

# MTH 301: Group Theory

## Semester 1, 2023-24

### General information

**Instructor:** Dr. Kashyap Rajeevsarathy

**Office:** AB1 (Infinity building) - 314

**E-mail:** kashyap@iiserb.ac.in

**Venue:**

- Offline classes: AB1 (Infinity building) - 316
- Online classes: Google Classroom - [i6bgfa4](#)

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

Day	Timing
Monday	12 pm - 1 pm
Thursday	2 pm - 3 pm
Friday	12 pm - 1 pm

**Course webpage:** Click [here](#).

### Course structure

#### Topics

- Definition of group, basic properties, examples (Dihedral, Symmetric, Groups of Matrices, Quaternion Group, Cyclic, Abelian Groups)

- Homomorphisms, Isomorphisms, subgroups, subgroup generated by a set, subgroups of cyclic groups
- Review of Equivalence relations, Cosets, Lagrange's theorem, Normal subgroup, Quotient Group, Examples, Isomorphism theorems, Automorphisms
- Group actions, orbits, stabilizer, faithful and transitive actions, centralizer, normalizer, Cayley's theorem, Action of the group on cosets
- Conjugation, Class equation, Cauchy's theorem, Applications to  $p$ -groups, Conjugacy in  $S_n$
- Sylow theorems, Simplicity of  $A_n$  and other applications
- Direct products, Structure of Finite abelian groups
- Semi-Direct products, Classification of groups of small order
- Normal series, Composition series, Solvable groups, Jordan-Hölder theorem, Insolubility of  $S_5$
- (If time permits) Lower and upper central series, Nilpotent groups, Basic commutator identities, Decomposition theorem of finite nilpotent groups

### **Suggested references**

1. I. N. Herstein, Topics in Algebra, 2nd Edition, Wiley, 2006
2. T. W. Hungerford, Algebra, Springer Verlag, 2005
3. M. Artin, Algebra, Prentice-Hall of India, 1994
4. D. S. Dummit, R. M. Foote, Abstract Algebra, 2nd Edition, Wiley
5. J. Rotman, A First Course in Abstract Algebra : With Applications, Prentice Hall
6. J. Rotman, An Introduction to Theory of Groups, Springer GTM, 1999
7. H. Kurzweil, B. Stellmacher, The Theory of Finite Groups, Springer Universitext, 2004
8. M. Suzuki, Group Theory I, Springer GMW 247

## Course policies

### Classes

- As this is a professional course, it would be in the best interest of the students to have offline lectures 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 weekly at the Google Classroom portal. You are responsible for checking the portal for any updates (from my end) and coming prepared for the interactive sessions.
  - There will be live interaction sessions every week during the scheduled lecture hours. These sessions will primarily enhance 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 about the topics being covered.
  - If you face any difficulties 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 to provide additional help or make alternative arrangements for you. Note that all live sessions will be recorded and posted in Google Classroom for the benefit of students with poor internet/data connectivity.

### Continuous assessments

**Continuous assessment will carry 30% weightage in your final grade as per the current academic policy (available [here](#)). This component of your grade will be computed based on two continuous assessment sub-components, namely homework assignments and quizzes, which will each carry a weightage of 15%.**

### Homework assignments

- Practice problem sets will be posted every other week. **It is highly imperative that you try solving these problems on your own, as your home-**

**work assignments will constitute select problems from these sets.**

- **Up to four homework assignments will be given during the semester that you will have to turn in. Your top three 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 Google Classroom. So it is your responsibility to check the Google Classroom for updates regularly.
- 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 the 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 indicate the steps 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 three quizzes may be administered during the course of the semester and your best two performances in these quizzes will count towards one continuous assessment component.**
- These quizzes will be administered during scheduled class hours. 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**

- **In adherence with the current academic policy (available [here](#)), mid-semester and end-semester examinations will carry weights of 30% and 40% in your final grade.**
- These exams will be administered in the officially assigned classrooms. However, if the 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 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 for not being 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). Your ethical (and moral) responsibility is 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 good reason for missing a scheduled test, please 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	30%
Mid-semester examination	30%
Final examination	40%