

## MATH 490 (Math Senior Seminar) – Fall 2013

**Melvin Royer**

Description :	A seminar designed to integrate mathematics and philosophy and how they relate to other disciplines. Special attention will be given to advanced topics in mathematics with emphasis on critical thinking and communicating and presenting these topics. The ways in which individual students will use mathematics and the world changing mission of the university in a career setting will also be explored. The Major Field Achievement Test in Mathematics will be administered as a part of this course. Required for mathematics and mathematics education majors. Prerequisite: Senior status in Mathematics or Mathematics Education					
Objectives:	<ol style="list-style-type: none"> <li>1. Articulate a personal philosophy of the relationship between mathematics and Christian faith (Math Objective #3)</li> <li>2. Demonstrate knowledge of the nature, foundations, and current philosophical issues of mathematics (3)</li> <li>3. Independently research and coherently present advanced mathematical topics (2,4,5)</li> <li>4. Apply logical thinking to help discern truth in spiritual, moral, and social issues (3)</li> <li>5. Develop and compile materials useful for securing employment/education of choice (5)</li> </ol>					
This class addresses World Changing Aims 1c, 1d, 2a, 2b, 2c, 3a						
Textbooks:	<ol style="list-style-type: none"> <li>1. Howell RW &amp; Bradley WJ: <u>Mathematics in a Postmodern Age</u>, Eerdsmans Publishing Co, 2001</li> <li>2. Livio M, <u>Is God a Mathematician?</u>, Simon &amp; Schuster, 2009</li> <li>3. Moore AW, <u>The Infinite</u> 2/e, Routledge, 2001</li> </ol>					
Instructor Contacts:	<ol style="list-style-type: none"> <li>1. Email: <a href="mailto:melvin.royer@indwes.edu">melvin.royer@indwes.edu</a></li> <li>2. Phone: 677-2987 (Office), 662-1673 (Home, before 9:30 PM)</li> </ol>		<ol style="list-style-type: none"> <li>3. FAX: 677-1704</li> <li>4. Office: Center Hall, Room 105</li> <li>5. Website: <a href="http://blackboard.indwes.edu">blackboard.indwes.edu</a></li> </ol>			
Instructor Schedule:	Times	Monday	Tuesday	Wednesday	Thursday	Friday
	7:50		Office		Office	
	8:55	Office	Office	Office		Office
	10:00	Chapel	Office	Chapel		Chapel
	11:05	PHY-120		PHY-120		PHY-120
	12:10					
	1:15	MAT-490	MAT-111	MAT-490	MAT-111	
	2:20	Office	MAT-111	Office	MAT-111	Office
3:25						

## Advice and Encouragement

1. “To every thing there is a season, and a time to every purpose under the heaven . . . a time to keep silent and a time to speak . . .” Eccl 3:1, 7. Usually in a college math course, there is more problem with students keeping silent than with them speaking. Questions are appropriate and appreciated at any time. Giving answers to my questions is also appreciated (unless you just answered the last question; then giving another student the opportunity to answer would be appropriate.)
2. “Consider the path for your feet and let all your ways be established.” Prov 4:26. The schedule shows what we will be covering the next class period. The wise will have previewed the section(s) before coming to class; all the relevant studies in learning show that having some prior knowledge greatly increases the rate and level of comprehension.

Physical preparedness is also important. Your mind resides in a body that was created to sleep, eat nutritious meals, etc. If you are constantly only one step ahead of your next deadline, please consult with your advisor and/or a trusted friend about simplifying your life – a good college experience requires spiritual and academic reflection time.

3. “... Talk about [these commandments] when you sit at home and when you walk along the road, when you lie down and when you get up. Tie them as symbols on your hands and bind them on your foreheads. Write them on the doorframes of your houses and on your gates.” Deut 6:7-9. There is no substitute for consistently doing the homework. Mathematics has many characteristics of a foreign language. Your retention will be much better if you study every day than if you wait until the weekend or just before the exam to try to catch up.
4. “As iron sharpens iron, so one man sharpens another.” Prov 27:17. My observation has been that students perform better (often much better) when they make a serious effort to become part of the class “community.” Academic benefits of studying and socializing together include the following: extra feedback to get your misconceptions corrected, other perspectives on what the important issues really are, emotional energy when preparing for tests, an emergency contact when you forget what assignment is due...
5. “And unto one he gave five talents, to another two, and to another one...” Matt 25:15. There will probably be a wide range of backgrounds and abilities in the class. Be respectful of others. Compete against your own God-given ability, not against each other. Don’t be too embarrassed to ask “stupid” questions.
6. “Therefore, since I myself have carefully investigated everything from the beginning, it seemed good also to me to write an orderly account for you ...” Luke 1:3 Don’t wait until the exam to try to write an orderly account of what you think you know – you need prior feedback. If you don’t understand a homework problem, unless I specifically say so, it would be less than wise to ignore it and hope it goes away. Your professors have office hours for a reason, but it must be you who makes the effort to make contact.
7. “For God so loved the world that He gave His one and only Son, that whoever believes in Him shall not perish but have eternal life.” John 3:16. Work hard and take the course seriously, but don’t neglect your spiritual life. Ultimately, the only mathematics you need to know is that God has only one Son, and that there are only two places to spend eternity.

