, contact one of the faculty members listed above, the Graduate Exam Coordinator, or the Graduate Chair. A collection of old qualifying exams can be found at http://www.math.unl.edu/graduate/exams/quals/

## 5.4 Algebra Syllabus

**Group Theory:** Groups, subgroups, homomorphisms, cosets, quotients, isomorphism theorems, direct and semi direct products, solvable groups, structure of cyclic, symmetric and alternating groups; free groups, structure theorem for finite abelian groups.

**Group actions:** Groups acting on sets, cosets, and themselves; orbits and stabilizers, permutation representations, Cayley's Theorem, the class equation, inner automorphisms and automorphism groups, $p$-subgroups and the Sylow Theorems.

**Ring Theory:** Definition and examples, homomorphisms, ideals, quotients, integral domains and their fields of fractions, maximal and prime ideals.

**Factorization in Commutative Rings:** Euclidean domains, Unique Factorization Domains, Principal Ideal Domains, Gauss's Lemma, polynomial factorization, Eisenstein's criterion, Gaussian integers.

**Modules:** Definition and examples: matrices, free modules, and bases over arbitrary commutative rings, Structure Theorem for finitely generated modules over PIDs, applications to linear operators: Jordan and rational canonical forms.

**Basic Linear Algebra:** vector spaces, bases, dimension, bases for infinite dimensional spaces (Zorn's Lemma), linear transformations, eigenvectors, characteristic polynomial, diagonalization, Cayley-Hamilton Theorem.

**Field Theory:** Definition and examples, algebraic and transcendental extensions, degree of a finite extension, multiplicativity of degrees, adjunction of roots, finite fields. Basic Galois Theory for Finite Separable Extensions: Definitions of Galois group and Galois field extensions, the main theorem of Galois theory, primitive elements, Kummer extensions, cyclotomic extensions, quintic polynomials.

**References.**


- D. Dummit and R. Foote, Abstract Algebra, 3rd edition, Wiley.
- M. Artin, Algebra, Prentice-Hall.
- S. MacLane and G. Birkhoff, Algebra, 3rd edition, Chelsea.
- J. Rotman, Advanced Modern Algebra, American Mathematical Society.

## 5.5 Analysis Syllabus

The analysis portion of the Ph.D. Qualifying Examination is a 4-hour written exam which covers the fundamentals of Real Analysis and its standard applications. The main topics are listed below, together with a few references. This list is intended only as a guide.

**Metric space topology:** countable and uncountable sets, including Cantor's diagonal arguments; topology of Euclidian space and metric spaces, norms and inner products; parallelogram law; compactness in terms of subsequences and open covers; the Heine-Borel theorem; connected sets;

**Sequences and series:** convergence of sequences in metric spaces; Cauchy sequences and completeness; lim sups and lim infs; comparison, ratio, root, integral tests for convergence of series; absolute and conditional convergence; rearrangements of series; alternating series test; summation by parts;

**Continuity of functions:** continuity and uniform continuity for functions of one or several variables; images of connected sets; intermediate value theorem; images of compact sets; extreme value theorem; monotonic functions;

**Calculus of functions of one variable:** definition of derivative; mean value theorem; intermediate value property for derivatives; Taylor's theorem; Riemann integrals; fundamental theorem of calculus; improper integrals and Cauchy principal values; functions of bounded variation; Riemann-Stieljes integrals;

**Sequences and series of functions:** uniform convergence; conditions for term-by-term continuity, integration, and differentiation; Weierstrass's M-test; power series and the radius of convergence; Weierstrass's approximation theorem; equicontinuity and the Arzela-Ascoli theorem;

**References:**


1. T. Apostol, *Mathematical Analysis*, 2nd Ed., Addison-Wesley, 1974.
2. K. Davidson and A. Donsig, *Real Analysis and Applications*, Prentice-Hall, 2002.
3. J. Orr, *Analysis Webnotes*, http://www.math.unl.edu/~jorr1/webnotes/home/home.htm, 1996.
4. W. Rudin, Principles of Mathematical Analysis, 3rd Ed., McGraw-Hill, 1976.
5. R. Strichartz, *The Way of Analysis*, Revised Ed., Jones and Bartlett, 2000.
6. W. Wade, *An Introduction to Analysis*, 3rd Ed., Pearson Prentice-Hall, 2004.

## 5.6 Applied Math Syllabus

Here is a list of qualifying exam topics drawn from a two-semester sequence taught from the second edition of J. David Logan's book *Applied Mathematics*. These are only the core topics to be studied for the exam. Additional material may be included.

1. **Dimensional Analysis and Scaling:** The Buckingham Pi theorem; Scaling
2. **Perturbation Methods:** Regular perturbation; Singular perturbation, boundary layer analysis; Asymptotic expansions of integrals
3. **Calculus of Variations:** Derivatives of functionals; The Euler equation; Generalizations, several functions, natural boundary conditions
4. **Integral Equations:** Volterra integral equations; Fredholm integral equations with separable kernels; Symmetric kernels
5. **Second-order, linear, two-point boundary value problems** Fundamental solutions second-order, linear differential operators; Green's functions for two-point boundary value problems; The self-adjoint case; eigenfunction expansions
6. **Introduction to partial differential equations:** Linearity versus nonlinearity, superposition; Derivation of PDEs; conservation laws in $\mathbb{R}^n$, constitutive equations; The heat equation; initial and initial-boundary value problems in $n$ space dimensions; Laplace's and Poisson's equations; boundary value problems and integral identities in $n$ space dimensions; Solution by separation of variables; The Laplace transform; The Fourier transform on $\mathbb{R}^n$
7. **Wave propagation:** Linear and nonlinear waves, characteristics; First-order, quasilinear conservation laws in one space dimension; Shock formation, jump condition; The wave equation, initial and initial-boundary value problems, D'Alembert's solution in one space dimension
8. **Continuum mechanics in $n \leq 3$ space dimensions:** Kinematics; Conservation of mass and momentum; Application to fluid dynamics, the Navier-Stokes equations
9. **Stability and Bifurcation:** One-dimensional problems; stability, classification of bifurcation points, exchange of stability; Two-dimensional problems; the phase plane, linear and nonlinear systems, bifurcation

