

Northwestern

MATH 517

Title Topics in algebra

Time MWF 10:20-11:10 AM

Location Zoom.

Instructor: Boris Tsygan

Email: b-tsygan@northwestern.edu

Office: Lunt 302

Phone: (847) 316-1969

Office Hours: Tuesday 12-2pm,

Thursday 12-1pm

1. COURSE DESCRIPTION

The course will be as concrete as possible. I will start with the Cartier isomorphism between differential forms and De Rham cohomology. I will use it to prove Deligne and Illusie theorem about degeneration of the Hodge to De Rham spectral sequence. Then I will define the ring of Witt vectors, following both the classical definition and Joyals interpretation via delta-rings. Then I will define De Rham-Witt complex and prove its main properties.

After that, I will discuss derived De Rham, crystalline, and prismatic cohomologies. I will also outline noncommutative versions of the above notions, such as Kaledins Cartier isomorphism, noncommutative Witt vectors, and degeneration theorem. I will say at least something about D-modules and deformations of symplectic manifolds in positive characteristic.

2. COURSE MATERIALS

Sources include: Illusie, De Rham Witt complex and crystalline cohomology

Bhatt, p -adic derived De Rham cohomology

Drinfeld, Prismaticization

Drinfeld, A stacky approach to crystals

Kaledin, Witt vectors, commutative and non-commutative

notes of Beilinson-Drinfeld seminar from last year;

YouTube talks

Drinfeld on crystalline and prismatic cohomology

Bhatt on prisms and deformations of De Rham cohomology

3. MISSING ACADEMIC WORK DUE TO ILLNESS

See [Northwestern's policy on missing academic work due to illness](#).

4. RESOURCES

Students can find useful resources for safety and security, academic support, and mental and physical health and well-being at the [NUhelp website](#) and [app](#).

5. ACCESSIBILITY

Any student requesting accommodations related to a disability or other condition must register with [AccessibleNU](#) and provide the instructor with an accommodation notification from [AccessibleNU](#), preferably within the first two weeks of class. All information will remain confidential. For more information, visit [AccessibleNU](#), or call (847) 467-5530.

6. ACADEMIC INTEGRITY

Academic integrity is taken very seriously at Northwestern. Students are responsible for reading and understanding Northwestern's academic integrity policies. **All suspected violations of academic integrity will be reported to the Weinberg College Deans Office.** These include: cheating, plagiarism, fabrication, unfair advantage, unauthorized collaboration, and aiding and abetting of academic dishonesty. Students found in violation of academic integrity may receive a zero on the assignment or a failing grade for the course, **and** may be suspended or permanently expelled from the University. See the [WCAS website](#) on academic integrity and [Academic Integrity: A Basic Guide](#) for more information.

7. SEXUAL MISCONDUCT AND REPORTING

Northwestern University is committed to fostering an environment where students are safe and free from sexual misconduct. [Confidential resources](#) are available to those who have experienced sexual misconduct. Faculty and instructors are not confidential resources and are required to report incidents of sexual misconduct, whether discussed in your assignments or in person, to the Title IX Coordinator, who can provide information about resources and options. I encourage students who have experienced sexual misconduct to talk with someone to get support. For more information, including how to request interim protective measures and academic accommodations or file a complaint, see the [Get Help page](#).

8. DISCRIMINATION AND SEXUAL HARASSMENT

Northwestern University's Policies on Discrimination, Harassment, and Sexual Harassment apply to all members of the University community, including students, staff, and faculty. Any student, staff, or faculty member who believes that he or she has been discriminated against or harassed on the basis of his or her race, color, religion, national origin, sex, sexual orientation, gender identity, gender expression, parental status, marital status, age, disability, citizenship, veteran status, genetic information or any other classification protected by law, should contact the Office of Equal Opportunity and Access at (847) 491-7458 or the Sexual Harassment Prevention Office at (847) 467-6571. Additional information about the University's discrimination and harassment policies, including the campus resources available to assist individuals with discrimination or harassment concerns, is available online on the [Human Resources Equal Opportunity and Access website](#).