MATH 6362 – 90L (Fourier Analysis)

Syllabus for Summer II 2021

**Classroom**: Meeting Online, <https://utrgv.zoom.us/j/2824166420>

**Time:** M-F, 9:45am – 11:15am,July 8, 2021 – August 13, 2021

**Instructor:**

Dr. Zhijun (George) Qiao

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**Online Office Hours**: Tuesdays & Fridays 2:00pm – 3:00pm or by appointment.

Join Office Hours through Zoom link: <https://utrgv.zoom.us/j/2824166420>

**Prerequisite:**

A student must have completed and passed MATH 2414/2415 (Calculus II/III) or MATH 3341 (Differential Equations) or MATH 2321 (Differential Equations and Linear Algebras) with a grade C or better or consent of instructor. The student not meeting this requirement may be asked to drop the course.

**Textbook:** Required textbook: *Fourier Analysis and Its Applications*, by **Gerald B. Folland**, Brooks/Cole Publishing Company. Instructor will provide a free pdf version for the chapter needs.

**Topics:** Fourier Series, Orthogonal Sets of Functions, Some Boundary Value Problems, Bessel Functions, Orthogonal Polynomials, The Fourier Transform, The Laplace Transform, Generalized Functions, and Green Functions. See Chapters 1 – 7.

**Software:** Students are encouraged to use the math software such as Maple or Matlab to verify some results or do some calculations.

**Daily supplies:**  You need to bring Textbook, Notebook, Loose leaf paper, Graph paper, Pen, Pencil etc to the class.

**Course Objectives:** This course includes trigonometric series and Fourier series, Dirichlet Integral, convergence and summation of Fourier series, uniform convergence and Gibbs Phenomena, L^2 space, properties of Fourier coefficients, Fourier Transform and applications, Laplace Transform and applications, distributions, Fourier series of distributions, Fourier Transforms of generalized functions, orthogonal systems. The purpose of this course is to show the students how to analyze a partial differential equation from a physical problem and how to solve the equation (along with initial and boundary conditions). Emphasis will be placed on the learning and understanding of definitions and abstractions in mathematics, as well as the study of the use of integration and series in real-world problems. A more detailed list of topics is given in the book chapters.

**Student Learning Outcomes:** After completing this course students will

* Understand the terminology, scope, main results, and applications of mathematical signal and image processing and Fourier analysis.
* Be able to compute and apply Fourier series and transforms, and use them to solve problems in mathematics, science, and engineering.
* Know the basic terminology and results of inner product spaces, Hilbert spaces, and normed linear spaces, such as the L^p spaces, and how they relate to signal and image processing.
* Understand wavelet analysis and multiresolution analysis and their applications.
* Know how to apply computer technology to gain insight into the topics discussed in class and to aid in performing computations.

**General Grade Policy**

**Homework and Projects –** Homework assignment is assigned daily and will consist of problems and reading from the textbook and occasional handout. Projects are based on the homework problems. A project will be taken two weeks, namely, ~ 3 times in the whole semester. ***Projects will be designed in two formats: each student gives presentation based on the homework, and the other is to solve some physical problems I will assign***. It is strongly recommended that students work all those homework problems since projects score are used to determine your project grade. Completing the assignments is the ***single most important part*** of this course. You will be expected to spend, on average, about 4 hours each week to complete the assignments. The assigned problems will not be collected or graded, but they will form the basis for projects, midterm exams, and the final exam. I will select your best 2 of your project scores in final grade. A homework assignment sheet will be delivered to everybody on the 1st day class. No late re-project will be accepted.

**Tests –** There will be one one-hour online test. All test problems must be taken during their scheduled times. The test time will be announced in advance (basically, a test will be given every two topics or chapters), and a brief review will be given before each test. All students must show their work on the tests. Score will be provided to you separately. No re-test opportunities.

**Final Exam –** The comprehensive final exam has been scheduled on **8/13/2021, Friday, 10:00 AM – 11:45 AM**. All students must take the final exam on the scheduled time. A summary review will be given in the class before the final exam.

