Fiscal Unit/Academic Org	Mathematics - D0671
Administering College/Academic Group	Mathematical And Physical Sci
Co-adminstering College/Academic Group	
Semester Conversion Designation	Converted with minimal changes to program goals and/or curricular requirements (e.g., sub-plan/specialization name changes, changes in electives and/or prerequisites, minimal changes in overall structure of program, minimal or no changes in program goals or content)
Current Program/Plan Name	Mathematics
Proposed Program/Plan Name	Mathematics - MATH-PHD
Program/Plan Code Abbreviation	MATH-PH
Current Degree Title	Doctor of Philosophy

Credit Hour Explanation

Program credit hour requirements		A) Number of credit hours in current program (Quarter credit hours)	B) Calculated result for 2/3rds of current (Semester credit hours)	C) Number of credit hours required for proposed program (Semester credit hours)	D) Change in credit hours
Total minimum credit hours required for completion of program		120	80.0	80	0.0
Required credit hours offered by the unit	Minimum	42	28.0	29	1.0
	Maximum	117	78.0	77	1.0
Required credit hours offered outside of the unit	Minimum	3	2.0	3	1.0
	Maximum	78	52.0	51	1.0
Required prerequisite credit hours not included above	Minimum	0	0.0	0	0.0
	Maximum	0	0.0	0	0.0

Program Learning Goals

Note: these are required for all undergraduate degree programs and majors now, and will be required for all graduate and professional degree programs in 2012. Nonetheless, all programs are encouraged to complete these now.

Program Learning Goals

- Attain knowledge & problem solving skills in broad set of core areas as expected of faculty at major math departments
- Attain scholarship & research skills in specialized field of math at level of professional research
- Engage in independent research

Assessment

Assessment plan includes student learning goals, how those goals are evaluated, and how the information collected is used to improve student learning. An assessment plan is required for undergraduate majors and degrees. Graduate and professional degree programs are encouraged to complete this now, but will not be required to do so until 2012.

Is this a degree program (undergraduate, graduate, or professional) or major proposal? Yes

Does the degree program or major have an assessment plan on file with the university Office of Academic Affairs? No

DIRECT MEASURES (means of assessment that measure performance directly, are authentic and minimize mitigating or intervening factors)

Standardized tests

- Local comprehensive or proficiency examinations

Classroom assignments

- Embedded testing (i.e. specific questions in homework or exams that allow faculty to assess students' attainments of a specific learning goal)

Evaluation of a body of work produced by the student

- Practicum, internship or research evaluation of student work

Direct assessment methods specifically applicable to graduate programs

- Candidacy exams
- Thesis/dissertation oral defense and/or other oral presentation
- Thesis/dissertation (written document)
- Publications

INDIRECT MEASURES (means of assessment that are related to direct measures but are steps removed from those measures)

Surveys and Interviews

- Student survey
- Alumni survey

Additional types of indirect evidence

- Job or post-baccalaureate education placement
- Peer review of program
- External program review
- Curriculum or syllabus review
- Grade review

USE OF DATA (how the program uses or will use the evaluation data to make evidence-based improvements to the program periodically)

- Meet with students directly to discuss their performance
- Analyze and discuss trends with the unit's faculty
- Analyze and report to college/school
- Make improvements in curricular requirements (e.g., add, subtract courses)
- Make improvements in course content
- Make improvements in course delivery and learning activities within courses
- Periodically confirm that current curriculum and courses are facilitating student attainment of program goals
- Benchmark against best programs in the field

Program Specializations/Sub-Plans

If you do not specify a program specialization/sub-plan it will be assumed you are submitting this program for all program specializations/sub-plans.

Pre-Major

Does this Program have a Pre-Major? No

Attachments

- PHD-ALL-Jan14.pdf: PhD Program Conversion Proposal

(Program Proposal. Owner: Kerler,Thomas)

Comments

Workflow Information

Status	User(s)	Date/Time	Step
Submitted	Kerler,Thomas	01/14/2011 04:06 PM	Submitted for Approval
Approved	Shapiro,Daniel B	01/14/2011 08:38 PM	Unit Approval
Pending Approval	Andereck,Claude David	01/14/2011 08:38 PM	College Approval

Department of Mathematics

100 Mathematics Building
231 West 18th Avenue
Columbus, OH 43210-1174

Phone (614) 292-4975

To: Office of Academic Affairs
From: Luis Casian, Chair, Department of Mathematics
Date: January 2011
Re: Semester program proposals for degree programs in the Department of Mathematics

The following programs in the Department of Mathematics are being converted from the quarter system to the semester system, with minimal changes:

1. BS in Mathematics
2. BA in Mathematics
3. Minor in Mathematics
4. BS in Actuarial Science
5. BA in Actuarial Science
6. MS in Mathematics
7. MMS in Mathematics
8. PhD in Mathematics

During the past year, the Department's Undergraduate Committee and Graduate Studies Committee have worked on semester conversions of those programs. This process involved frequent consultations with faculty members involved with particular courses or course sequences, and involved repeated editing of the conversion documents.

Many changes will also be made to the structure and flow of freshman-level math courses. Since those courses do not involve students enrolled in those eight programs, their changes are not discussed in these program conversion documents.

These proposed conversion plans and transition policies were approved by the Undergraduate and Graduate Committees, and were discussed during a faculty meeting in December 2, 2010. The semester conversion plans were approved by the Department's tenure-track faculty, by a vote of 49 yes and 0 no.

Luis Casian
Professor and Chair

Program Rationale

Doctor of Philosophy – Mathematics

- The program requirements for semesters are largely a direct conversion of respective requirements for the current program under quarters. Particularly, program rules for the major examinations (qualifying, candidacy, oral defense) are unaffected by the semester conversion.
- General explicit or implied hour requirements are well below the university requirement of 120 quarter or 80 semester hours so that any changes in our course requirement have no impact on the total hours required for the degree.
- The only (modest) adjustment concerns our so called breadth course requirements. These are to ensure that students attains preparations in three different areas of mathematics in sufficient depth. A student choses three of five areas (Analysis, Algebra, Differential Equations, Topology/Geometry, Alternate Topics), and within each chosen area picks one course sequence.