## 5.7 Differential Equations Syllabus

Here is a list of qualifying exam topics drawn from a two-semester sequence taught from the Second Edition of the book, The Theory of Di?erential Equations: Classical and Qualitative, authored by Walter Kelley and Allan Peterson. Chapter 4 (perturbation theory) and Chapter 8 in this book are not covered in this qualifying exam. Below are the core topics to be studied for the exam. Additional material may be included (see, for example, the * sections below).

1. **Linear Systems.**
2. **Putzer's Algorithm.**
3. **Induced Matrix Norm.** This includes the study of the matrix norm induced by the tra?c norm, the Euclidean norm, and the max norm. Also the Lozinski measure of a matrix and its application to global stability.
4. **Floquet Theory.** This includes Floquet's Theorem, Floquet multipliers, and Floquet exponents and the applications of these results.
5. **Existence and Nonexistence of Periodic Solutions.** This includes the Poincaré-Bendixson Theorem, the Bendixson-Dulac Theorem, Liénard's Theorem, and limit cycle theory.
6. **LaSalle Invariance Theorem.** This includes domains of attraction.
7. **Existence and Uniqueness Theorems.** This includes not only initial value problems but also boundary value problems. Also the extendability of solutions to maximal intervals of existence.
8. **Self-Adjoint Di?erential Equation.** This includes disconjugacy theory, Poyla and Trench factorizations, the study of recessive and dominant solutions, the Sturm Separation and Sturm Comparison Theorems, and the spectral theory of self-adjoint boundary value problems. Also the importance of the relationship of the Riccati equation to the self-adjoint equation (Reid Roundabout Theorem).
9. **Linear Equations of Degree $n$.** This includes factoriztion of $n$-th order linear equations, the study of principal solutions, and the study of Green's functions for higher order multipoint boundary value problems.
10. * **Fixed Point Theorems and Their Applications to Ordinary Di?erential Equations.**
11. * **Theory of Upper and Lower Solutions to Boundary Value Problems.**

## 5.8 Discrete Syllabus

This material is covered in the introductory graduate sequence Math 850 and Math 852.

Enumeration

1. Basic Counting Principles. Counting permutations and combinations. Binomial coefficients and multinomial coefficients. Combinatorial identities. Partitions. Stirling numbers of the first and second kind. Catalan numbers. The Twelvefold Way.
2. Recurrence relations. Solving recurrences via the characteristic equation method and generating functions.
3. Ordinary and exponential generating functions. Exponential Formula.
4. Principle of Inclusion-Exclusion.
5. Burnside's Lemma.
6. The basic probabilistic method and linearity of expectation.

Discrete Structures: Coding Theory, Design Theory, Posets

1. Basic concepts of Coding Theory. Hamming metric. Parameters. Shannon's Theorem.
2. Linear codes. Properties of generator matrix and parity check matrix. Syndrome decoding. Hamming codes.
3. Sphere packing, Singleton, and Gilbert–Varshamov bounds. Asymptotic bounds.
4. Generalized Reed–Solomon codes.
5. Basic concepts of posets. Dilworth's Theorem. Sperner's Theorem. LYM Inequality. Erdős–Ko–Rado Theorem.
6. Basic concepts of designs. Relation of parameters. Fisher's Inequality. Nonexistence results. Finite projective planes.

Graph Theory

1. Basic concepts of graphs. Graphic sequences. Havel–Hakimi Theorem. Eulerian graphs. Characterization of trees. Minimum weight spanning trees and algorithms. Matrix Tree Theorem.
2. Matchings in bipartite and non-bipartite graphs. Hall's Theorem. König–Egeváry Theorem. Tutte's 1-factor Theorem.
3. Connectivity and edge-connectivity. Menger's Theorem. Network flows. Ford–Fulkerson algorithm. Max Flow–Min Cut Theorem.
4. Vertex and edge coloring. Greedy bounds. Szekeres–Wilf Theorem. Brooks' Theorem. Turán's Theorem. Vizing's Theorem and Shannon's Theorem.

5. Planar graphs. Outerplanar graphs. Euler's Formula. Kuratowski's Theorem. Five Color Theorem. Statement of Four Color Theorem.

6. Hamiltonian cycles. Dirac's Theorem. Ore's Theorem.

References


Douglas B. West, *Combinatorial Mathematics*, prepublication version, 2011.

Douglas B. West, *Introduction to Graph Theory*, 2nd edition, Prentice Hall, 2001.

Peter J. Cameron, *Combinatorics: Topics, Techniques, Algorithms*, Cambridge University Press, 1995.

Béla Bollobás, *Modern Graph Theory*, Springer, 1998.

Herbert S. Wilf, *Generatingfunctionology*, 3rd edition, A. K. Peters, 2006.

Ron M. Roth, *Introduction to Coding Theory*, Cambridge University Press, 2006.

Vera Pless and W. Cary Huffman, *Fundamentals of Error-Correcting Codes*, Cambridge University Press, 2003.

## 5.9 Topology Syllabus

**Note:** "Math 871/872" was formerly "Math 970-971"; the old numbering appears on older topology qualifier exams, but the new numbering is used on links to these exams.