**Grading –** The course grade will be based on

|  |  |
| --- | --- |
| HW/Quizzes/Discussion BoardBest 2 out of 3 projects at 75 pts each |  50 pts150 pts |
| Midterm Test  | 100 pts |
| Comprehensive Final Exam | 100 pts |
| Total | 400 pts |

The course grade will be assigned according to a scale no higher than A(85-100%), B(75-84%), C(60-74%), F(below 60%).

**THERE WILL BE NO MAKE-UP EXAMS GIVEN**.

If a student is absent during a scheduled major test and quiz, the student must go by the instructor’s office during the scheduled office hours to discuss the validity of the excuse.  In the case of a valid excuse, the missed test grade will be replaced by the final exam grade.    If a student does not have a valid excuse, the grade for the missed test is a zero and cannot be replaced.  If you arrive late to a test you will not be given additional time to complete the exam.  Anyone arriving to a test after somebody else who took the exam has left will not be allowed to take the exam. Students missing more than one exam may be dropped from the course. With an unexcused absence, a score of 0 will be recorded for the missed HW/Quiz or exam.

**Tutoring: you may use online resources as your own study for the homework problem solving**.

***Classroom Behavior:***

* All beepers and cellular phones must be turned off before you enter the classroom.
* Once in class, a student is expected to remain in class for the duration of the class.  If a student needs to leave class early, than the student needs to discuss the situation with the instructor before class begins.
* During class students are expected to be courteous to the instructor and other classmates. Examples of discourteous behavior are unnecessary talking, sleeping, tardiness, leaving class while instructor is lecturing, sharpening pencils during the lecture, etc.
* No Food Allowed In Classroom.
* Chronic tardiness and discourteous behavior will not be tolerated and is cause for a student's dismissal from class for the remainder of the semester.

**UTRGV Policy Statements**

UTRGV requires all electronic communication between the University and students be conducted through the official University supplied systems UTRGV-Mail. Please use your UTRGV-Mail account for all correspondence with me.

**Calculators, Cell Phones, and Other Electronic Equipment**

Calculators will be permitted for use on exams. Electronic equipment such as cell phones, pocket organizers, tablet or laptop computers, or electronic writing pads or pen-input devices will not be permitted during exams. Please make sure that cell phones are turned off and stored way during class.

**MANDATORY COURSE EVALUATION PERIOD:**

Students are required to complete an ONLINE evaluation of this course, accessed through your UTRGV account ([*https://my.utrgv.edu/home*](https://my.utrgv.edu/home)); you will be contacted through email with further instructions. Students who complete their evaluations will have priority access to their grades. Online evaluations will be available: July 1 – 8 for summer I semester courses.

**ATTENDANCE:** Students are expected to attend all scheduled classes and may be dropped from the course for excessive absences. UTRGV’s attendance policy excuses students from attending class if they are participating in officially sponsored university activities, such as athletics; for observance of religious holy days; or for military service. Students should contact the instructor in advance of the excused absence and arrange to make up missed work or examinations.

**STUDENTS WITH DISABILITIES:**

If you have a documented disability (physical, psychological, learning, or other disability which affects your academic performance) and would like to receive academic accommodations, please inform your instructor and contact Student Accessibility Services to schedule an appointment to initiate services. It is recommended that you schedule an appointment with Student Accessibility Services before classes start. However, accommodations can be provided at any time. **Brownsville Campus**: Student Accessibility Services is located in Cortez Hall Room 129 and can be contacted by phone at (956) 882-7374 (Voice) or via email at ability@utrgv.edu. **Edinburg Campus:** Student Accessibility Services is located in 108 University Center and can be contacted by phone at (956) 665-7005 (Voice), (956) 665-3840 (Fax), or via email at ability@utrgv.edu.