  The student needs to successfully complete each of the three course sequences.

  Under quarter rules the definition of successful completion was to pass two of three quarter courses with a grade of "B+" or better. There reasons for requiring only two of three quarters are that a few sequences are indeed only two quarters long, and that students who had a "bad" quarter where they received a low grade could recover in the third quarter with a satisfactory grade.

  Under the semester plan every course sequences used in the current breadth is converted in a respective semester sequences. The rules for area and sequence selections of the breadth requirements therefore can be and have been directly translated from the quarter to a semester version.

  Successful completion has been defined as passing the entire two-semester sequences with a grade of "B+" or better. The increase from two quarter to two semesters was chosen since one semester of a sequence was deemed not to provide the desired depth into a breadth area.

  All two quarter sequences have been converted to two semester sequences, which addresses the first reason for the original two out of three rule.

  Moreover, the semester rules allow one of the six grades received in the courses that count toward the requirement to be below a "B+" (but above "C-") which addresses the second original reason for the two out of three rule.

  Concerns about the increase of credit hours subject to the rules of the breadth requirements have been considered. Overall the additional burden was deemed as minimal since, in reality, the number of hours taken by students in these course sequences is not changing significantly. Particularly, the minimum total hour requirement of approved mathematics courses before candidacy exceeds the number of hours implied by the breadth requirements so that the change is effectively a shift of elective to required hours without changing the total hours required in mathematics.

  Moreover, for the majority of students this shift has no or little impact since students who take the first two quarters of a sequence typically also take the third quarter even if they have already met the breadth requirement for the sequence in the first two quarters.
- Minor shifts in the implied credit hours in the language requirement are due to semester plans of the language departments. Please see their rationales for the changes.

Table of Mathematics Graduate Semester Courses

The tables in the following four pages list the semester courses proposed by the graduate program of the mathematics department. They are grouped by sequences and subjects together with the quarter equivalent courses and sequences.

New and Discontinued Courses

The only new course is Math 5603 (although this also fits into an existing sequence). The only course sequence that is not continued, although it was regularly taught during the academic year until now, is Math 872-874. See the included justification.

Several quarter courses have been discontinued and not converted since they have not been taught in several years. They include Math 650 (Principles of Mathematical Analysis), Math 667 (Introduction to the Mathematics of Cryptography), Math 669 (Introduction to Number Theory), Math 705 (Special Functions), Math 712-714 (Applied Functional Analysis I-III), Math 767-768 (Approximation Theory I-II), and Math 863 (Potential Theory).

Further summer courses were discontinued and not converted since they were part of our Headstart program which due to budget reasons has been restructured and no longer uses regularly scheduled classes. These include Math 735, 736 (Teaching College Mathematics), Math 787.xx (Graduate Problem Seminars), and Math 609 (Applications of Mathematical Software).

Finally a few quarter courses in topology and geometry do not occur in the conversion table due to the new topology/geometry curriculum that started on AU 2010. Particularly, Math 655-657 (Elementary Topology I-III) and Math 860 (Algebraic Topology I) were converted or absorbed into the current Math 640 and Math 756-757 quarter courses. These, in turn, have been converted to Math 5801, 6801, and 6802 in the semester proposal.

Credit Hour Balances

The table accounts for the overall balance of credit hours as follows.

For each semester (quarter) course the number of semester (quarter) credit hours and frequency of offering are recorded. (e.g., Freq.=1 means offered annually, Freq.=2 means offered biennially). The average annual semester (quarter) credit hours invested in the course is computed as Ave Cred=Credit/Freq.

For each group the total annual average quarter credits of the quarter courses are computed. Similarly the semester credits for the semester courses, which are then converted 2:3 to quarter credits. (results in blue numbers for the quarter and semester versions).

The difference (in average annual quarter credits) is recorded in the DIFF column. Increases in credits due to conversion are in red and decreases in green.

Summary

There is an overall increase of about 6 quarter credit hour equivalents in planned regular offerings of mathematics graduate courses. If the missing summer courses are counted in we have indeed a decrease in offered hours.

There are two notable shifts in credit hours. The first is an increase at the Master (600/5000) level at the cost of a decrease of offered hours at the PhD (700/6000) level. This is motivated by the introduction of our new MMS program, and a respective reduction in size of our PhD program. The second is a shift from topology to geometry hours within the topology/geometry curriculum. See the included justifications.