## **Grading:**

### 1. *Attendance*

The discussion-based nature of this course makes attendance and preparedness vital. The student's final course grade may be lowered by 1/3 of a letter grade per unexcused absence.

### 2. *Class openings*

Each student will be assigned several dates on which they will present a 1-3 minute opening thought to the class. While Christian content is obviously encouraged, being a Christian is not a prerequisite to the class and therefore any encouraging or educational philosophical thoughts are acceptable. Using notes and slides is acceptable, but reading lengthy passages or playing audio/video is not; the goal is for you to present thoughts important enough to you that you have personalized them.

### 3. *Reading Quizzes / Response papers*

Quizzes (take-home) and/or short response papers will be given over much of the assigned reading. Your lowest quiz score will be dropped before your quiz average is computed.

### 4. *Mathematical Autobiography*

Each student will give a 10-15 minute oral presentation on his or her past experiences involving mathematics. The presentation must include discussions of why you chose to study mathematics and what interaction with mathematics (if any) you see yourself having in the near future. Optional topics include family history/influences, influential teachers or mentors, memorable books, school activities, personal strengths/weaknesses assessment, personal connections between mathematics and faith, etc. Speaking from notes is acceptable; direct reading is not. At the close of the presentation, the student may optionally ask for feedback/advice; there is no expectation of this.

### 5. *Topic Presentation*

Each student will be assigned a topic in mathematics/philosophy related to the reading. The student will present the topic orally to the class, then lead a subsequent class discussion.

### 6. *Philosophy Paper*

Near the end of the course, each student will write a personal philosophy of mathematics based upon agreement or disagreement with the course readings or other similar material.

### 7. *Career plan*

Each student will compile a career plan of artifacts important toward initial career objectives.

### 8. *Major Project*

The student will complete a major paper and poster on a topic from mathematics or mathematics education agreed upon with the instructor. Near the end of the semester, the student will give a formal presentation on the topic open to any IWU faculty and students

who care to attend. Independent research and discovery are encouraged though not required.

#### 9. *Major Field Achievement Test*

The Major Field Achievement test, a standardized comprehensive exam over the undergraduate mathematics curriculum, will be administered. Scores on the MFT are reported on a scale from 120 to 200, and the class points awarded to the student will be  $\frac{1}{4}$  his/her MFT score. More information about the MFT is available at

<http://www.ets.org/mft/about/content/mathematics>

Students needing to take other standardized tests are encouraged to do so near the same time as the MFT due to the large overlap in content. In particular, students planning to pursue teaching licensure should take PRAXIS II (offered several times each semester at IWU; registration deadlines and more information at [www.ets.org/praxis/prxaboutll.html](http://www.ets.org/praxis/prxaboutll.html)), and students thinking of graduate school should take the GRE General Test (offered at Ball State, Ft Wayne, and Indianapolis on an ongoing basis by appointment; more information at [www.ets.org/gre/](http://www.ets.org/gre/)). Some graduate schools also require the GRE Mathematics Subject Test.

#### 10. *Mentoring*

Students will be assigned at least one freshman/sophomore mentee in the MAT 223 Orientation to Math Via Discrete Processes class. At a minimum, mentors will allow each of their mentees to individually interview them regarding tips for success in the IWU mathematics program. It is hoped that mentors will also be open to being a support structure to their mentees anytime during the semester as requested.

#### 11. *Final exam*

The final examination for the course will consist of two parts. The first part will be a 15 minute oral exam with the instructor and any of the other math faculty who choose to attend. Questions may cover broad mathematical concepts across the undergraduate curriculum (e.g. “How would you summarize the relationship between the fields of number theory and abstract algebra?”) or connections between faith, philosophy, and mathematics (e.g. “In your opinion, is mathematics created or discovered? Why?”) The second part will consist of an anonymous written assessment of the IWU mathematics program.

