Real Analysis  MATH 5351.001  
Department of Mathematics & Statistics  
Spring 2020

A. COURSE INFORMATION

Course number/section:  MATH 5351.001  
Class meeting time:  MWF 8:00 - 8:50 AM  
Class location:  OCNR 258  
Course Website:  https://bb9.tamucc.edu/

B. INSTRUCTOR INFORMATION

Instructor:  Dr. Beate Zimmer  
Office location:  CI 310  
Office hours:  MWF 11:00 AM – 12:00 noon  
MW 1:00-2:00 PM  
Telephone:  (361) 825-2682  
e-mail:  beate.zimmer@tamucc.edu  
Appointments:  e-mail to make appointments outside the announced office hours

C. COURSE DESCRIPTION

Catalog Course Description  
This course includes such topics as sequences and series of constants and functions, the Riemann integral, Fourier series, and an introduction to Lebesgue measure and integration.

Extended Course Description  
This course provides essential mathematical background for students in the Masters program in mathematics. Real Analysis is the theory behind calculus and a deeper understanding is needed to successfully teach calculus or to do research in analysis or differential equations.

D. PREREQUISITES FOR THE COURSE

Prerequisites  
MATH 4301 (Advanced Calculus).

Corequisites  
None.

E. REQUIRED TEXTBOOK(S), READINGS AND SUPPLIES

Required Textbook(s)  
The required textbook for the course is Elementary Classical Analysis, 2nd edition, by Marsden and Hoffman. It is strongly suggested that you read the appropriate sections in the book before class.
Optional Textbook(s) or Other References
Recommended reading is H. Royden, Real Analysis, 3rd edition (or 4th edition), which covers the lectures on measure theory and the Lebesgue integral that aren’t covered by the Marsden book.

Supplies
Homework is assigned weekly. The notes from class will be available on BlackBoard after class. You may print them, but don’t have to. Costs for printing should not exceed $20.

F. STUDENT LEARNING OUTCOMES AND ASSESSMENT
Assessment is a process used by instructors to help improve learning. Assessment is essential for effective learning because it provides feedback to both students and instructors. A critical step in this process is making clear the course’s student learning outcomes that describe what students are expected to learn to be successful in the course. The student learning outcomes for this course are listed below. By collecting data and sharing it with students on how well they are accomplishing these learning outcomes students can more efficiently and effectively focus their learning efforts. This information can also help instructors identify challenging areas for students and adjust their teaching approach to facilitate learning.

By the end of this course, students should be able to:

1. correctly state the main theorems covered in this class
2. prove theorems from the class
3. use the theorems to prove related results
4. write technical proofs
5. solve a number of problems in the problem sections at the ends of the chapters
6. discuss the differences between the Riemann integral and the Lebesgue integral

G. INSTRUCTIONAL METHODS AND ACTIVITIES
Methods and activities for instruction include: Lectures and discussions.

H. MAJOR COURSE REQUIREMENTS AND GRADING
The methods of evaluation and the criteria for grade assignments are:
Homework will be assigned weekly and is due at the start of the next week. Homework may consist of problems from the textbook or other sources. No late homework is accepted. The lowest homework grade gets dropped. Office hours are a great opportunity to ask questions about homework. Working with other students is fine, but be sure to turn in your own product in the end. The homework assignments are non-trivial - they are meant to take several days and it is not a good idea to wait until the evening before the due date to start them. Late homework receives no credit. The lowest homework grade gets dropped. No exam grades get dropped.
The Final exam is comprehensive.

Calculator policies and partial credit:
All exams are no-calculator exams.