Semester Conversion Table for Mathematics Graduate Courses

	QUARTER				SEMESTER					
Semester Transcr Name	**Num**	**Credit**	**Freq**	**Ave. Cred.**	**Num**	**Credit**	**Freq**	**Ave. Cred.**	**DIFF**	**Justification**
Ess Numer Methods	606	3	1	3	5602	3	1	3		Quarter sequence Math 606, 607 (at 3 and 5 q-cr) converted to semester sequence Math 5602, 5601 (3 s-cr each)
Computational PDEs	607	5	1	5	5601	3	1	3		
Balance (in quarter credits)				**8**				**9**	**1.0**	
Numer Linear Algeb				0	5603	3	1	3		New Course. Limitations in hardware require better algorithms in handling of large data, particularly large matrices. The demands on training successful students in computing have thus change and are addressed with this course.
Balance (in quarter credits)				**0**				**4.5**	**4.5**	
Math Mod Bio Proc	865L	3	1	3	5651	3	1	3		Math 865L (3 q-cr) provides the foundation for the required summer internships of our Math-Biology MS program. The time allotted in Mathy 865L was too shirt so that it is extended to the 3 hour semster course Math 5651.
Balance (in quarter credits)				**3**				**4.5**	**1.5**	
Meth Relativ Thy 1 &2	665	4	1	4	5756	3	1	3		Quarter sequence Math 665, 666 (4 q-cr each) converted to semester sequence Math 5756, 5757 (3 s-cr each)
	666	4	1	4	5757	3	1	3		
Balance (in quarter credits)				**8**				**9**	**1.0**	
Variat & Tens Calc	701	5	2	2.5	5451	3	2	1.5		Conversion of quarter course Math 701 (5 q-cr) to semester course Math 5451 (3 s-cr)
Balance (in quarter credits)				**2.5**				**2.25**	**-0.3**	
Appl Diff Eqs 1 & 2	615	3	1	3	5401	3	1	3		Quarter sequence Math 615, 616, 617 (3 q-cr each) converted to semester sequence Math 5401, 5402 (3 s-cr each)
	616	3	1	3	5402	3	1	3		
	617	3	1	3						
Balance (in quarter credits)				**9**				**9**	**0.0**	
Intro Set Theory	647	3	1	3	5001	3	1	3		Math 647 (3 q-cr) converted to Math 5001 (3 s-cr). While Math 647 was an introduction to set theory targeted at logic students, Math 5001 will be a general introduction to basic set theoretic techniques used throughout mathematics. The quarter sequence Math 648, 649 converted to semester course Math 5051 (3 s-cr).
Intro Math Logic	648	3	1	3	5051	3	1	3		
	649	3	1	3						
Balance (in quarter credits)				**9**				**9**	**0.0**	
Intro Real Analy 1 & 2	651	5	1	5	5201	5	1	5		Quarter sequence Math 651, 652, 653 (5 q-cr each) converted to semester sequence Math 5201, 5202 (5 s-cr each).
	652	5	1	5	5202	5	1	5		
	653	5	1	5						
Balance (in quarter credits)				**15**				**15**	**0.0**	
Int Compl Analysis	660	5	1	5	5221	3	1	3		Conversion of quarter course Math 660 (5 q-cr) to semester course Math 5221 (3 s-cr). Increase in time from 654 to 5251 is balanced with decrease in time from 660 to 5221.
Complex Var & App	654	3	1	3	5251	3	1	3		
Balance (in quarter credits)				**8**				**9**	**1.0**	
Finite Linear Math	601	3	1	3	5101	3	1	3		Quarter sequence Math 601, 602, 603 (3 q-cr each) converted to semester sequence Math 5101, 5102 (3 s-cr each)
Infin Linear Math	602	3	1	3	5102	3	1	3		
	603	3	1	3						
Balance (in quarter credits)				**9**				**9**	**0.0**	
Algebra 1 & 2	670	5	1	5	5111	5	1	5		Quarter sequence Math 670, 671, 672 (5 q-cr. each) converted to semester sequence Math 5111, 5112 (5 s-cr. each)
	671	5	1	5	5112	5	1	5		
	672	5	1	5						
Balance (in quarter credits)				**15**				**15**	**0.0**	

Semester Conversion Table for Mathematics Graduate Courses

	QUARTER				SEMESTER					
Semester Transcr Name	**Num**	**Credit**	**Freq**	**Ave. Cred.**	**Num**	**Credit**	**Freq**	**Ave. Cred.**	**DIFF**	**Justification**
Intro Number Thy	683	4	1	4	5152	3	1	3		Conversion of quarter course Math 683 (4 q-cr) to semester course Math 5152 (3 s-cr).
				4				**4.5**	**0.5**	
Gen Topol & Knots	640	3	1	3	5801	3	1	3		Quarter sequence Math 640, 641, 642 (3 q-cr each) converted to semester sequence Math 5801, 5702 (3 s-cr each)
Curves & Surfaces	641	3	1	3	5702	3	1	3		
	642	3	1	3						
Balance (in quarter credits)				**9**				**9**	**0.0**	
Num Meth Sc Comp 1 & 2	707	3	1	3	6601	4	1	4		Quarter sequences Math 727, 728, 729 (1 q-cr each) and Math 707, 708, 709 (3 q-cr each) are combined and converted to semester sequence Math 6601, 6602 (3 s-cr each)
	708	3	1	3	6602	4	1	4		
	709	3	1	3						
	727	1	1	1						
	728	1	1	1						
	729	1	1	1						
Balance (in quarter credits)				**12**				**12**	**0.0**	
Appl Comp Vars 1 & 2	804	3	2	1.5	7651	3	2	1.5		Quarter sequence Math 804, 805, 806 (3 q-cr each) converted to semester sequence Math 7651, 7652 (3 s-cr each)
	805	3	2	1.5	7652	3	2	1.5		
	806	3	2	1.5						
Balance (in quarter credits)				**4.5**				**4.5**	**0.0**	
Computationl PDE 1 & 2	807	3	2	1.5	7611	3	2	1.5		Quarter sequence Math 807, 808, 809 (3 q-cr each) converted to semester sequence Math 7611, 7612 (3 s-cr each)
	808	3	2	1.5	7612	3	2	1.5		
	809	3	2	1.5						
Balance (in quarter credits)				**4.5**				**4.5**	**0.0**	
Ordin Differ Eqs 1	715	3	1	3	6411	3	1	3		Quarter sequence Math 715, 716, 717 (3 q-cr each) converted to semester sequence Math 6411, 6451 (3 s-cr each)
Part Differ Eqs 1	716	3	1	3	6451	3	1	3		
	717	3	1	3						
Balance (in quarter credits)				**9**				**9**	**0.0**	
Ordin Differ Eqs 2 & 3	820	3	2	1.5	7412	3	2	1.5		Quarter sequence Math 820, 821, 822 (3 q-cr each) converted to semester sequence Math 7412, 7413 (3 s-cr each)
	821	3	2	1.5	7413	3	2	1.5		
	822	3	2	1.5						
Balance (in quarter credits)				**4.5**				**4.5**	**0.0**	
Part Differ Eqs 2 & 3	835	3	2	1.5	7452	3	2	1.5		Recent changes in the composition of our faculty and student interest have increased the need in a more thorough training in PDE. The two quarter sequence Math 835-836 thus needed to be extended to a standard two semester sequence Math 7452-7453.
	836	3	2	1.5	7453	3	2	1.5		
Balance (in quarter credits)				**3**				**4.5**	**1.5**	

