MTH 203 - INTRODUCTION TO GROUPS AND SYMMETRY
SEMESTER 1, 2018-19

General Information

Instructor: Dr. Kashyap Rajeevsarathy
Office: AB1-108
Office hours: Wednesday, 2:00 PM - 3:00 PM
Email: `kashyap@iiserb.ac.in`
Office hours: Wed, 10:00 AM - 11:00 AM
Schedule:

Day	Timing	Classroom
Monday	12:00 PM - 12:55 PM	L4, LHC
Wednesday	5:00 PM - 5:55 PM	Studio AIR
Thursday	2:00 PM - 2:55 PM	Studio AIR
Friday	12:00 PM - 12:55 PM	L4, LHC

Webpage: MTH 203 webpage
Tutors:

1. Dr. Dheeraj Kulkarni
   Office: AB1-203
   Office hours: Monday, 5:00 PM - 6:00 PM
   Email: `dheeraj@iiserb.ac.in`

2. Dr. Jyoti Prakash Saha
   Office: AB1-206
   Office hours: Thursday, 10:00 AM - 11:00 AM
   Email: `jpsaha@iiserb.ac.in`

Teaching assistants:

1. Apeksha Sanghi
   Office: AB1A (Student Building) - 10
   Office hours: Tuesday, 7:00 PM - 8:00 PM
   Email: `apeksha16@iiserb.ac.in`

2. Arusha C
   Office: AB1A (Student Building) - 2
   Office hours: Thursday, 7:00 PM - 8:00 PM
   Email: `arushnmath@iiserb.ac.in`

3. Neeraj Dhanwani
   Office: AB1A (Student Building) - 1
   Office hours: Saturday, 3:00 PM - 4:00 PM
   Email: `nkd9335@iiserb.ac.in`

Topics

You are advised to regularly check the Lesson plan for the course.

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 $SO(2)$.

- 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 $SO(3)$.

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

Homework policy

- Homework assignments will be due every other week. The problems to be turned in and the due dates will be posted on the course webpage. So it is your responsibility to regularly check the course webpage for any updates.

- If you must miss the class on a due date, try turning in your assignment in advance or have some one else turn it in for you.

- 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 class-mates, I would caution you against copying solutions verbatim from someone else's work. **Please be warned that submitted assign-ments with word for word identical solutions to problems will not be graded.**

Quiz and exam policy

- Up to two quizzes may be administered during the course of the semester - one before the midterm and another before the final. The syllabus for the quizzes with be announced in class.

- The schedule for the midterm and final exams will be as per the aca-demic calendar.

- The topics for the midterm exam will be announced in class in due course. However, the final exam will be comprehensive with more emphasis on topics that will be discussed after the midterm exam.

- No books, notes, or electronic devices of any kind may be used during exams.

- When graded exams or quizzes are returned, please check them care-fully for any grading errors. All grading issues should be brought to my attention as soon as possible. Note that your scores are not rene-gotiable after the final grades are submitted.

- Do not make travel plans that might prevent you from taking any scheduled exam or quiz. 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.

- Strong disciplinary action will be initiated against students indulging in academic malpractices (or misconduct) during quizzes/exams which include any form of cheating, impersonation, copying, carrying unauthorized material 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:

- Homework & Quizzes - 20 %

- Midterm - 30 %

- Final Exam - 50 %