The Topology Qualifying Examination covers the fundamentals of point-set and algebraic topology, along with standard applications. The main topics are listed below, together with a few references.

Point-set Topology

**Topological spaces and continuous functions:** Topology, open and closed sets, basis, subbasis; continuous function, homeomorphism; closure, limit points; subspace topology, product topology, and quotient/identification topology.

**Homeomorphism invariants:** Separation properties ($T_0$, $T_1$, Hausdorff, regular, normal), countability properties; connectedness, path connectedness, components; compactness, metrizability. Applications.

**Continuous deformations:** Retraction, deformation retraction, contractible, mapping cylinder, homotopic maps, homotopy type.

Algebraic topology

**Fundamental groups:** Fundamental group, induced homomorphism; free group, group presentation, Tietze's theorem, amalgamated product of groups, Seifert - van Kampen Theorem; cell complex, presentation complex, Classification of surfaces.

**Covering spaces:** Covering map, Lifting theorems; covering space group action; universal covering, Cayley complex; Galois Correspondence Theorem, deck transformation, normal covering; applications to group theory.

**Homology:** Simplicial homology, singular homology, induced homomorphism, homotopy invariance; exact sequence, long exact homology sequence, Mayer-Vietoris Theorem. Applications.

References

J.R. Munkres, Topology (Second Edition), Prentice-Hall.

A. Hatcher, Algebraic Topology, Cambridge.

W.S. Massey, A Basic Course in Algebraic Topology, Springer.

## 5.10 Comprehensive Exam

The student's Ph.D. Supervisory Committee will determine the timing and the content of the Ph.D. Comprehensive Exam. Consequently, the student is strongly advised to form a Supervisory Committee before taking any components of the exam. The GAC serves as the default Ph.D. Supervisory Committee for students who have qualified for the Ph.D. program but have not yet formed a Ph.D. Supervisory Committee. The Supervisory Committee is required to follow Graduate College rules regarding the Comprehensive Exam, which may be found online at
http:/bulletin.unl.edu/graduate/Doctoral_Degree_Requirements#Comprehensive_Examination_and_Admission_to_Candidacy. In particular, the Comprehensive Exam *must* include a written portion and *may*, at the discretion of the Supervisory Committee, include an oral portion.

Typical Comprehensive Exams in the Mathematics Department consist of two parts:

**Part I:** One of the following (a) A four-hour written exam in algebra over the material usually covered in Math 901–902. Recent text: Lang, Algebra. Additional References: Hungerford, Algebra; Kaplansky, Fields and Rings.
(b) A four-hour written exam in analysis based on the material usually covered in Math 921–922. Recent text: Royden, Real Analysis. Additional References: Rudin, Real and Complex Analysis; Folland, Real Analysis.

**Part II:** A four-hour written exam or a two-hour oral exam administered by the Supervisory Committee, to test the student's breadth of understanding of the field of knowledge of which his/her special subject is a part.

A student who has used a course sequence (e.g. Math 901–902 or Math 921–922) to complete a portion of the Qualifying Examination cannot use it again as a portion of the Comprehensive Examination.

As with the Qualifying Exam, the "standard" Comprehensive Exams are written and graded by committee and a recommendation is made to the students Supervisory Committee. The decision as to whether or not the student has passed the Comprehensive Exam, and if not, which part(s) of the exam must be repeated, rests with the Supervisory Committee.

Very few students take one of the standard Comprehensive Exams without enrolling in the appropriate course sequence. Any student who wishes to take one of these exams without enrolling in the cognate course should contact their Supervisory Committee or the Graduate Chair to determine the suitability of this course of action. Examples of old Comprehensive Exams are located online at www.math.unl.edu/graduate/exams/comps/

## 5.11 Language Exams

In the Fall of 2012 the Faculty voted that that there is no longer a departmental language exam requirement for the Ph.D., and there is no university language requirement. The Supervisory Committee has the discretion to require a language exam of its choosing. If there is a language exam, it does not need to be completed before a student can apply for candidacy. In fact, candidacy should be established as soon as a student has passed his or her comprehensive exam.

# Chapter 6

# Assistantships

Most graduate students in the Department of Mathematics are financially supported by means of teaching assistantships. This section discusses some of the terms and duties of this type of support.

Some students are supported with fellowships. These fellowships may be awarded by the department, the university, or by external sources. Information on university and external fellowships is available at http://www.unl.edu/gradstudies/current/funding#fellowships The Mathematics Department administers the MCTP and GAANN grants and there are usually several fellowships available each year from these programs. The application deadline for most university-affiliated fellowships usually falls around February 1.

## 6.1 Appointment and Reappointment

There are four teaching appointments offered by the department. The Full-Time Equivalence (FTE), compensation, and number of contact hours for each appointment are shown below.

GTA compensation is determined by two factors. The first is teaching load, measured in full-time equivalence (FTE). The second is progress toward the PhD, measured by the passing of the Qualifying and Comprehensive Exams.

These amounts are for the 10 month academic year running from August until May. Summer funding follows a different schedule and largely depends upon the source of the support and the nature of the work assignment. The amount of summer support is generally between $2,600 and $4,700.

Paychecks are distributed monthly, August through May, on the last business day of the month. Federal and state taxes are withheld, but so long as the student is carrying enough credit hours of classes, no FICA (Social Security) is withheld. The university pays 79% of the student health insurance premium for those students who are enrolled in the health plan. Students who have another source of health insurance and do not want to be enrolled should contact Tom Danaher.

The remaining 21% of the health insurance premium is added to your student bill.