Semester Conversion Table for Mathematics Graduate Courses

	QUARTER				SEMESTER					
Semester Transcr Name	**Num**	**Credit**	**Freq**	**Ave. Cred.**	**Num**	**Credit**	**Freq**	**Ave. Cred.**	**DIFF**	**Justification**
Adv Math Logic 1-4	745	3	1	3	6001	3	2	1.5		Quarter sequence Math 745, 746, 747 (3 q-cr each, offered annually) converted to two-year semester sequence Math 6001, 6002, 6003, 6004 (each course 3 s-cr and offered biennially)
	746	3	1	3	6002	3	2	1.5		
	747	3	1	3	6003	3	2	1.5		
					6004	3	2	1.5		
Balance (in quarter credits)				**9**				**9**	**0.0**	
Thy Probability 1 & 2	722	4	2	2	6251	4	2	2		Quarter sequence Math 722, 723, 724 (4 q-cr each) converted to semester sequence Math 6251, 6252 (4 s-cr each)
	723	4	2	2	6252	4	2	2		
	724	4	2	2						
Balance (in quarter credits)				**6**				**6**	**0.0**	
Real Analysis 1 & 2	750	5	1	5	6211	5	1	5		Quarter sequence Math 750, 751, 752 (5 q-cr each) converted to semester sequence Math 6211, 6212 (5 s-cr each)
	751	5	1	5	6212	5	1	5		
	752	5	1	5						
Balance (in quarter credits)				**15**				**15**	**0.0**	
Functnl Analysis 1 & 2	857	3	2	1.5	7211	3	2	1.5		Functional analysis quarter sequence was offered as Math 857 in autumn and continued as Math 961 in winter and spring and thus equivalent to a 3 quarter sequence of 3 q-cr each. It is converted to semester sequence Math 7211, 7212 (3 s-cr each)
	961 (Wi)	3	2	1.5	7212	3	2	1.5		
	961 (Sp)	3	2	1.5						
Balance (in quarter credits)				**4.5**				**4.5**	**0.0**	
Ergodic Theory 1 & 2	931	3	2	1.5	7221	3	2	1.5		Ergodic Theory quarter sequence was offered as Math 931, 932 in autumn and winter and as Math 950 in spring and and thus equivalent to a 3 quarter sequence of 3 q-cr each. It is converted to semester sequence Math 7221, 7222 (3 s-cr each)
	932	3	2	1.5	7222	3	2	1.5		
	933/950	3	2	1.5						
Balance (in quarter credits)				**4.5**				**4.5**	**0.0**	
Complex Analysis 1 & 2	753	5	1.5	3.3333333	6221	3	1.5	2		Quarter sequence Math 753, 754 (5 q-cr each) converted to semester sequence Math 6221, 6222 (3 s-cr each)
	754	5	1.5	3.3333333	6222	3	1.5	2		
Balance (in quarter credits)				**6.6666667**				**6**	**-0.7**	
Combin Graph Thy 1 & 2	775	5	1	5	6501	5	1	5		Quarter sequence Math 775, 776, 777 (5 q-cr each) converted to semester sequence Math 6501, 6502 (5 s-cr each)
	776	5	1	5	6502	5	1	5		
	777	5	1	5						
Balance (in quarter credits)				**15**				**15**	**0.0**	
Abstract Algebra 1 & 2	770	5	1	5	6111	5	1	5		Quarter sequence Math 770, 771, 772 (5 q-cr each) converted to semester sequence Math 6111, 6112 (5 s-cr each).
	771	5	1	5	6112	5	1	5		
	772	5	1	5						
Balance (in quarter credits)				**15**				**15**	**0.0**	
Commutativ Algebra	978	3	2	1.5	6151	3	2	1.5		Quarter course Math 978 (2-5 q-cr) converted to semester course Math 6151 (3 s-cr). This course will be offered, by demand, biennially during school year or during summer.
NonCommut Algebra	982	5	2	2.5	6152	3	2	1.5		
Balance (in quarter credits)				**4**				**4.5**	**0.5**	

Semester Conversion Table for Mathematics Graduate Courses

	QUARTER				SEMESTER					
Semester Transcr Name	**Num**	**Credit**	**Freq**	**Ave. Cred.**	**Num**	**Credit**	**Freq**	**Ave. Cred.**	**DIFF**	**Justification**
Algebr Numb Theory	780	3	2	1.5	7121	3	2	1.5		Quarter sequence Math 780, 781, 782 (3 q-cr each) converted to semester sequence Math 7121, 7122 (3 s-cr each)
Analyt Numb Theory	781	3	2	1.5	7122	3	2	1.5		
	782	3	2	1.5						
Balance (in quarter credits)				**4.5**				**4.5**	**0.0**	
Basic Algeb Geomet	840	3	2	1.5	7141	3	2	1.5		Quarter sequence Math 840, 841, 842 (3 q-cr each) converted to semester sequence Math 7141, 7142 (3 s-cr each)
Adv Algeb Geomet	841	3	2	1.5	7142	3	2	1.5		
	842	3	2	1.5						
Balance (in quarter credits)				**4.5**				**4.5**	**0.0**	
Algebr Topology 1 & 2	756	4	1	4	6801	3	1	3		Quarter seq. Math 756,757,758 (4 q-cr ea) → semester seq. Math 6801,6802 (3 s-cr ea). Hour reductions for topology courses (6801,6802,7811) in favor of increases for geometry courses (6701,6702,7711,7721) correct curricular imbalance between fields.
	757	4	1	4	6802	3	1	3		
	758	4	1	4						
Balance (in quarter credits)				**12**				**9**	**-3.0**	
Differen Manifolds	765	4	1	4	6701	3	1	3		Quarter seq. Math 765, 766 (4 q-cr ea) → semester seq. Math 6701, 6702 (3 s-cr ea). Hour reductions for topology courses (6801,6802,7811) in favor of increases for geometry courses (6701,6702,7711,7721) correct curricular imbalance between fields.
	766	4	1	4	6702	3	1	3		
Balance (in quarter credits)				**8**				**9**	**1.0**	
Different Geometry	851	3	2	1.5	7711	3	2	1.5		Quarter seq. Math 851, 852 (3 q-cr ea) → semester seq. Math 7711, 7721 (3 s-cr ea). Hour reductions for topology courses (6801,6802,7811) in favor of increases for geometry courses (6701,6702,7711,7721) correct curricular
	852	3	2	1.5	7721	3	2	1.5		
Balance (in quarter credits)				**3**				**4.5**	**1.5**	
Differ Topology 1 & 2	866	3	2	1.5	7851	3	2	1.5		Quarter sequence Math 866, 867, 868 (3 q-cr each) converted to semester sequence Math 7851, 7852 (3 s-cr each).
	867	3	2	1.5	7852	3	2	1.5		
	868	3	2	1.5						
Balance (in quarter credits)				**4.5**				**4.5**	**0.0**	
Homotopy Theory	861	3	2	1.5	7811	3	2	1.5		Quarter sequence Math 861, 862 (3 q-cr ea) → semester course Math 7811 (3 s-cr). Hour reductions for topology courses (6801,6802,7811) in favor of increases for geometry courses (6701,6702,7711,7721) correct curricular imbalance between fields.
	862	3	2	1.5						
Balance (in quarter credits)				**3**				**2.25**	**-0.8**	
Lie Algebras	854	3	2	1.5	7161	3	2	1.5		The Lie theory sequence satisfies a strong cross-disciplinary demand and absorbs several topics from the discontinued Math 872-874 sequence. The 2 quarter sequence Math 854-855 (3 q-cr) is thus extended to a semester sequence Math 7161-7162 (3 s-cr).
Lie Grps & Rep Thy	855	3	2	1.5	7162	3	2	1.5		
Balance (in quarter credits)				**3**				**4.5**	**1.5**	
(Group Theory)	872	3	2	1.5	no replacement					Anticipated retirements and departures of faculty in the area led to the decision not to continue the course sequence under semesters.
	873	3	2	1.5						
	874	3	2	1.5						
Balance (in quarter credits)				**4.5**				**0**	**-4.5**	