#### 12. *Professional Development*

Participation in any of the following out-of-class activities will add the indicated number of points to the student’s point total as well as his/her points possible. For example, suppose Students #1 and #2 each earn 800 total class points, but Student #2 also earns 50 professional development points. Student #1 will then have a course average of  $800/900 = 88.9\%$ , while student #2 will have an average of  $850/950 = 89.5\%$ . A maximum of 100 professional development points is allowed, and an activity can only be used for professional development points in a single class. Students are free to propose to the instructor ideas for other activities.

<i>Activity</i>	<i>Points</i>
IWU MAC Meeting	10
IWU Math Department public relations event (e.g. visit day presentation)	10
IWU Math Colloquium/Guest speaker (attending/presenting)	10/30
Off-campus math conference (pre-approved by instructor)	30-50

### 13. Weighting

Class openings	25
Reading Quizzes / Papers	175
Math Autobiography	25
Topic Presentation	75
Philosophy Paper	50
Career plan	75
Major project	425
Major Field Achievement Test	50
Mentoring	25
Final Exam	75
TOTAL	1000 pts (+ prof development up to 100)

### 14. Scale

The following minimum percentages will guarantee the indicated grade. At the end of the course, the scale may be curved to be more lenient, but do not count on this.

Grade	A	A-	B+	B	B-	C+	C	C-	D+	D
Guaranteed Percentage	93	90	87	83	80	77	73	70	67	60

### **Citizenship:**

#### *Attendance:*

Students are responsible for attending all sessions of all classes for which they are enrolled. I reserve the right to take attendance without notice on any class day and to use the record as a homework score. Poor attendance has always been a leading cause of failure in math courses. Our mutual goal is your success in this course.

#### *Distractions:*

Tardiness is an unacceptable distraction to the other members of the class. Everyone occasionally runs a few minutes behind, but being tardy an excessive amount or an excessive number of times may result in denial of credit for work due that day.

Usage of cell phones, MP3 players, laptops (other than for note-taking or classwork), etc., during class is inappropriate and discourteous to other members of the class.

#### *Dishonesty:*

Cheating is defined as submitting work for academic evaluation that is not the student's own, copying answers from another student during an examination, using prepared notes or materials during an examination, or other misrepresentations of academic achievement submitted for evaluation and a grade. Plagiarism in research writing is considered cheating. Plagiarism is defined by the MLA Handbook as "the act of using another person's ideas or expressions in writing without acknowledging the source... to repeat as your own someone else's sentences, more or less verbatim."

It is the responsibility of each student to be aware of policies regulating academic conduct including definitions of academic dishonesty, the possible sanctions, and the appeals process.

Any undergraduate student apprehended and charged with cheating, including plagiarism, during his or her college matriculation, shall receive the following discipline:

1. First incident of cheating: failure in paper, assignment, or exam.
2. Second incident of cheating: failure in the course involved.
3. Third incident of cheating: dismissal from the university.

**Disabilities:**

If you have a disability for which you may need academic accommodation (including special testing, auxiliary aids, non-traditional formats), please inform the instructor as soon as possible and/or contact the Center for Student Success, Extension 2257.

**Email:**

If necessary, email will be sent to students' IWU student email accounts. Such email is considered official university correspondence and students are responsible for checking their email on a daily basis.

**The Writing Center:**

The Writing Center is a valuable resource for the writing you will do in this class. Trained Writing Consultants will help you with any stage of the writing process, from developing your topic to polishing your final draft. They WILL NOT write or edit your papers for you, but they WILL help you recognize your weaknesses as writers and provide you with tools for strengthening your writing and editing skills. The Writing Center is located in Elder Hall, Room 222, and is open from 8:00 a.m. -10:00 p.m. Monday through Thursday, 8:00 a.m. - 5:00 p.m. on Friday, and noon to 5:00 p.m. on Saturday. To make an appointment, go to <http://indwes.mywconline.com/>, call extension 2189, or stop by the Writing Center.