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>% of FINAL GRADE</th>
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<tbody>
<tr>
<td>Three exams</td>
<td>60%</td>
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<tr>
<td>Homework</td>
<td>20%</td>
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<tr>
<td>Final Exam</td>
<td>20%</td>
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</tbody>
</table>

Grading Scale: Grades will be no stricter than
A = 90.00 – 100%
B = 80.00 – 89.99%
C = 70.00 – 79.99%
D = 60.00 – 69.99%
F = below 60%

I. COURSE CONTENT/SCHEDULE

<table>
<thead>
<tr>
<th>DATE</th>
<th>TOPIC</th>
<th>CHAPTER</th>
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</thead>
<tbody>
<tr>
<td>1 W 1/22</td>
<td>Ordered Fields, Completeness of ( \mathbb{R} ), Least upper bounds</td>
<td>1.1 – 1.3</td>
</tr>
<tr>
<td>2 F 1/24</td>
<td>Cauchy Sequences, lim sup, lim inf, Euclidean space</td>
<td>1.4 – 1.6</td>
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<tr>
<td>3 M 1/27</td>
<td>Open and closed sets</td>
<td>2.1 - 2.4</td>
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<tr>
<td>4 W 1/29</td>
<td>Closure and Completeness</td>
<td>2.5, 2.6, 2.8</td>
</tr>
<tr>
<td>5 F 1/31</td>
<td>Sequences and Series</td>
<td>2.7, 2.9</td>
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<tr>
<td>6 M 2/3</td>
<td>Compactness</td>
<td>3.1, 3.2</td>
</tr>
<tr>
<td>7 W 2/5</td>
<td>Nested Sets</td>
<td>3.3</td>
</tr>
<tr>
<td>8 F 2/7</td>
<td>Connectedness</td>
<td>3.4, 3.5</td>
</tr>
<tr>
<td>9 M 2/10</td>
<td>Continuous images of connected and compact sets</td>
<td>4.1, 4.2</td>
</tr>
<tr>
<td>10 W 2/12</td>
<td>Review of Topology</td>
<td></td>
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<tr>
<td>11 F 2/14</td>
<td>(Riemann) integrable functions</td>
<td>8.1</td>
</tr>
<tr>
<td>12 M 2/17</td>
<td>Volume and sets of measure zero</td>
<td>8.2</td>
</tr>
<tr>
<td>13 W 2/19</td>
<td>Outer measure</td>
<td></td>
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<tr>
<td>14 F 2/21</td>
<td><strong>Exam 1</strong></td>
<td></td>
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<tr>
<td>15 M 2/24</td>
<td>Measurable sets and Lebesgue measure</td>
<td></td>
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<tr>
<td>16 W 2/26</td>
<td>A nonmeasurable set</td>
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<tr>
<td>17 F 2/28</td>
<td>Lebesgue measurable functions</td>
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<tr>
<td>DATE</td>
<td>TOPIC</td>
<td>CHAPTER</td>
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<tr>
<td>18 M 3/2</td>
<td>Littlewood’s three principles</td>
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<tr>
<td>19 W 3/4</td>
<td>Lebesgue’s theorem for the Riemann integral</td>
<td>8.3</td>
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<tr>
<td>20 F 3/6</td>
<td>Properties of the Riemann integral</td>
<td>8.4</td>
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<td></td>
<td><strong>Spring Break</strong></td>
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<tr>
<td>21 M 3/16</td>
<td>The Lebesgue integral of a bounded function over a set of finite measure</td>
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<tr>
<td>22 W 3/18</td>
<td>The Lebesgue integral of a nonnegative function</td>
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<tr>
<td>23 F 3/20</td>
<td>The general Lebesgue integral</td>
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<tr>
<td>24 M 3/23</td>
<td>Convergence in measure</td>
<td></td>
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<tr>
<td>25 W 3/25</td>
<td>The derivative</td>
<td>6.1</td>
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<tr>
<td>26 F 3/27</td>
<td>Continuity of differentiable mappings</td>
<td>6.3</td>
</tr>
<tr>
<td>27 M 3/30</td>
<td>Conditions for Differentiability</td>
<td>6.4</td>
</tr>
<tr>
<td>28 W 4/1</td>
<td><strong>Exam 2</strong></td>
<td></td>
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<tr>
<td>29 F 4/3</td>
<td>Distributions</td>
<td>8.7</td>
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<tr>
<td>30 M 4/6</td>
<td>Distributions</td>
<td>8.7</td>
</tr>
<tr>
<td>31 W 4/8</td>
<td>Fubini’s theorem for the Riemann integral</td>
<td>9.1</td>
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<tr>
<td>32 F 4/10</td>
<td>Interchanging limits</td>
<td>9.7</td>
</tr>
<tr>
<td>33 M 4/13</td>
<td>Interchanging limits</td>
<td>9.7</td>
</tr>
<tr>
<td>34 W 4/15</td>
<td>Inner product spaces</td>
<td>10.1</td>
</tr>
<tr>
<td>35 F 4/17</td>
<td>Inner product spaces</td>
<td>10.1</td>
</tr>
<tr>
<td>36 M 4/20</td>
<td>Orthogonal families of functions</td>
<td>10.2</td>
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<tr>
<td>37 W 4/22</td>
<td>Orthogonal families of functions</td>
<td>10.2</td>
</tr>
<tr>
<td>38 F 4/24</td>
<td>Completeness and Convergence</td>
<td>10.3</td>
</tr>
<tr>
<td>39 M 4/27</td>
<td><strong>Exam 3</strong></td>
<td></td>
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<tr>
<td>40 M 4/29</td>
<td>Completeness and Convergence</td>
<td>10.3</td>
</tr>
<tr>
<td>41 F 5/1</td>
<td>Computation of Fourier series</td>
<td>10.5</td>
</tr>
<tr>
<td>42 M 4/30</td>
<td>Computation of Fourier series</td>
<td>10.5</td>
</tr>
<tr>
<td>43 W 5/5</td>
<td>Review</td>
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</table>

