Syllabus

INDIANA WESLEYAN UNIVERSITY

Session Dates: 3/1/22-4/25/22
Winter/Spring II 2022
MATH-504 Real Analysis (Online)
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Course Description

This course offers a rigorous study of the real numbers and associated functions in order to deepen students' understanding of calculus and raise their ability to effectively formulate and communicate mathematics. It reviews concepts of real-valued functions defined on the real line and proceeds to extend these results as applicable to complex valued functions and metric spaces. It also includes a rigorous examination of properties of some important special functions. Prerequisite: A bachelor's degree with a Mathematics major or must be state certified (in any state) to teach Mathematics at a secondary school level and show evidence of completing an undergraduate course in Introduction to Real Analysis with a minimum grade of "C."

Prerequisite Courses: Undergraduate Real Analysis

Course Outcomes

Upon completion of this course, you should be able to:

1. Analyze the construction and topology of the real line as a complete ordered field.
2. Apply the concepts of convergence of sequences and series of numbers and functions.
3. Determine the continuity, differentiability, and integrability of functions.
4. Adapt concepts of real analysis to vector spaces.
5. Compose solutions and rigorous proofs of results arising in real analysis.
6. Examine God's natural order in light of mathematical understanding.

Course Textbook

Rudin, W. (1976). Principles of Mathematical Analysis (3rd ed.). New York, NY: McGraw-Hill Education.

IWU Diversity Statement

IWU, in covenant with God's reconciling work and in accordance with the Biblical principles of our historic Wesleyan tradition, commits to build a community that reflects Kingdom diversity. We will foster an intentional environment for living, teaching and learning, which exhibits honor, respect, and dignity. Acknowledging visible or invisible differences, our community authentically values each member's earthly and eternal worth. We refute ignorance and isolation and embrace deliberate and courageous engagement that exhibits Christ's commandment to love all humankind.

Course Module Summary

Module	Discussion	Assignment	Exam	Total Points per Module
Module One	2/30	1/70		100
Module Two	2/40	1/70		110
Module Three	2/30	1/70		100
Module Four	1/20	1/70	1/100	190
Module Five	2/30	1/70		100
Module Six	2/40	1/70		110
Module Seven	1/10	1/70	1/100	180
Module Eight	2/40	1/70		110
TOTAL	**14/240**	**8/560**	**2/200**	**1000**

Grading Scale

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

Pacing Guide

- Module 1 is due by the end of Week 1.
- Module 2 is due by the end of Week 2.
- Module 3 is due by the end of Week 3.
- Module 4 is due by the end of Week 4.
- Module 5 is due by the end of Week 5.
- Module 6 is due by the end of Week 6.
- Module 7 is due by the end of Week 7.
- Module 8 is due by the end of Week 8.

Module One Outline

Assignments	Type	Due- (See syllabus pacing guide for details)	Estimated Time*	Points
1.1 Biblical Wisdom	Discussion	End of module.	1 hour	10
1.2 Chapter 1 Homework	Dropbox	End of module.	9 hours	70
1.3 Discussion	Discussion	Initial post due halfway through module. Two follow-up responses due at end of module.	2 hours	20
Totals			**12 hours**	**100**

Module Two Outline

Assignments	Type	Due- (See syllabus pacing guide for details)	Estimated Time*	Points
2.1 Module 2 proof critique	Discussion	Post due halfway through module. Critique due at end of module.	2 hours	20
2.2 Chapter 2 Homework	Dropbox	End of module.	9 hours	70
2.3 Discussion	Discussion	Initial post due halfway through module. Two follow-up responses due at end of module.	2 hours	20
Totals			**13 hours**	**110**

Module Three Outline

Assignments	Type	Due- (See syllabus pacing guide for details)	Estimated Time*	Points
3.1 Biblical Wisdom	Discussion	End of module.	1 hours	10
3.2 Chapter 3 Homework	Dropbox	End of module.	9 hours	70
3.3 Discussion	Discussion	Initial post due halfway through module. Two follow-up responses due at end of module.	2 hours	20
Totals			**12 hours**	**100**

Module Four Outline

Assignments	Type	Due- (See syllabus pacing guide for details)	Estimated Time*	Points
4.1 Module 4 proof critique	Discussion	Post due halfway through module. Critique due at end of module.	2 hours	20
4.2 Chapter 4 Homework	Dropbox	End of module.	9 hours	70
4.3 Exam I	Dropbox	End of module.	5 hours	100
Totals			**16 hours**	**190**