Transition Policy

Doctor of Philosophy - Mathematics

- Breadth Requirements: Since all course sequences involved in the breadth requirements are converted into respective semester equivalents, and the area designations have not been changed fulfillment of the current quarter requirements for a quarter course sequence is directly counted as the fulfillment of the semester requirement of the corresponding semester sequence.

  The dictionary of course sequences is give in the table below. A typical course selection that would fulfill the breadth requirement would be Math 770, 771 and Math 750, 751 in AY11/12 and Math 6701, 6702 in AY12/13.

  There are a few situations which occur only rarely in our experience, and which will be handled on an individual basis with approval of the Graduate Studies Committee. These include:

  - Although the great majority of students complete the courses of a breadth course sequences within the same year, some student may take courses of the same sequence in different years. If one of the years is AY11/12 or earlier and the other is AY12/13 or later the most adequate continuation and counting of courses towards the requirement will be determined in consultation also with the respective instructors.
  - The grade forgiveness rule for semesters should only apply to grades received in the semester courses used for fulfilling the breadth requirement, and should not be used for grades received in quarter courses. It can be applied to one semester course if two of the breadth requirements come from semester sequence. If only one semester sequence is used for the requirement, the forgiveness rule can be applied to one of its courses only with approval of the Graduate Studies Committee.
  - Combinations of the above complications will be considered by the Graduate Studies Committee individually.

Semester Breadth Sequence	Quarter Breadth Sequence
Math 6111, 6112	**Math 770, 771, 772**
Math 7121, 7122	Math 780, 781, 782
Math 7141, 7142	Math 840, 841, 842
Math 7161, 7162	Math 854, 855
Math 6211, 6212	**Math 750, 751, 752**
Math 7211, 7212	Math 857, 961
Math 7221, 7222	Math 931, 932
Math 6411, 6451	**Math 715, 716, 717**
Math 7412, 7413	Math 820, 821, 822
Math 7452, 7453	Math 835, 836
Math 6801, 6802	**Math 756, 757, 758**
Math 6701, 6702	**Math 765, 766**
Math 7851, 7852	Math 866, 867, 868
Math 7711, 7721	Math 851, 852

Semester Breadth Sequence	Quarter Breadth Sequence
Two of Math 6001 - 6004	**Math 745, 746, 747**
Math 6501, 6502	**Math 775, 776, 777**
Math 6251, 6252	**Math 722, 723, 724**
Math 6221, 6222	**Math 753, 754**
Math 7651, 7652	Math 804, 805, 806
Math 6601, 6602	**Math 707, 708, 709**
Math 7611, 7612	Math 807, 808, 809

- Language Requirement. This involves taking and passing only one course, which may be either a quarter or a semester course from the admissible list of language courses. The courses are listed below.

Semester Language Courses	Quarter Language Courses
French 5571, 5572	French 571, 572, 573
Russian 3151, 3152	Russian 571, 572, 573
German 5101, 5102	German 571, 572, 573

- Any hour requirements are converted by counting every quarter hour as 2/3 of a semester hour.
- Other requirements, such as qualifying examinations, Invitations lectures, candidacy and oral defense examination preparations, are independent of the semester transition.

I. Requirements for Admission to the Candidacy Examination

Graduate students admitted to the program with Ph.D. as their intended degree have to fulfill the following requirements before being allowed to apply for the Candidacy Examination:

I.1. Qualifying Examination

I.1.a) Content:
There are two qualifying examinations, one in Real Analysis and the other in Abstract Algebra. The content is based on the course sequences Math 5201, 5202 and Math 5111, 5112. Syllabi and suggested textbooks can be found in Appendix [**A??**] .

I.1.b) Administration, Scheduling, and Format:
The qualifying examinations are designed, administered, and graded by respective departmental committees overseen by the Graduate Studies Committee. Each examination is offered twice a year, once in the first week of the autumn semester in August, and a second time in the week following the spring break in March. Typically an examination is three hours long and closed-book.

I.1.c) Time Limit:
Students who have PhD-Track status have until the spring semester of their second year of study to pass both examinations at the *PhD-Level*. After passing the exam a student will be automatically put on regular PhD status. Incoming student may petition to be put immediately on regular PhD-status in which case they must pass the examinations by the end of the first year of entry into the program.

Students are advised to take the examinations each time they are offered, not only because skipping an examination is effectively the same as failing it. Taking the examinations also informs the course selection during the first year and helps identify weaknesses to work on for future examinations.