In order to be allowed to teach, a student from a non-English-speaking country must attend the Institute for International Teaching Assistants (ITA), an intensive three-week program running from late July to mid-August. (In order to be admitted to the ITA, the

| FTE | Base Pay ($) | Typical Duties |
|---|---|---|
| 0.33 | 15,800 | 4 contact hours fall semester; 4 contact hours spring semester |
| 0.37 | 16,400 | 6 contact hours fall semester; 3 contact hours spring semester |
| 0.40 | 17,500 | 5 contact hours fall semester; 5 contact hours spring semester |
| 0.49 | 19,700 | 6 contact hours fall semester; 6 contact hours spring semester |

| Benchmark | Additional Pay ($) |
|---|---|
| Completed Qualifing Exams | 600 |
| Completed Comprehensive Exams | 1,200 |

| Contact Hours | Average equivalent hours/week commitment |
|---|---|
| 3 | 10–12 |
| 4 | 13–15 |
| 5 | 16–18 |
| 6 | 19–21 |

Table 6.1: Pay Scale for GTAs

student must score at least 22 on the TOEFL.) At the end of the ITA, the student must pass a "final panel." An international student who does not pass the final panel of the ITA will be hired as a grader at a substantially lower salary than the GTA stipend.

New GTAs are typically assigned calculus recitations. Second year students will teach standardized sections of Math 101 or 100A. Thereafter you are generally put in charge of your own classes. More advanced GTAs teach calculus, contemporary mathematics, and courses in arithmetic and geometry for elementary teachers. Summer teaching positions are usually available. Students whose teaching performance is adequate and who are making satisfactory progress toward their degree can expect continued support for five to six years, with possible further support under certain circumstances.

Initially, satisfactory progress is determined at the discretion of the GAC, largely based upon qualifying exam performance and course grades. Upon the establishment of a supervisory committee, the GAC and this committee will determine satisfactory performance based largely upon comprehensive exam performance, course grades, and adviser's recommendation. After completion of the comprehensive exam, the supervisory committee has primary responsibility for determining sufficient progress, though the GAC will be interested in timely achievement of certain key tasks, to include the discharge of the language requirement and advancement to candidacy.

Typically a request form will go out to all teaching assistants toward the end of the semester on which you can request to teach specific classes for the following semester. It is good to develop your teaching résumé, but be careful what you ask for, since you might get it. Some classes are more difficult to teach than others, and this should be considered in conjunction with the difficulty of your own classes when requesting a teaching assignment.

Some GTAs are assigned grading duties in addition to, or in lieu of, their teaching duties. All course and grading assignments are made by Allan Donsig. Request for teaching assignments are made via the web, and the vice chair will send a general email to

all graduate students asking for their course requests several months prior to the beginning of the next semester.

## 6.2 Duties

The duties associated with being a graduate teaching assistant in the Department of Mathematics can be split into two areas: teaching duties and department duties. Be aware that GTA duties during summers sometimes differ from normal duties during the school year. See the following chapter on summers for more information.

### 6.2.1 Teaching Duties

There are many duties listed in this section, but the four most important facts to note are:

1. As a GTA, you are *never*, under any circumstances, to cancel your class. If you are unable to make it to your class YOU are responsible for finding someone to cover your class. If you are unable to find a replacement, contact Lori Mueller or Allan Donsig as soon as possible.

2. In a similar manner, you are not allowed to sign overrides to grant students permission to enroll in your class. All students must apply for an override by submitting the override form to the main office (Avery Hall 203).

3. As a GTA, you must hold a certain number of office hours each week. If you are teaching recitation sections, you are required to have at least two office hours per week (not counting your hours in the MRC). If you are teaching your own class, you are required to have at least three hours of office hours (again, not counting your hours in the MRC). In addition to these set office hours, you must also offer times "by appointment" to accomodate students who cannot make your regular office hours.

4. If you encounter any problems while teaching (academic dishonesty, behavior issues, etc), Allan Donsig and Lori Mueller are available to help you deal with these issues. Do not hesitate to ask for assistance if you need it.

Teaching assistants generally have appointments of 0.33, 0.37, or 0.49-FTE with workloads as described in Section 6.1. While some teaching assistants will grade for other classes, almost all graduate students will have teaching assignments in one of the following courses:

When teaching Math 100A or 101, you will have predesigned lesson plans, convener designed homework and exams to help ease you into the process of teaching for the first time.

Beyond Math 101 you will be responsible for all aspects of teaching these courses, from preparing and delivering lectures to writing and grading tests and quizzes. Each of the courses listed above has a convener who is in charge of making a master syllabus for the course, and from which the unit final exam will be written (Math 203 does not have a final exam). The convener is also responsible for making the final exam. If you have questions about any of the material that is listed on the syllabus you should discuss this with the

| Course Number & Description | | Class Time (hours) |
|---|---|---|
| Math 100A | Intermediate Algebra | 3 |
| Math 101 | College Algebra | 3 |
| Math 102 | Trigonometry | 2 |
| Math 103 | College Algebra and Trigonometry | 5 |
| Math 106 | Calculus I (Recitation) | 2 |
| Math 107 | Calculus II (Recitation) | 2 |
| Math 203 | Contemporary Mathematics | 3 |

Table 6.2: Typical GTA Teaching Duties

convener. Advanced graduate students who have taught classes before may be asked to serve as the convener for the courses listed above. For more information on being a convener see 6.2.2.

Advanced graduate students, and those with previous teaching experience may be asked to teach one of the following courses:

| Course Number & Description | | Class Time (hours) |
|---|---|---|
| Math 104 | Business Calculus | 3 |
| Math 106 | Calculus 106 (Lecture) | 3 |
| Math 208 | Calculus III | 4 |
| Math 221 | Differential Equation | 3 |
| Math 314 | Matrix Theory | 3 |

Those teaching Math 221 and Math 314 will also be responsible for making their own final exams.