Module Five Outline

Assignments	Type	Due- (See syllabus pacing guide for details)	Estimated Time*	Points
5.1 Biblical Wisdom	Discussion	End of module.	1 hours	10
5.2 Chapter 5 Homework	Dropbox	End of module.	9 hours	70
5.3 Discussion	Discussion	Initial post due halfway through module. Two follow-up responses due at end of module.	2 hours	20
Totals			12 hours	100

Module Six Outline

Assignments	Type	Due- (See syllabus pacing guide for details)	Estimated Time*	Points
6.1 Module 6 proof critique	Discussion	Post due halfway through module. Critique due at end of module.	2 hours	20
6.2 Chapter 6 Homework	Dropbox	End of module.	9 hours	70
6.3 Discussion	Discussion	Initial post due halfway through module. Two follow-up responses due at end of module.	2 hours	20
Totals			13 hours	110

Module Seven Outline

Assignments	Type	Due- (See syllabus pacing guide for details)	Estimated Time*	Points
7.1 Biblical Wisdom	Discussion	End of module.	1 hour	10
7.2 Chapter 7 Homework	Dropbox	End of module.	9 hours	70
7.3 Exam II	Dropbox	End of module.	5 hours	100
Totals			15 hours	180

Module Eight Outline

Assignments	Type	Due- (See syllabus pacing guide for details)	Estimated Time*	Points
8.1 Module 8 proof critique	Discussion	Post due halfway through module. Critique due at end of module.	2 hours	20
8.2 Chapter 8 Homework	Dropbox	End of module.	9 hours	70
8.3 Discussion	Discussion	Initial post due halfway through module. Two follow-up responses due at end of module.	2 hours	20
Totals			13 hours	110

* These timings are based on estimations of average times to complete each assignment. Actual assignment completion times will vary.

Resources

1. Any calculus book that you are familiar with

   Since this course essentially covers the theory behind a typical undergraduate calculus course, having a calculus book to reference may be helpful to see simpler examples of the theory being studied
2. Lay, S. (2014) *Analysis With an Introduction to Proof* (5th Ed), Upper Saddle River NJ, Pearson.

   An excellent undergraduate text covering much of the same material as our textbook but at a slightly lower (and perhaps more readable) level
3. http://ocw.mit.edu/courses/mathematics/18-100b-analysis-i-fall-2010/

   Extensive course materials from a similar course from the Massachusetts Institute of Technology

Advice & Encouragement

1. "To everything 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.
2. "Consider the path for your feet and let all your ways be established." Prov 4:26. The syllabus shows the schedule for the course. The wise will have previewed the section(s) in the textbook before viewing any videos and attempting homework; 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 assignments. 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 a test to try to catch up.
4. "As iron sharpens iron, so one man sharpens another." Prov 27:17. Students usually 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 test 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 your instructor specifically says so, it would be less than wise to ignore it and hope it goes away. Your

professors are available to help 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.

Policies

1. *Discussions*
   Participation in online discussions will be required for each module. As specified in each individual module, this may consist of posting a proof, a comment on a classmates' proofs, a response to a scripture devotional, etc.
2. *Homework Assignments*
   Homework will be assigned and collected for each module. Each homework should be submitted in a single PDF document which can be generated by a scan of neatly handwritten work, saving a document typed with a word processor mathematical add-in (such as Equation Editor in Microsoft Word), or typeset using a LaTeX editor such as http://www.overlead.com.
   Grading will be based on a combination of completion, correctness, and clarity/style as determined by your instructor. Complete work must be shown on all problems. Working together on homework is strongly encouraged, but any collaboration should be a mutual learning experience rather than simply exchanging answers (which is considered a form of plagiarism). Unless your instructor indicates otherwise, copying homework solutions posted on the internet or using a solutions manual designated for instructors is considered plagiarism.
3. *Tests*
   Two tests will be given as indicated on the schedule. They will consist of a combination of proofs and of short answer questions (where students are asked to state important definitions and theorems or provide an example or counterexample to a statement).

Expectations, Policies, and Important Student Information

Expectations

Instructor Expectations of Students

- Submit assignments on time. If there are circumstances beyond your control, discuss possible options for completion with your instructor.
- Accomplish work on your own unless otherwise instructed (i.e., do not cheat or plagiarize).