The comprehensive Final Exam is on Friday, May 8, 8:00 AM – 10:30 AM.

Note: Changes in this course schedule may be necessary and will be announced to the class by the Instructor. The exams shown are directly related to the Student Learning Outcomes described in Section F.

J. **COURSE POLICIES**

**Attendance/Tardiness**
Attendance will be taken each class. For most students attending class is a faster way of learning the material than trying to catch up on missed material solely from the book. Tardiness is often disruptive to the whole class and is not appreciated. If you are delayed and arrive late for class please do so quietly. Usually the topic/technique of the day is
introduced in the first few minutes of class; missing that part usually means that you will be
lost all class.

**Late Work and Make-up Exams**
Missed homework assignments or quizzes can not be made up; the drop grades accommodate those. Make-up exams will not be given. If a student misses an exam and has a valid excuse, the final exam score will serve as the score for that exam. This rule can only be used for one exam, the second missed exam is a zero.

**Extra Credit**
There is no extra credit in this class.

**Cell Phone Use**
Cell phones and such must be turned off before class. Each time your phone rings during class, your course grade goes down by 1%.

**Laptop Use**
You may use a laptop to take notes during lecture. Distracting other students by surfing the web is not acceptable behaviour.

**Food in Class**
No food in class (except during the final, where non-noisy foods are OK).

**Missed Exam**
If you have to miss an exam, it is your responsibility to contact me no later than the day of the exam. Failure to contact me on or before the exam day results in a grade of zero points for the exam. This also applies to the final exam. For missed final exams due to an acceptable excuse the university rules about I (Incomplete) grades apply and the make-up is at the instructor’s convenience early in the next long semester. Only extreme emergencies or official university business are acceptable reasons to miss exams and documentation will be required. Car trouble, routine doctor’s appointments, family reunions or graduations of siblings etc. are not valid reasons to miss exams. If your reason to miss the exam is not a valid one, your exam score is 0 points. Be sure to check before missing an exam whether your reason is acceptable.

**Participation**
Participation is not part of the grade, but you learn more by interacting, than by watching passively.

**K. COLLEGE AND UNIVERSITY POLICIES**

- **Academic Integrity (University)**
  University students are expected to conduct themselves in accordance with the highest standards of academic honesty. Academic misconduct for which a student is subject to penalty includes all forms of cheating, such as illicit possession of examinations or examination materials, falsification, forgery, complicity or plagiarism.
(Plagiarism is the presentation of the work of another as one’s own work.) In this class, academic misconduct or complicity in an act of academic misconduct on an assignment or test will result in a failing grade.

- **Classroom/Professional Behavior** Texas A&M University–Corpus Christi, as an academic community, requires that each individual respect the needs of others to study and learn in a peaceful atmosphere. Under Article III of the Student Code of Conduct, classroom behavior that interferes with either (a) the instructor’s ability to conduct the class or (b) the ability of other students to profit from the instructional program may be considered a breach of the peace and is subject to disciplinary sanction outlined in article VII of the Student Code of Conduct. Students engaging in unacceptable behavior may be instructed to leave the classroom. This prohibition applies to all instructional forums, including classrooms, electronic classrooms, labs, discussion groups, field trips, etc.