GTA's teaching 100A, 101, 102 or 103 will be required to attend a workshop for instructors before the beginning of the fall semester. In addition, these courses will likely have weekly meeting during the semester to deal with course issues and professional development. For those GTA's whose teaching assignment is something other than Math 100A, 101, 102, or 103, you should meet with the course convener before the semester begins. (For those students who are teaching their first course during the summer session you should contact Lori Mueller and ask for copies of the syllabus from the last semester, and if possible any course guidelines that should be addressed; see Chapter 7.) For additional help on teaching style or technique you can contact the department of Graduate Studies, see Section 8.1.1.

As a GTA, you are *never*, under any circumstances, to cancel your class. If you are unable to make it to your class YOU are responsible for finding someone to cover your class. If you are unable to find a replacement, contact Lori Mueller or Allan Donsig as soon as possible. In a similar manner, you are not allowed to sign overrides to grant students permission to enroll in your class. All students must apply for an override by submitting the override form to the main office (Avery Hall 203). On the first day of classes you may find drop letters in your mailbox. These letters are to be delivered to the students during the first week of classes. They outline why the student is being dropped from the course. The reasons for this are either not having passed a prerequisite course, or not qualifying

via the Math Placement Exam. You need to attempt to deliver these letters every day of class for the first week.

In the course of teaching a class or recitation, it will often occur that a student asks if they should drop the class. It is important never to say yes. Because of issues related to student loans, scholarships, etc. the student should always be advised to speak with their academic advisor before deciding to drop.

#### Final Exams

Those GTAs that are teaching Math 100A, 101, 102, 103, 104, 106, 107, or Math 208 will have a unit final. That is, the conveners of each course will write a final exam that all students in that course will take. The unit finals are always scheduled from 6-8 p.m. during finals week, and all the students in the above mentioned courses will be taking their finals on the same day. (The exact day is always known prior to the start of the semester and will be stated on the syllabus.) If for some reason a student is unable to make the unit final they must inform Lori Mueller or Allan Donsig as soon as possible to schedule an alternate exam. You are not allowed to let a student take the final exam early. Grading duties for the final exam are assigned by the convener and grading should be completed in a timely fashion.

Course materials should be kept for at least one year after completion of the course. Please do not dispose of final exams yourself; bring them to Lori Mueller, who can make sure that social security numbers are taken care of as they should be. The main office can also dispose of any other old course materials you have, if you don't want to check for names and social security numbers.

### 6.2.2 GTA Conveners

GTA's may on occasion be asked to serve as a convener for Math 102 or Math 103. As a convener, it is their duty to write a master syllabus for all the sections of the course they are teaching. In addition to the syllabus, they should meet with all the other GTA's teaching that course to discuss what policies should be followed, e.g. whether or not there will be quizzes, how many tests will be given, whether there will be projects, if there will be low quiz scores drop, total number of points available, etc. **These policies should be uniform over all the sections of that course.** Conveners are also responsible for writing the final exam, and an alternate final exam. It is suggested that you ask the other instructors for problems that should be included on the final exam so as to ease the burden of writing the entire final exam yourself. After the exam has been written a copy should be sent to Lori Mueller so that it can be photocopied for all the sections. You should also make up grading assignments for final exam and notify the other instructors of their grading assignment.

### 6.2.3 Departmental Duties

As a Graduate Teaching Assistant, your duties to the department include, but are not limited to, teaching your assigned course or courses and/or grading for other courses as per your appointment/reappointment contract, making yourself available for scheduled office hours, serving as a counselor in the Math Resource Center (MRC) and performing

any other service as agreed upon by you and the department chair (or other department administrator). Your time in the MRC is not to be counted as your only office hours. You are required to have office hours outside of the time that you are in the MRC.

Unless otherwise stated in your contract, as a GTA you are required to serve as a counselor in the MRC two hours a week during either the Fall or Spring semester. As a counselor you are to assist students with questions that they may have in the courses listed in the previous section.

Every year the department hosts Math Day, a mathematics competition for high schools across Nebraska. You are required to help out with Math Day in some manner. The department will distribute sign up sheets to your mailbox several weeks in advance. Return the sheet to the Center for Science, Mathematics, and Computer Education indicating at what times you will be able to help.

# Chapter 7

# Summers

Summers are different than the rest of the academic year. Expectations, classes, and teaching during the summer differ substantially from those during the year, and so it is important to be aware of what is different and what remains the same.

## 7.1 Classes

Course offerings are slim pickings during the summer. If none of the summer classes look like your cup of tea, faculty are often willing to do a reading course with you. However, they may travel a lot or otherwise filling up their summer schedule, so it is in your best interest to start making inquiries as soon as possible.

GAANN trainees are required to be registered during both summer sessions, though MCTP trainees are not.

Keep in mind that people are pretty flexible in the summer. If you can't be here for the first week of first session and the last week of second session, hope is not lost for taking a class. Faculty will often work with you to find something that works for both of you. However, the sessions in which you teach and are registered for your own class(es) must coincide!

## 7.2 Teaching

**Syllabus and Book:** You should receive an email before each summer session starts with a template syllabus from the previous summer. Update dates of lectures, Gateway exams (if applicable), MRC/Math Lab hours, Math Placement policy and readiness requirements, and the final exam date, and return it to Lori Mueller for proofing before any photocopying is done to ensure that all required University and Department verbage is included. You may also contact Lori Mueller as soon as you have been notified of your summer teaching assignment for the syllabus template.

**MRC:** The Math Resources Center is available during the summer. See
http://www.math.unl.edu/resources/undergraduate/mrc
for the scheduled summer hours and location. This information must be advertised to your students via your class syllabus.

