

MTH 203: Introduction to groups and symmetry

Syllabus and course policies

Semester 1, 2022-23

General information

Instructor: Dr. Kashyap Rajeevsarathy

Office: AB1 (Infinity building) - 314

E-mail: kashyap@iiserb.ac.in

Course webpage: Click [here](#).

Schedule: Classes during SLOT I (in [Time Table](#))

Virtual classes and announcements: Google classroom - [hs2pulj](#)

Offline class schedule:

Day	Timing	Venue
Monday (Class)	12:00 pm - 1:00 pm	L1
Wednesday (Tutorial)	5:30 pm - 6:30 pm	Multimedia (Studio) classroom
Thursday (Class)	6:00 pm - 7:00 pm	L4
Friday (Class)	12:00 pm - 1:00 pm	L1

Tutors and office hours: You may either contact your tutors during these scheduled weekly office hours or email them to fix an appointment.

Tutor name	Email	Office	Office hour
Diksha	diksha@iiserb.ac.in	AB1A - 106	Saturday, 10 am - 11 am
Shrikant Shekhar	shrikant19@iiserb.ac.in	AB1A - 106	Saturday, 10 am - 11 am
Satyajit Maity	satyajitm20@iiserb.ac.in	AB1A - 102	Friday, 6 pm - 7 pm
Rajesh Dey	rajesh17@iiserb.ac.in	AB1A - 102	Friday, 6 pm - 7 pm

Course structure

Topics

- Examples of symmetries: Symmetries of equilateral triangle and square; translations, rotations and reflections in the Euclidean plane.
- Definition of a group, subgroup, abelian group, group \mathbb{Z} of integers, statement of division algorithm, description of all subgroups of \mathbb{Z} .
- Equivalence relations, group of congruence classes \mathbb{Z}_n , order of an element in a group, definition of cyclic group, cyclicity of groups of prime order, group of units in \mathbb{Z}_n .
- Definition of a homomorphism and normal subgroup, kernel and image of a homomorphism, quotient group, isomorphism theorems (statement and applications).
- Permutations of a finite set, permutation group S_n , cycle notation, length of a cycle, transpositions, decomposing a permutations as a product of transpositions, parity of a permutation, alternating group A_n as normal subgroup, conjugacy in permutation groups, generating sets of S_n and A_n .
- Groups of real and complex matrices: general linear groups, determinant of a matrix as a group homomorphism, special linear groups, complex matrices as real matrix, orthogonal and special orthogonal groups, unitary and special unitary groups.
- Two dimensional symmetries: group of symmetries of geometric objects in Euclidean spaces, dihedral group as the group of symmetries of a regular polygon, isometries of the Euclidean plane, a detailed account of the classification of isometries: translations, rotations, reflections, glide reflections; wallpaper symmetries, finite subgroups of $\text{SO}(2, \mathbb{R})$.
- Three dimensional symmetries: platonic solids and their dual, symmetries of a tetrahedron, symmetries of a cube and octahedron, symmetries of icosahedron and dodecahedron, classification of finite subgroups of $\text{SO}(3, \mathbb{R})$.

Suggested references

Books

1. Mark A. Armstrong, *Groups and Symmetry (Undergraduate Texts in Mathematics)*, Springer, 1997.
2. Joseph J. Rotman, *A First Course in Abstract Algebra (3rd Ed.)* , Pearson, 2005
3. Micheal Artin, *Algebra (2nd Ed.)*, Pearson, 2010
4. Kristopher Tapp, *Matrix groups for Undergraduates*, AMS, 2005.
5. Kristopher Tapp, *Symmetry: A Mathematical Exploration*, Springer, 2012.

Notes

1. Neil Strickland, Notes on [Groups and Symmetry](#).
2. Andrew Baker, Notes on [Groups and Symmetry](#).
3. Dave Bayer, Notes on [Groups and Symmetry](#).

Course policies

Classes

- All lectures for this course will be delivered offline during scheduled class hours.
- However, if the need arises to have online lectures for an extended period of time, please make note of the following points:
 - Reading material and prerecorded video lectures will be posted at a Google Classroom portal every week. It is your responsibility to check the portal for any updates (from my end) and come prepared for the interactive sessions.