- **Statement of Civility**
  Texas A&M University–Corpus Christi has a diverse student population that represents the population of the state. Our goal is to provide you with a high quality educational experience that is free from repression. You are responsible for following the rules of the University, city, state and federal government. We expect that you will behave in a manner that is dignified, respectful and courteous to all people, regardless of sex, ethnic/racial origin, religious background, sexual orientation or disability. Behaviors that infringe on the rights of another individual will not be tolerated.

- **Deadline for Dropping a Course with a Grade of W (University)** I hope that you never find it necessary to drop this or any other class. However, events can sometimes occur that make dropping a course necessary or wise. **Please consult with your academic advisor, the Financial Aid Office, and me, before you decide to drop this course.** Should dropping the course be the best course of action, you must initiate the process to drop the course by going to the Student Services Center and filling out a course drop form. Just stopping attendance and participation **WILL NOT automatically result in your being dropped from the class.** Please consult the Academic Calendar ([http://www.tamucc.edu/academics/calendar/](http://www.tamucc.edu/academics/calendar/)) for the last day to drop a course.

- **Grade Appeals (College of Science and Engineering)** As stated in University Procedure 13.02.99.C2.01, Student Grade Appeal Procedures, a student who believes that he or she has not been held to appropriate academic standards as outlined in the class syllabus, equitable evaluation procedures, or appropriate grading, may appeal the final grade given in the course. The burden of proof is upon the student to demonstrate the appropriateness of the appeal. A student with a complaint about a grade is encouraged to first discuss the matter with the instructor. For complete details, including the responsibilities of the parties involved in the process and the number of days allowed for completing the steps in the process, see University Procedure 13.02.99.C2.01, Student Grade Appeal Procedures. These documents are accessible through the University Rules website at
http://www.tamucc.edu/provost/university_rules/index.html,

and the College of Science and Engineering Grade Appeals webpage at
http://sci.tamucc.edu/students/GradeAppeal.html

For assistance and/or guidance in the grade appeal process, students may contact
the chair or director of the appropriate department or school, the Office of the
College of Science and Engineering Dean, or the Office of the Provost.

• Disability Services
  The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute
  that provides comprehensive civil rights protection for persons with disabilities.
  Among other things, this legislation requires that all students with disabilities be
  guaranteed a learning environment that provides for reasonable accommodation of
  their disabilities. If you believe you have a disability requiring an accommodation,
  please call (361) 825-5816 or visit Disability Services in Corpus Christi Hall 116.
  If you are a returning veteran and are experiencing cognitive and/or physical access
  issues in the classroom or on campus, please contact the Disability Services office
  for assistance at (361) 825-5816.

http://disabilityservices.tamucc.edu/

• Statement of Academic Continuity In the event of unforeseen adverse event,
  such as a major hurricane and classes could not be held on the campus of Texas
  A&M University–Corpus Christi this course would continue through Blackboard
  and/or e-mail. In addition the syllabus and class activities may be modified to
  allow continuation of the course. University Facilities (i.e. e-mail, web sites, and
  Blackboard) will be operational within two days of closing the physical campus.
  However, students need to make certain that the course instructor has a primary
  and secondary way of contacting each student.

L. OTHER INFORMATION

• Academic Advising The College of Science & Engineering requires that students
  meet with an Academic Advisor as soon as they are ready to declare a major. The
  Academic Advisor will set up a degree plan, which must be signed by the student,
  a faculty mentor, and the department chair. Meetings are by appointment only;
  advisors do not take walk-ins. Please call or stop by the Advising Center to check
  availability and schedule an appointment. The College’s Academic Advising Center
  is located in Center for Instruction 350 or can be reached at (361) 825-3928.

GENERAL DISCLAIMER

I reserve the right to modify the information, schedule, assignments, deadlines, and
course policies in this syllabus if and when necessary. I will announce such changes in a
timely manner during regularly scheduled lecture periods.