**Computer exams/HW:** Math 102, 106, and 107 require the Gateway exam as part of the course curriculum. If you are teaching one of these courses, you must contact Rex Dieter to let him know what dates you have chosen to have the GAteway exam made available to your students. He will publish these dates on the departments' Gateway Exam webpage with a link for your students to access it. You will be required to create your own Gateway Administration Folder; ask Rex Dieter for written instructions on how to do this. The Gateway exam can be proctored in our Math lab (18 Avery Hall) or the Arts and Sciences Testing Center (127 Burnett Hall).

Currently, Math 100A and 101 are requiring MyMathLab during the summer.

**Projects:** Courses that have projects during the school year may not have projects during the summer. Talk to Lori Muelleror Allan Donsigto see if yours does.

**Final Exams:** During the summer sessions, there is no common final exam. You are required to write your own or get together with other instructors teaching the same course and write it together. All alternate final exam requests must be forwarded to Lori Mueller for approval. The department rule stands strong that no final exam will be administered prior to the scheduled final exam date and time. In case one of your students is approved for an alternate final exam, you are responsible for writing the alternate final exam.

**Guidance/Conveners:** There is no "Super TA" in the summer. If you have any questions or concerns about your course before or during the session, ask your section lecturer (for reci instructors), Allan Donsig, or Lori Mueller.

**Pay:** If you work first session, you get paid during June and July. If you work second session, you get paid during July and August, and so you will not be getting paid in June. Plan ahead!

Furthermore, you should register for whatever classes you are taking during the same session in which you are teaching, in order to get paid.

# Chapter 8

# Preparing for Graduation

## 8.1 Professional Development

Whether your academic goals are to obtain a masters degree or a Ph.D. degree, the University and department will assist you in your development. The Graduate College and the office of Graduate Studies offers many programs to help graduate students. The Graduate Student Academic and Professional Development program offered by Graduate Studies can help graduate students explore the various academic and nonacademic career paths available to the them. They work with UNL Career Services and UNL faculty to provide resources and materials in

- basics of an effective cover letter
- cover letter do's and don'ts
- Curriculum Vitæ (CV)
- effective interview strategies
- delivering the "job talk"
- job search strategies

For those students pursuing a Ph.D. the department offers two seminars related to these topics. The Academic Job search workshop, and the Professional Development seminar. The Academic Job Search workshop is offered in the fall semester and students are encouraged to take it the year prior to their graduation. The Professional Development Seminar is offered in the spring semester and students are encouraged to participate in this a year prior to graduation as well. While much of the materials presented in these programs is geared toward the academic profession, those pursuing non-academic jobs are encouraged to participate.

### 8.1.1 Graduate Studies Teaching Services

In addition to these programs, the Graduate Studies office offers many other services to assist graduate students with their teaching duties. Among these are an annual workshop held during the fall semester. Graduate Studies also offers individual consultation on teaching. They will observe/videotape your classes and offer suggestions that may help improve your teaching.

## 8.2 Applying for jobs

As a service for those students who are graduating with a Ph.D. the department will mail all application materials free of charge. Materials must be given to the department within a reasonable time frame. To have materials mailed you should supply the department with the following information:

Address labels or a Word document or PDF file with the address labels formatted
Cover letters, CVs, and other relevant documents
Names of people writing recommendation letters
The items that should be included in each application along with the deadline

## 8.3 Graduation forms

Make sure that you obtain a copy of the degree forms deadlines from either the Graduate Studies website http://www.unl.edu/gradstudies/current/degrees.shtml or from the Graduation Services office in Canfield Administration Building. Almost all of the forms that you need will be downloadable from the Graduate Studies webpage.

## 8.4 Post-Graduation

Upon your departure from the department, you will need to supply Lori Mueller with copies of **ALL** your grade books, and also the final exams from the last semester you taught. Along with these grade books you should include any and all documents that pertain to your grading scales as well as any other information that might be useful in a grading appeal. You are also asked to complete an AMS questionnaire that Marilyn Johnson will give you.

# Chapter 9

# University Policy

## 9.1 Policy and Procedures on Unlawful Discrimination

See http://hr.unl.edu/policies for complete details.

The University of Nebraska–Lincoln (UNL) has an institutional obligation to provide a place where persons can work and study free of illegal discrimination. More specific aspects of that obligation are defined by Titles VI and VII of the Civil Rights Act of 1964, Title IX of the Education Amendments of 1972, the Rehabilitation Act of 1978, the Americans with Disabilities Act of 1990, and the Age Discrimination in Employment Act, among other federal and state laws, agency regulations and judicial interpretations. University officials have a duty to promptly investigate and take appropriate action on all known incidents of illegal discrimination.

In addition to its legal obligations, UNL is a community which, within legal restraints, may establish norms of behavior to govern the interaction of individuals within the community. These norms may, and often do, go beyond enforcement of any legal obligation established for the University as an institution.

The UNL seeks to achieve a working and learning environment that is open to all people. Diversity is one hallmark of great institutions of learning and has long been one of the strengths of our society. Dignity and respect for all in the UNL community is the responsibility of each individual member of the community. The realization of that responsibility across the campus is critical to UNL's success.

UNL has a policy of equal educational and employment opportunities and of nondiscrimination in the classroom and workplace. Educational programs, support services and workplace behavior, including decisions regarding hiring, promotion, discipline, termination and all other terms and conditions of employment, should be made without discrimination on the basis of race, color, religion, sex, national origin, age, disability, veteran status, marital status or sexual orientation. No person should be subject to retaliation for seeking a review of a complaint of discrimination, for participating in an investigation of such a complaint, or for seeking redress for discrimination.