## Topics List

The course revolves around the following questions from the philosophy of mathematics:

- 1) To what extent has the world, as some philosophers and theologians claim, shifted from a “modern” worldview to a “postmodern” worldview, and how has this shift impacted mathematics?
- 2) What is possible and what is not possible to show using logical reasoning?
- 3) Should the extent to which mathematics has been useful in describing the physical universe be surprising to us, and if so, how should we explain it?
- 4) When researchers develop new mathematics, are they creating mathematics or discovering mathematics?
- 5) In what sense do abstract mathematic objects like triangles and the number “three” exist?
- 6) What is a proof and how does mathematically proven “truth” relate to other concepts of truth?
- 7) To what extent does mathematics have intrinsic value and/or beauty outside its role as a tool for science?
- 8) Can there potentially be an infinite number of objects? Can there actually be an infinite number of objects?
- 9) How, if at all, can paradoxes of the infinite be resolved mathematically?

## Tentative Schedule

Date	Day	Topics	Reading Assignment
Sept 2	M	Introduction; Overview of math philosophy	Livio: Ch 1, Ch 2 Howell: Introduction
Sept 4	W	Mathematical philosophy	Livio: Ch 6, Ch 7
Sept 9	M	Logic and Mathematics Autobiography/Autobiography	Howell: Ch 1, Ch 2
Sept 11	W	Modernism/Postmodernism Autobiography/Autobiography	Livio: Ch 8 Wigner article
Sept 16	M	<i>Presentation – Unreasonable Effectiveness (Wigner)</i>	Livio: Ch 9
Sept 18	W	Created vs. Discovered Autobiography	Howell: Ch 3
Sept 23	M	<i>Presentation – Existence of Math (Howell 3)</i>	
Sept 25	W	Mathematical Existence Autobiography	Howell: Ch 4
Sept 30	M	<i>Presentation – The Nature of Proof (Howell 4)</i>	Moore: Introduction Oppy chapter
Oct 2	W	Mathematical Truth Autobiography	Howell: Ch 8
Oct 7	M	<i>Presentation – Mathematics and Values (Howell 8)</i>	Moore: Ch 1
Oct 9	W	Mathematical Value; Paradoxes of the infinite Autobiography	Moore: Ch 2, Ch 6
Oct 14	M	<i>Presentation - Early Thoughts on Infinite (Moore 2,6)</i>	Howell: Ch 11
Oct 16	W	Mathematical Learning Autobiography	Moore: Ch 8
Oct 21	M	<i>Presentation – Cantor’s Ordinals (Moore 8)</i>	
Oct 23	W	Course Logistics Autobiography	Moore: Ch 10
Oct 28	M	<i>Presentation -- Transfinite Mathematics (Moore 10)</i>	
Oct 30	W	Project oral preliminary reports	
Nov 4	M	Project oral preliminary reports	
Nov 6	W	Project oral preliminary reports	Moore: Ch 11
Nov 11	M	<i>Presentation – Lowenheim-Skolem Theorem (Moore 11)</i>	Moore: Ch 12
Nov 13	W	<i>Presentation -- Godel’s Theorem (Moore 12)</i>	Howell: Ch 9
Nov 18	M	<i>Presentation – Creativity and Computers (Howell 9)</i>	
Nov 20	W	Course Logistics	Howell: Conclusion
Nov 25	M	Conclusion	
Nov 27	W	THANKSGIVING	
Dec 2	M	<i>Symposium presentations 3:30-6:30 (no class)</i>	
Dec 4	W	<i>Symposium presentations 3:30-6:00 (no class)</i>	

Major Fields Achievement Test:

Final Exam: Tuesday December 10 (individually scheduled times)

**Mission Statement and Objectives**  
**Mathematics Program**  
**Summer 2013**

“The Department of Mathematics is committed to preparing students academically and spiritually for careers and/or advanced study. This preparation will occur through a Christian liberal arts curriculum developing solid foundations in mathematics content, technological skills, and critical analysis and problem solving ability. Communication, teamwork, and leadership skills will be developed through a multi-disciplinary philosophical approach in integrating faith, learning, and service.”

- 1) PROOF: ...understand and proficiently implement the logical role and methodology of rigorous proof in the axiomatic development of mathematics.
- 2) CONTENT: ...understand core mathematical content in standard areas of analysis, algebra, geometry, and probability.
- 3) NATURE: ...proficiently articulate the overall nature of mathematics including its history; current organization; and interfaces with Christian faith, philosophy, and other academic disciplines.
- 4) APPLICATION: ...proficiently analyze, model, and solve real-world problems using mathematical/statistical software as appropriate.
- 5) COMMUNICATION: ...proficiently communicate mathematics in both written and oral form