- There will be live interaction sessions every week during the scheduled lecture hours. These sessions will be primarily aimed at enhancing your conceptual understanding of the reading material and video lectures posted during the week. Therefore, you are advised to effectively use these sessions to clarify your doubts on the topics being covered.
- If you face any difficulties in participating in the live interaction sessions due to limitations in internet connectivity, data availability (or coverage) or technology, please contact me immediately. I will try my best to provide additional help or make alternative arrangements for you. Note that all live sessions will be recorded and posted in the Google Classroom for the benefit of the students with poor internet/data connectivity.

Continuous assessments

- **Continuous assessment will carry 20% weightage in your final grade as per the current academic policy.**
- **This component of your grade will be computed based on two continuous assessment components, namely Homework and Quizzes, each of which will carry a weightage of 10%.**

Assignments

- **Homework assignments will be due every other week. It is imperative that you try solving these problems on your own, as your homework assignments will constitute select problems from these sets.**
- **Up to eight homework assignments will be given during the course of the semester that you would have to turn in. Your top six performances in these assignments will together count towards one continuous assessment component.**
- **The problems to be turned in and the due dates will be posted on the [Course webpage](#) and the [Google Classroom](#). So it is your responsibility to regularly check the webpage for any updates.**

- If you must miss the due date (for genuine reasons), try turning in your assignment in advance, or write to me seeking an extension.
- If physical submission is not possible, your solutions should be turned in via email either as a typed document or as a scanned softcopy of handwritten solutions.
- Problems written should be legible and must clearly indicate the steps used to arrive at the solution.
- While you are encouraged to share and discuss ideas with your classmates, I would strongly caution you against copying solutions verbatim from your classmate/friend. **Please be warned that:**
 - (a) **Assignments with nearly identical solutions will not be graded.**
 - (b) **If there is evidence that even a part of an assignment is copied (or plagiarized), the entire assignment will be given a score of zero.**

Quizzes

- **Up to four quizzes may be administered during the course of the semester and your best three performances in these quizzes will count towards one continuous assessment component.**
- These quizzes will be given in the regular classrooms. However, if the need arises, quizzes and exams may be hosted on any online proctoring platform endorsed by the Institute. In such situations, students may be required to take the quiz while sitting in front of their computer webcams/mobile phone cameras during the entire duration of the examination.
- The schedules and syllabuses for the quizzes will be announced in class and also posted on the [Google Classroom](#).

Mid-semester and end-semester exams

- The midterm and final examinations will contribute 30% and 50% weightage towards your final grade, respectively.
- These exams will be administered in the officially assigned classrooms. However, if a need arises, the exams may be hosted on any online proctoring platform endorsed by the Institute. In such situations, students may be required to take the quiz while sitting in front of their computer webcams/mobile phone cameras during the entire duration of the examination.
- The final exam will be comprehensive with possibly more emphasis on the topics that are covered after the mid-semester exam.
- When graded exams are returned, please check them carefully for any grading errors. All grading issues should be brought to my attention as soon as possible. Note that test scores are not renegotiable after final grades are submitted.
- Do not make travel plans that might prevent you from taking any scheduled exam. If you have a verifiable reason why you cannot be present at an exam, you must contact me in advance to make an alternative arrangement.

General policies concerning assessment

- Books, notes, or electronic devices of any kind are strictly prohibited while taking tests (exams and quizzes). It is your ethical (and moral) responsibility to exercise honesty and integrity while taking them.
- When graded tests are returned, please check them carefully for any grading errors. All grading issues should be brought to my attention as soon as possible. Note that your scores are not renegotiable after the final grades are submitted.
- Do not make plans that might prevent you from taking any scheduled exam or quiz. If you have a justifiable reason for missing a scheduled test, you must contact me in advance to make an alternative arrangement.

- Strong disciplinary action will be initiated against students indulging in academic malpractices (or misconduct) during quizzes (or exams) which include any form of cheating, impersonation, copying, plagiarism, etc., as per the prevailing academic norms of the Institute available at: [Circular - Disciplinary actions for various acts of academic malpractices.](#)

Grading scheme

A total of 100 percentage points will be distributed as follows:

Component	Weightage
Continuous assessment	20%
Mid-semester examination	30%
Final examination	50%