## 9.2 Student Code of Conduct: Academic Dishonesty

The entire bulletin can be found at http://stuafs.unl.edu/ja/code/three_print.shtml

The maintenance of academic honesty and integrity is a vital concern of the University community. Any student found guilty of academic dishonesty shall be subject to both academic and disciplinary sanctions. Academic dishonesty includes, but is not limited to, the following:

1. Cheating. Copying or attempting to copy from an academic test or examination of another student; using or attempting to use unauthorized materials, information, notes, study aids or other devices for an academic test, examination or exercise; engaging or attempting to engage the assistance of another individual in misrepresenting the academic performance of a student; or communicating information in an unauthorized manner to another person for an academic test, examination or exercise.
2. Fabrication and Falsification. Falsifying or fabricating any information or citation in any academic exercise, work, speech, test or examination. Falsification is the alteration of information, while fabrication is the invention or counterfeiting of information.
3. Plagiarism. Presenting the work of another as one's own (i.e., without proper acknowledgment of the source) and submitting examinations, theses, reports, speeches, drawings, laboratory notes or other academic work in whole or in part as one's own when such work has been prepared by another person or copied from another person.
4. Abuse of Academic Materials. Destroying, defacing, stealing, or making inaccessible library or other academic resource material.
5. Complicity in Academic Dishonesty. Helping or attempting to help another student to commit an act of academic dishonesty.
6. Falsifying Grade Reports. Changing or destroying grades, scores or markings on an examination or in an instructor's records.
7. Misrepresentation to Avoid Academic Work. Misrepresentation by fabricating an otherwise justifiable excuse such as illness, injury, accident, etc., in order to avoid or delay timely submission of academic work or to avoid or delay the taking of a test or examination.
8. Other. Academic units and members of the faculty may prescribe and give students prior notice of additional standards of conduct for academic honesty in a particular course, and violation of any such standard of conduct shall constitute misconduct under the Student Code of Conduct and the University Disciplinary Procedures.

# Chapter 10

# Department Policy

## 10.1 Policy and Procedures on Discrimination and Harassment

*Sent to the department on August 22, 2006 by John Meakin, Chair.*

As we begin a new academic year, I want to bring to your attention some basic institutional and departmental policies regarding discrimination, including sexual harassment and other forms of harassment. The university has a detailed statement *University of Nebraska-Lincoln Policy and Procedures on Unlawful Discrimination, including Sexual and other Prohibited Harassment*, that may be found on the UNL website at
http://www.unl.edu/pr/policy.html.
It is critical to the success of the mission of the University and of our Department, that we all understand and respect these policies and procedures, especially with regard to our relationships with our students, colleagues, and co-workers. Let me quote and comment on just a few sentences from the UNL document:

> 1.1 Introduction. The University of Nebraska–Lincoln (UNL) seeks to achieve a working and learning environment that is open to all people. Diversity is one hallmark of great institutions of learning and has long been one of the strengths of our society. Dignity and respect for all in the UNL community is the responsibility of each individual member of the community. The realization of that responsibility across the campus is critical to UNL's success.

Comment: Our department fully embraces this goal. It is our aim to create an environment that enhances the learning and professional development of all of our faculty, staff, and students and that respects diversity of ideas and people. It is the responsibility of all members of our department to ensure that this goal is achieved. Please be sensitive to this goal in your dealings with our staff, faculty, and graduate students, and with undergraduate students in classes that you are teaching.

> 4.1.1. Discrimination: The University of Nebraska–Lincoln shall not discriminate based upon race, color, religion, sex, national origin, age, disability, veteran status, marital status or sexual orientation.

Comment: Our department fully embraces this goal. Please bring to my attention any instances of discrimination in the workplace, or in dealings between instructors and students, either in or out of the classroom.

> 4.1.2. Discrimination in the Form of Sexual Harassment: It is the policy of the University of Nebraska-Lincoln that no member of the UNL community may sexually harass another. Sexual harassment is a form of discrimination based upon gender. It is prohibited at UNL and is subject to the procedures and sanctions contained in this policy.

Comment: Our department has a zero tolerance policy towards sexual harassment. Sexual harassment may be physical, verbal, or emotional. Sexual harassment can occur in a variety of circumstances, including but not limited to the following: The victim as well as the harasser may be a woman or a man. The victim and the harasser do not have to be of the opposite sex. The victim does not have to be the person harassed but could be anyone affected by the offensive conduct. The harasser's conduct must be unwelcome. Please bring to my attention any instances of sexual harassment, either in the workplace, in the classroom, or in relations between instructors and students.

> 4.2. Consensual and Domestic Relationships. UNL policy requires recusal (the relinquishment of the supervisory role) when supervisory or evaluative relationships exist between members of the university community who share sexual, romantic, or domestic relationships. This policy covers, but is not limited to, persons in the following professional relationships: line officers and faculty; faculty and students; tenured and non-tenured faculty; graduate assistants and students; supervisors and the employees they supervise; and student or employee and administrator, coach, advisor, counselor, or residential staff member who has supervisory responsibility for that student or employee.

Comments: While UNL certainly does not seek to inhibit consensual and domestic relationships between people, it does seek to remove a power differential that makes mutual consent inherently suspect and that raises questions of conflict of interest. This has particular implications about relationships between people in our academic environment. Ideally, instructors should avoid becoming involved in a consensual relationship with any student in a class they are teaching.

If a faculty member believes that the potential for a consensual relationship exists with a graduate student or an undergraduate student in the department, the faculty member has a responsibility to notify me as soon as possible about the relationship. I will take all possible steps to ensure that the faculty member does not have any duties or responsibilities that result in a position of power over the student and that there is no perception of preferential treatment of the student as a result of the relationship.