I.2. Breadth Course Requirements

I.2.a) Purpose and Selection Rules:
The course requirements described below aim to ensure that graduates master not only their eventual field of specialization but also develop the breadth, versatility, and maturity expected from mathematicians working in academic professions that traditionally require a Ph.D.-degree. The rules, referring to the course list below, are as follows:

i) Among the five areas below (indicated by boxes) a student chooses three areas

ii) Within each area the student chooses one year-long course sequence

iii) At least five of the six chosen courses must be passed with a grade of "B+" of higher.

iv) The grade of one of the chosen courses may be lower than "B+" but must be higher than "C-".

I.2.b) Additional Proficiency Requirements:
If a student intends to use a 7000-level sequence in order to fulfill a breadth requirement he/she

needs to prove in addition mastery of the material of a corresponding 6000-level sequence which is indicated in the third columns of the tables below. The lecturer (or lecturers) of the 6000-level sequence (offered during the same year as the 7000-level sequence) assesses and certifies that the student has demonstrated satisfactory proficiency in respective the 6000-level material.

It is the students responsibility to contact the lecturer(s) of the 6000-level course sequence **before** the semester start, and negotiate the way in which proficiency is assessed. A *Breadth Core Proficiency* form, containing relevant information about the assessment, needs to be returned by the 6000-level lecturer to the Graduate Office before the end of the semester.

A copy of the form will be forwarded to the 7000-level instructor(s) as well as the student's file in the Mathematics Graduate Office.

I.2.c) Area and Course List:

ALGEBRA		
Course Numbers	**Sequence Title**	**Proficiency Req.**
Math 6111, 6112	**Abstract Algebra**	None
Math 7121, 7122	Number Theory	Math 6111, 6112
Math 7141, 7142	Algebraic Geometry	Math 6111, 6112
Math 7161, 7162	Lie Groups	Math 6111, 6112

ANALYSIS		
Course Numbers	**Sequence Title**	**Proficiency Req.**
Math 6211, 6212	**Real Analysis**	None
Math 7211, 7212	Functional Analysis	Math 6211, 6212
Math 7221, 7222	Ergodic Theory	Math 6211, 6212

DIFFERENTIAL EQUATIONS		
Course Numbers	**Sequence Title**	**Proficiency Req.**
Math 6411, 6451	**Differential Equations**	None
Math 7412, 7413	Ordinary Differential Equations	Math 6411, 6451
Math 7452, 7453	Partial Differential Equations	Math 6411, 6451

TOPOLOGY/GEOMETRY		
Course Numbers	**Sequence Title**	**Proficiency Req.**
Math 6801, 6802	**Algebraic Topology**	None
Math 6701, 6702	**Differential Manifolds & Geometry**	None
Math 7851, 7852	Differential Topology	Math 6801, 6802
Math 7711, 7721	Riemannian & Kähler Geometry	Math 6701, 6702

ALTERNATE TOPICS		
Course Numbers	**Sequence Title**	**Proficiency Req.**
Any two of Math 6001-6004	**Advanced Mathematical Logic**	None
Math 6501, 6502	**Combinatorics and Graph Theory**	None
Math 6251, 6252	**Theory of Probability**	None
Math 6221, 6222	**Complex Analysis**	None
Math 7651, 7652	Applied Complex Variables and Asymptotics	Math 6221, 6222
Math 6601, 6602	**Numerical Methods in Scientific Computing**	None
Math 7611, 7612	Computational Partial Differential Equations	Math 6601, 6602

I.2.d) Time Expectations:
Students who enter regular PhD status during their first year are expected to have their breadth requirements completed by the end of the spring semester of their second year of study. Students who enter regular PhD status during their second year are expected to have their breadth requirements completed by the end the spring semester of their third year of study.

I.3. Foreign Language Requirement

The foreign language requirement ensures the ability to read (with the aid of a dictionary) one foreign language chosen from French, German, or Russian, and can be met in one of the following two ways:

I.3.a) Language Course
Students with no or only little prior knowledge of the chosen language can fulfill their language requirement by passing German 5101, German 5102, Russian 3151, Russian 3152, French 5571 or French 5572 with a grade of "B" or better.

I.3.b) Language Examination
Students who have sufficient familiarity with their chosen languages can fulfill their requirement by passing an examination instead. It involves the translation of a passage from a mathematical text submitted by the Department's Language Coordinator and graded by the appropriate language department. The student may suggest textbooks or articles to the Language Coordinator.

I.3.c) Time Expectation
The language requirement has to be fulfilled **before** applying for the candidacy examination.

I.4. Other Requirements

Below several other requirements that have to be met before applying for a candidacy examination:

I.4.a) Choice of Dissertation Advisor
It is the student's responsibility to find a dissertation advisor with sufficient time before the candidacy exam, since the advisor helps planning the candidacy examination and chairs the examination committee. The advisor must be member of the Graduate Faculty at the Category P level in the mathematics department.

The student needs to submit an Advisor Change Form to the Mathematics Graduate Office, which

has to be signed both by the intended dissertation advisor as well as the vice-chair for graduate studies. The form also has to be submitted if the dissertation advisor is the same person as the assigned academic advisor, indicating the change in function of the advisor.

Students typically find their dissertation advisor through classes, independent studies projects, Invitations and similar lectures, or prior interest in a specialization.

I.4.b) Invitation Requirement
During the time between placed on regular PhD status and submitting the Advisor Change Form a student needs to enroll into the Invitation to Mathematics lecture series at least once a year.

I.4.c) Candidacy Examination Committee
The student should work together with the advisor to find additional three members of the candidacy examination committee. The student should negotiate topics for the examination as described in Section II.2.d below.

I.4.d) Coursework Requirement and Hour Recommendation
The student needs to have completed 26 semester credit hours of approved mathematics coursework (as defined in [Section for MS degree here] but excluding statistics courses) with a grade of "C+" or higher by the end of the semester of the candidacy examination.

Although not required, students are strongly recommended to have accumulated at least 65 semester graduate credit hours (or the quarter equivalent) at the end of the semester of their candidacy examination. This is to ensure that the university requirement of 80 semester hour is met at the time of the oral defense. Student are allowed to take up to 19 hours of Math 8999 with their advisor during the semester of their candidacy exam.

