Mathematics 6322 (Spring 2020): Homological Algebra II

Instructor: Dmitri Pavlov, Assistant Professor
Lectures: TuTh 9:30–11, MA 17
Credit hours: 3
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1 Course Outline

This course will teach the basics of homological algebra, understood in the broadest possible sense, including homotopical algebra, sheaf cohomology, and other topics.

A classical array of topics will be covered, including the following: spectra, sheaf cohomology, de Rham cohomology, Dolbeault cohomology, derived stacks, as well as their applications to algebra, including various homology and cohomology theories for algebraic objects such as groups, rings, and modules.

The exposition will be heavily geometric, and connections to other areas of mathematics will be strongly emphasized, including, but not limited to, differential geometry, complex analysis, number theory, algebraic geometry, partial differential equations, and topology.

2 Catalog Course Description

Homological dimensions, Koszul homology, local cohomology, duality theories, global dimension and regular rings, Cohen–Macaulay rings.

3 Course Specific Expected Learning Outcomes

Upon completion of this course, students will be able to apply homological algebra to their area of research.

4 Assessment of Expected Learning Outcomes

Homework assignments will be given throughout the course. Students may also elect to do a project (a 10-page paper and a 1-hour oral presentation) on a topic relevant to the subject matter. Midterms and a final may be administered in class or as 4-hour take-home exams.

5 Grading

The final grade depends on the homework, projects, midterms, and final exam, if any of these were administered.

6 Text

The material will be drawn from a variety of sources, individual texts will be indicated as the course progresses.

Some recommended texts include the following:

Jacob Lurie: Kerodon

Denis-Charles Cisinski: Higher categories and homotopical algebra

Jacob Lurie: Higher topos theory

Jacob Lurie: Higher algebra

Emily Riehl: Categorical Homotopy Theory

William G. Dwyer, Philip. S. Hirschhorn, Daniel M. Kan, Jeffrey H. Smith: Homotopy limit functors on model categories and homotopical categories

Daniel Dugger: A primer on homotopy colimits

Sergei Gelfand, Yuri Manin: Methods of homological algebra

Charles A. Weibel: An introduction to homological algebra

7 Schedule

There will be 28 class meetings on the following days:

    January 16
    January 21
    January 23
    January 28
    January 30
    February 4
    February 6
    February 11
    February 13
    February 18
    February 20
    February 25
    February 27
    March 3
    March 5
    March 10
    March 12
    March 24: Canceled
    March 26: Canceled
    March 31
    April 2
    April 7
    April 9
    April 14
    April 16
    April 21
    April 23
    April 28
    April 30
    May 5

8 Operating Policy 34.19: Student absence for observance of religious holy day

1. "Religious holy day" means a holy day observed by a religion whose places of worship are exempt from property taxation under Texas Tax Code §11.20.

2. A student who intends to observe a religious holy day should make that intention known in writing to the instructor prior to the absence. A student who is absent from classes for the observance of a religious holy day shall be allowed to take an examination or complete an assignment scheduled for that day within a reasonable time after the absence.

3. A student who is excused under section 2 may not be penalized for the absence; however, the instructor may respond appropriately if the student fails to complete the assignment satisfactorily.

9 Operating Policy 34.22(2b): Reasonable accommodation for students with disabilities

Any student who, because of a disability, may require special arrangements in order to meet the course requirements should contact the instructor as soon as possible to make any necessary arrangements. Students should present appropriate verification from Student Disability Services during the instructor's office hours. Please note: instructors are not allowed to provide classroom accommodations to a student until appropriate verification from Student Disability Services has been provided. For additional information, please contact Student Disability Services in West Hall or call 806–742–2405.

10   Operating Policy 34.12(5): Academic dishonesty definitions

Students must understand the principles of academic integrity, and abide by them in all class and/or course work at the University. Academic Misconduct violations are outlined Part I, section B.1 of the Code of Student Conduct. If there are questions of interpretation of academic integrity policies or about what might constitute an academic integrity violation, students are responsible for seeking guidance from the faculty member teaching the course in question.

Academic misconduct includes cheating, plagiarism, collusion, falsifying academic records, misrepresenting facts, violations of published professional ethics/standards, and any act or attempted act designed to give unfair academic advantage to oneself or another student. Additional information about academic misconduct is available in the Texas Tech University Handbook in Part II, section B of the Community Policies section in the Student Handbook at http://www.depts.ttu.edu/dos/handbook/.