If a graduate student (or a lecturer, or an undergraduate student with instructional responsibility) believes that the potential for a consensual relationship exists with a student in a class he or she is assigned to teach, the instructor has the responsibility to notify me about this as soon as possible. If necessary I will find a way to reassign the instructor's duties for the semester so that the instructor and the student in his or her class are not put in a position of either apparent or real conflict of interest.

# Appendix A

# Purpose of a Doctorate in Mathematics

The purpose of doctoral education in mathematics is to produce the next generation of mathematicians who will advance mathematical research and maintain the integrity and vitality of the discipline. Doctoral graduates in mathematics should become stewards of the discipline, people who are entrusted with preserving and developing the mathematical literature and with communicating mathematical knowledge to others.

A doctoral graduate in mathematics should have a deep active knowledge of some area of mathematics, and should have made a significant contribution to the literature in that area. In addition, doctoral graduates in mathematics should possess:

a broad knowledge of the mathematical literature, its historical development, and how diverse parts of mathematics relate to each other;

a general understanding of the centrality of mathematics in society, and the interrelations between mathematics and other disciplines;

preparation and skill to teach mathematics at different levels;

an understanding of and commitment to the ethical principles that underlie professional work in the discipline of mathematics;

a sense of membership in the community of current and former mathematical scholars, and an understanding of the historical roots of this community;

a commitment to the profession, engaging in professional service, both within the graduates immediate community, and within the broader community of mathematical scholars;

the ability to communicate the beauty and power of mathematical ideas to diverse audiences;

the ability to help others learn to combine creativity and imagination with the rigor, logic, and precision of mathematics.

Essential to the notion of stewardship of the discipline is that a doctoral graduate should have a sense of shared ownership of the body of mathematical ideas, and a sense of responsibility to preserve, develop, and enhance the understanding of these ideas. This can be accomplished through research contributions that advance the boundaries of knowledge in the discipline, through educating, nurturing and inspiring a new generation of students, through professional service to the discipline, and through contributions that advance the interaction between mathematics and other disciplines.

Doctoral and postdoctoral education should produce scholars who are prepared for a variety of careers that utilize their mathematical knowledge. Ideally, the doctoral granting

institution will continue to mentor its graduates long after they have embarked on their careers. Doctoral graduates should leave their graduate institutions with an appreciation that they belong to a community of mathematicians who share a responsibility to be stewards of their discipline and to communicate mathematical ideas to others. Many scholars choose academic careers; others choose careers in business, industry or government.

**Academic careers in doctoral granting departments**

Those who pursue academic careers in research-intensive, doctoral granting departments should develop a deep technical and historical understanding of the literature in their area and should continue to make research contributions to this literature that are judged significant by their peers. They should develop a general understanding of the role and significance of the literature in their area as it relates to the overall mathematical literature and the literature in related disciplines. They should develop a sense of responsibility for maintaining the integrity and vitality of their area, for communicating mathematical knowledge effectively to a broad audience of students, professionals, and the general community, and for educating and inspiring the next generation of mathematicians and mathematically literate people. They should assume responsibility for providing professional service to their institution, to the community of scholars in their area, and to the discipline as a whole.

**Academic careers in teaching-intensive departments**

Those who pursue careers in teaching-intensive departments should develop an understanding of the depth and breadth of the mathematical literature. They should be able to recognize and nurture mathematical talent, to engage talented students in creative mathematical experiences, and to inspire such students to seek additional mathematical education. They should remain intellectually engaged in the discipline throughout their careers, and be aware of important developments in the research literature and the literature in mathematics education. Although the demands of their teaching duties may limit the time they have available for scholarly work, they should endeavor to remain active as scholars. They should have a general understanding of the relationship between mathematics and other disciplines. They should serve as ambassadors for the discipline as it is represented to a general audience of students, and they should provide students with a perspective on the discipline and its role in society.

**Careers in government or the private sector**

Those who pursue careers in government or the private sector should have a broad understanding of the general mathematical literature and its relationship to other fields. They should be able to use their mathematical training to solve interdisciplinary problems and problems in other disciplines. They should serve as ambassadors for the discipline, at the interface between mathematics and other fields. They should be able to absorb essential ideas and problems from other fields and bring mathematical ideas to bear. They should be intellectually adaptable, and should be able to communicate mathematical ideas to professionals in different fields, and to communicate important ideas from other fields to the mathematical community.

# Appendix B

# Change Log

2.3 26 March 2013: Updated Department Contacts, updated current GSAB members, updated website links, added differential equations and discrete syllabus, updated other syllabi, updated qual exam/comprehensive exam requirements, updated (lack of) language exam requirement, added course requirements (changed in April 2011)

2.1 18 August 2009: Updated Graduate Exam Chair, added Acting Chair information, added Full Time Certification and ABD info in the Degree chapter (with links), updated current GSAB members, added a section for future changes, assorted minor edits

2.0 4 July 2007: Added Summer chapter, updated vice and grad chairs and current GSAB members, updated course and exam requirements as per GAC changes, many other minor edits

1.2 17 Aug 2007: Added Harassment chapter, added CAPS info, added Current GSAB members

1.1.1 4 Jun 2007: Changed Grad Sec's title

1.1 29 Nov 2006: Added Topology Qual Syllabus

1.0.1 23 Aug 2006: Update of Algebra Qual Syllabus

1.0 14 Aug 2006: Initial release to incoming students

# Appendix C

# Future Changes

2.2 Include information on "All But Dissertation" (ABD) policies; include section on health insurance enrollment (link to policy, enrollment); update links if no longer current.