I.5. Time Expectations and Limits

All students must pass their candidacy examination within three years from entering regular PhD status, and by the end of the spring semester of their fourth year of study (whichever comes first). It is the students responsibility to make sure that all of the requirements listed above are met in time.

II. Candidacy Examination

The Candidacy Examination tests a students preparedness to do independent research and write a doctoral thesis in mathematics. It is a formal university examination and therefore subject to all rules and procedures of the Graduate School, some of which are mentioned below. For all other rules see Sections VII.4-7 of the Graduate School Handbook.

II.1. Graduate School Paper Work

The following forms issued by the Graduate School need to be completed and submitted within all deadlines and following all instructions. Late or incomplete submissions are almost never accepted by the Graduate School.

II.1.a) Notification of Doctoral Candidacy Examination
This form must be submitted to the Graduate School no later than two weeks before to the oral portion of the examination. It is available on the Graduate School web pages as well as in the Mathematics Graduate Office.

The form requires the names of all committee members, the dates of the written and oral portions,

as well as signatures from the advisor and vice-chair for graduate studies.

A copy of the form has to be submitted to the Mathematics Graduate Office.

II.1.b) Candidacy Examination Report
This form is sent to the advisor (as chair of the examination committee) after the above notification has been submitted and in time before the scheduled oral portion.

The advisor needs to bring this form to the oral examination, where the result of the examination is documented with the signatures of all committee members.

The form has to be submitted to the Graduate School within one working day after the oral portion.

A copy of the form has to be submitted to the Mathematics Graduate Office.

II.2. Examination Committee

II.2.a) Chair
The committee is chaired by the advisor of the student and needs to hold Category P status in the mathematics department. The advisor is responsible for the coordination of both portions of the examination. Particularly, the advisor determines dates for issuing, submitting, and evaluation of the written part, as well as the times and format of the oral part.

II.2.b) Authorized (Voting) Members
Besides the advisor the examination committee has to include three additional authorized members of the Graduate Faculty, who are approved on the Notification of Doctoral Candidacy Examination and who vote on the outcome of the examination. The additional members may also hold Category M status or be from other departments with the permission of the department

II.2.c) Additional (Non-Voting) Members
Besides the four authorized members the committee can include further members who help generating and grading problems of the written examination, but do not vote on the outcome of the examination. Subject to petition to the Graduate School and permission of the department, non-voting members do not have to be Graduate Faculty and may be, for example, post-docs who have previously taught or directed the student.

II.2.d) Topics of the Examination
The topics and scope of the written and oral portions of the examination are determined by committee members. The should be negotiated with the advisor and student before the examination. They may be taken from Ph.D.-level courses (6000-level and up) as well as the areas of research.

The topics are expected to surround the planned dissertation area of the candidate. However, at least two areas of mathematics, as defined by the breadth requirements in Section I.2.c above, should be represented in the examination.

Part of the questions of the oral examination are typically based on the written examination but may also cover other related topics.

II.3. Written Portion

II.3.a) University Time Limit
The university requires that the oral portion has to be completed within 30 days after the beginning of the written portion. Thus no problems should be give to the student more than 30 days before the scheduled oral examination.

II.3.b) Program Guidelines
The written examination is typically a take-home exam which consists of four problem sets each of which is provided by one of the authorized committee members. The dates when the problems are to be issued, due dates for returning them, and timeline for evaluation are to be determined by the advisor. The advisor may also set guidelines regarding the communication between committee members and candidate during and after the written portion of the examination.

II.3.c) Evaluation
The student needs to return the written examination to the committee members in a timely fashion in order to allow enough time for evaluation by and discussion among the committee members. The advisor sets the due dates which should be no less than three business days before the oral portion.

If, based on the evaluation of the written portion, the advisor or another member of the committee see no possibility for a satisfactory overall performance on the candidacy examination, the student may be advised to waive the right to take the oral portion, although the student has the right to insist on the oral portion.

II.3.d) Other Formats
An advisors may propose and request approval from the Graduate Studies Committee for another format for the examination which deviates from the program guidelines in Section II.3.b but complies with Graduate School requirements.

II.4. Oral Portion

II.4.a) University Requirements
Graduate School rules require the oral portion to be approximately two hours long and to be scheduled after the written portion and within 30 days of the begin of the written portion. All authorized committee members have to be present during the examination and the entire time of the examination should be devoted to questioning of the student by members. Additional presentations by the candidate can be made outside the two hour examination period.

II.4.b) Program Guidelines
The graded problem set of each committee member should be made available to the student as well as other committee members before the start of the oral portion. Each committee member questions the student for approximately half an hour in an order to be determined by the advisor. During each part other committee member may join the questioning. Questions may be based on the solutions to the written portions as well as other related topics.

II.4.c) Evaluation
Immediately at the end of the oral portion the authorized committee members decide in absence of the student on the outcome of the examination. The student should be informed as soon as the decision is reached and the Candidacy Examination Report completed and returned on the same or the following business day. See Sections II.1.b and II.5 for details.

II.4.d) Other Formats
As for the written portion the advisor can request a format that deviates from the program guidelines but complies with university rules.

II.5. Results

II.5.a) Decision
The decision whether the students performance on the candidacy examination is satisfactory needs to be reached unanimously among the authorized committee members. If one or more members decide the performance was unsatisfactory the committee needs to decide whether the student should be granted a second attempt at the examination or not. In all cases the advisor has to complete the Candidacy Examination Report, all members need to sign in the appropriate places, and the form needs to be submitted as in Section II.1.b.

II.5.b) Failed Examinations
If a student does not pass the examination the advisor should submit copies of the written examination to the Mathematics Graduate Office and inform the vice-chair for graduate studies of the details of the examination.

If the student is permitted a second attempt at the examination Graduate School rules require a Graduate School representative. All Graduate School procedures for including the representative should be carefully followed. If a student fails the examination a second time then the student is automatically dismissed by the Graduate School.

III. Candidacy and Requirements before Dissertation

Candidacy is the period between passing the candidacy examination and the final oral defense. Before entering candidacy a student is expected to have acquired the mathematical knowledge and skills required for independent research in the chosen area through coursework and independent study. During candidacy a student is expected to focus mainly on research and completion of a dissertation.