**SCHOLASTIC INTEGRITY:**

As members of a community dedicated to Honesty, Integrity and Respect, students are reminded that those who engage in scholastic dishonesty are subject to disciplinary penalties, including the possibility of failure in the course and expulsion from the University. Scholastic dishonesty includes but is not limited to: cheating, plagiarism, and collusion; submission for credit of any work or materials that are attributable in whole or in part to another person; taking an examination for another person; any act designed to give unfair advantage to a student; or the attempt to commit such acts. Since scholastic dishonesty harms the individual, all students and the integrity of the University, policies on scholastic dishonesty will be strictly enforced (Board of Regents Rules and Regulations and UTRGV Academic Integrity Guidelines). All scholastic dishonesty incidents will be reported to the Dean of Students.

**SEXUAL HARASSMENT, DISCRIMINATION, and VIOLENCE:**

In accordance with UT System regulations, your instructor is a “responsible employee” for reporting purposes under Title IX regulations and so must report any instance, occurring during a student’s time in college, of sexual assault, stalking, dating violence, domestic violence, or sexual harassment about which she/he becomes aware during this course through writing, discussion, or personal disclosure. More information can be found at [www.utrgv.edu/equity](http://www.utrgv.edu/equity), including confidential resources available on campus. The faculty and staff of UTRGV actively strive to provide a learning, working, and living environment that promotes personal integrity, civility, and mutual respect in an environment free from sexual misconduct and discrimination.

**COURSE DROPS:** According to UTRGV policy, students may drop any class without penalty earning a grade of DR until the official drop date. Following that date, students must be assigned a letter grade and can no longer drop the class. Students considering dropping the class should be aware of the “3-peat rule” and the “6-drop” rule so they can recognize how dropped classes may affect their academic success. The 6-drop rule refers to Texas law that dictates that undergraduate students may not drop more than six courses during their undergraduate career. Courses dropped at other Texas public higher education institutions will count toward the six-course drop limit. The 3-peat rule refers to additional fees charged to students who take the same class for the third time.

**Tentative Course Schedule:**

**Part 1:** Fourier Series

**Part 2:** Orthogonal Sets of Functions

**Part 3:** Some Boundary Value Problems

**Part 4:** Bessel Functions, Orthogonal Polynomials

**Part 5:** The Fourier Transform, The Laplace Transform,

**Part 6:** Generalized Functions

**Part 7:** Green Functions.

**Tentative Course Schedule:**

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| --- | --- | --- |
| **Section** | **Topics** | **Test** |
| 1.1, 1.2 | Intro, Linear Diff. Eqs. |  |
| 1.3  | Sep of Variables |  |
| 2.1 | Fourier series of a periodic fuction |  |
| 2.2 | A convergence theorem |  |
| 2.3, 2.4 | Derivatives, integrals, Fourier series |  |
| 2.5 | Some applications and preparation for Proj 1 |  |
|  |  | Project 1 |
| 3.1, 3.2 | Vectors and Inner products |  |
| 3.3, 3.4  | Convergence and completeness |  |
| 3.5, 3.6 | Sturm-Liouville Problems |  |
|  |  |  |
| 4.1, 4.2 | 1d Heat flow |  |
| 4.3 | 1d wave motion |  |
| 4.4,4.5 | Dirichlet problem and multi-Fourier series |  |
|  |  | Midterm Test |
| 5.1 | Solutions of Bessel’s equation |  |
| 5.2 | Bessel function identities |  |
| 5.3 | Asymptotics |  |
| 5.4 | Orthogonal sets and Applications |  |
|  |  | Project 2 |
| 6.1,6.2 | Introductions and Legendre Polynomial |  |
| 6.3 | Spherical coordinates |  |
| 6.4 | Hermite polynomials |  |
| 6.5, 6.6 | Laguerre polynomials, other bases |  |
|  |  | Project 3 |
| 7.1 | Convolutions |  |
| 7.2 | Fourier Transform |  |
| 7.3 | Applications |  |
| 7.4 |  | Final Exam |
|  | **Dead day (No class)** |  |
| **All Contents in the whole semester** | **Final Exam** |