III.1. Registration Requirements

III.1.a) Three-Hour Enrollment
Post-candidacy students are expected to enroll themselves for exactly 3 credit hours of MATH 8999 with their dissertation advisor every semester. Additional credit hours for enrollment are not included in the Graduate Associateship tuition waiver. A student may request to have tuition covered for academically essential non-MATH courses by the department by an application to the Graduate Studies Committee. In all other cases tuition has to be paid for by the student or an external resource.

III.1.b) Continuous Enrollment
Students admitted 2008 or later who passed their candidacy examination are required to be enrolled during every semester. For detailed rules on leaves see Section VII.8 of the Graduate Handbook.

III.2. Dissertation Requirements

III.2.a) Time Limit
The university allows a maximum of five years from passing the candidacy examination until submission of the final copy of the dissertation. Expectations of the mathematics graduate program for the same time period, however, are about three years or less. Continuation in the program is contingent on timely and satisfactory progress towards completing a dissertation as determined by the Graduate Studies Committee.

III.2.b) Hour Requirements
The university requires a total of 80 graduate semester credit hours. Of those 50 semester credit hours have to be beyond the Masters degree. See I.4.d for respective hour recommendation before the candidacy examination.

III.2.c) Dissertation Committee
The Dissertation Committee consists of three Graduate Faculty with Category P status, one of whom is the advisor who also chairs the committee. Although it is the advisor's responsibility to select the members of the Dissertation Committee, the student should be involved in the selection decisions. The two authorized members besides the advisor may also be Graduate Faculty may also be from other departments if permitted by the Mathematics Department.

The committee should be formed as early as possible during the candidacy period in order for members to familiarize themselves with the research of the candidate but at the very latest at the end of the second week of the semester of graduation.

IV. Dissertation and Final Oral Examination

IV.1. Graduate School Paper Work

The following Graduate School forms are involved in the graduation of doctoral students. All instructions on the forms and in the Graduate School Handbook have to be followed, and all deadlines observed. Exceptions are typically not granted by the Graduate School.

For all three forms below a copy has to be submitted to the Mathematics Graduate Office at the same time it is submitted to the Graduate School.

IV.1.a) Application to Graduate – Doctoral Degree
This form must be submitted to the Graduate School by the second week of the semester of graduation. It has to include the names of all Dissertation Committee members. It requires signatures of the student, the advisor, and the department.

IV.1.b) Doctoral Draft Approval/Notification of Final Oral Examination
The draft approval requires the signatures of all Dissertation Committee members, confirming that the dissertation draft is sufficient to warrant an oral defense. The names of the Final Examination Committee members should be the same as the ones on Dissertation Committee. Additional non-voting members can be included following the Graduate School rules and with permission of the department. The draft approval form must be returned no later than two weeks before the scheduled oral examination to the Graduate School.

IV.1.c) Final Oral Examination Report
After submission of the draft approval form the Graduate School will send the Final Oral Examination Report to the advisor. The form should be brought to the final oral examination. After the oral examination all members of the examination committee have to sign off to indicate either satisfactory or unsatisfactory performance. The form must be returned by the posted deadline for the semester of graduation..

IV.2. Dissertation Document

IV.2.a) Dissertation Draft
The first dissertation draft has to be submitted in word-processed form to all three Dissertation

Committee members at least a month before the planned oral examination. The committee members need to give their approval on the draft approval form at least two weeks before the oral examination, see Section IV.1.b above.

IV.2.b) Oral Examination
A typed hard-copy of the approved draft needs to be submitted to the Graduate School Representative a week before the examination. All members of the examination committee should have a copy of the draft during the oral examination.

IV.2.c) Final Dissertation Copy and Thesis Abstract
The final copy of the dissertation is approved only after the oral examination is passed. The document has to follow all rules specified in the *Guidelines for Formatting Theses, Dissertations, and D.M.A. Documents* issued by the Graduate School. A LaTeX template designed to conform with these university rules is available on the department's web page. In addition, an abstract of 500 words of less is required.

IV.2.d) Submissions of Dissertation
The final copy of the dissertation has to be submitted electronically through OhioLink by the published deadline for the semester of graduation. All Ohio State dissertations are also archived with ProQuest/UMI.

In addition, the dissertation title, dissertation abstract, and an electronic version of the dissertation have to be submitted to the Mathematics Graduate Office by the same deadlines.

IV.3. Oral Examination and Result

IV.3.a) Final Oral Examination Committee and Graduate School Representative
The Final Oral Examination Committee consists of the Dissertation Committee and a Graduate School Representative, who is appointed by the Dean of the Graduate School shortly after the draft approval form has been submitted. The representative is normally a Graduate Faculty from another department. The representative has to receive a copy of the dissertation draft at least one week before the oral examination, is permitted to questions the candidate during the examination, and has a vote in the final decision.

IV.3.b) University Format Requirements
The oral examination is required to last approximately two hours with all members of the Final Oral Examination Committee present during the entire period. The examination may include a presentation of the dissertation by the student. However, at least one hour of the two-hour examination period must be allotted to discussion of the research and questioning of the student by committee members.

IV.3.c) Program Format Guidelines
The examination should include a presentation of the research results by the student that is up to an hour long. This part of the oral examination should be pubic to members of the mathematics department. The advisor should announce the time and location of the examination ahead of time to faculty and graduate students.

The advisor decides whether the discussion and questioning part of the oral examination is open to other members of the department. Often other graduate students are excused for this part of the examination, while interested faculty may stay.

Additional explanation of the dissertation results beyond the presentation in the first hour of the

examination have to be the result of questioning of the committee members in order to comply with university rules.

The advisor may follow a format that deviates from the program guidelines but complies with the university requirements with permission of the Graduate Studies Committee.

IV.3.d) Decision

The decision on passing the final oral examination should be reached immediately after the examination by the Final Oral Examination Committee. Only members and all members of the committee should be present during the deliberations. The student is considered to have passed the Final Oral Examination if there is a unanimously affirmative vote by all committee members.

The Final Oral Examination Report has to be signed off by all members. It should be returned to the Graduate School as soon as possible (and no later than the posted deadline) and a copy given to the Mathematics Graduate Office.