Academic Year	AY2018/19	**Semester**	Semester 1
Course Coordinator	Lim Kay Jin		
Course Code	MH2200		
Course Title	Groups and Symmetries		
Pre-requisites	MH1200 Linear Algebra I		
No of AUs	3		
Contact Hours	*2 hours of lecture and 1 hour of tutorial*		
Proposal Date			

Course Aims

This core MAS course aims to introduce group theory as an abstraction of planar isometries and structures that is essential for more advance algebra courses and applications. The axiomatic concepts serve as a language to study concrete examples in broader sense and helps in developing logical thinking.

Intended Learning Outcomes (ILO)

By the end of this course, you (as a student) should be able to:

1. *State the definitions and fundamental results in group theory.*
2. *Visualize and manipulate planar isometries and symmetries as examples of group, and their relations with complex numbers.*
3. *Classify and manipulate planar isometries as translations, rotations, reflections and glide reflections.*
4. *Provide, prove, identify or recognize various examples and non-examples of groups, subgroups, normal subgroups and quotient groups.*
5. *Manipulate group elements using generators and relations.*
6. *Present and interpret Cayley tables.*
7. *Present permutations in different forms and compute their orders and signatures.*
8. *Read and write simple and logically proofs based on axioms or fundamental results.*
9. *Analyze groups based on their orders and other properties.*
10. *Provide, prove and manipulate various examples of group homomorphism or isomorphism.*
11. *Compute and manipulate cosets of a subgroup in a group.*
12. *Construct the quotient group G/N given a group G and its normal subgroup N.*

Course Content

Planar isometry, symmetry of shape, group axiom, Cayley table, subgroup, quotient group, cyclic group, dihedral group, congruent modulo, permutation group, alternating subgroup, general linear group, group homomorphism, group isomorphism, coset, puzzle.

Assessment (includes both continuous and summative assessment)

Component	**Course LO Tested**	**Related Programme LO or Graduate Attributes**	**Weighting**	**Team/Individual**	**Assessment rubrics**
1. Final Examination	All	A1,A2,A3,B1,B4	60%	Individual	Point-based marking
2. Continuous Assessment 1 (CA1): Midterm Test I	1,2,3,5,8	A1,A2,A3,B1,	20%	Individual	Point-based marking
3. CA2: Midterm Test II	4,5,6,8,9, 10	A1,A2,A3,B1,	20%	Individual	Point-based marking
Total			100%		

Formative feedback

For the final exam, feedbacks shall be posted in NTULearn after the grades are announced.

For the midterm tests, tutors shall provide feedback during tutorial classes. Solutions will also be given by the instructor including common mistakes.

Learning and Teaching approach

Approach	***How does this approach support students in achieving the learning outcomes?***
Derivation and demonstrating problem solving (Lecture)	*Motivate the student understanding of mathematical definitions through examples. Demonstrate the process of abstraction and how the abstract concepts can be applied to various scenarios. Develop students' logical thinking using proofs and examples.*

Problem solving (Lecture and Tutorial)	*Develop competence in logical thinking and problem solving especially in abstract algebra.*
Playing games	*The computer games provide the hands-on experience and help the students understanding abstract concepts through visualization of concrete objects.*

Reading and References

J. B. Fraleigh, A First Course in Abstract Algebra, 7th ed. Pearson (ISBN-13: 978-0321156082)

Course Policies and Student Responsibilities

1. *Students absent from tests/exam will receive a score of zero. Exception is granted only to those who have obtained a Leave of Absence.*
2. *Students absent from tutorial classes may send an email to their respective tutors regarding their absence and attend the assigned replacement classes.*

Academic Integrity

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values.

As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the academic integrity website for more information. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Course Instructors

Instructor	Office Location	Phone	Email
Lim Kay Jin (Dr)	SPMS-MAS-05-16	65137462	limkj@ntu.edu.sg

Planned Weekly Schedule

Week	Topic	Course LO	Readings/ Activities
1	Review of complex numbers, planar isometries	2,3,8	Sections* 1.1-1.2
2	Planar isometries, symmetries of a regular n-gon	2,3,6,8	Sections 1.2-2.1
3	Dihedral group, axioms of group	1,2,4,5,6,8	Sections 3.1 and Game (dihedral group)
4	Examples of group, Cayley table, subgroup	4,5,6,8	Section 3.2
5	Z, cyclic group, Abelian group, order of an element, order of a group	1,4,5,8	Section 3.3 and Game (dihedral group)
6	Review of equivalence relation, group of integers modulo n	1,4,5,6,8	Sections 4.1-4.2 and Game (equivalent classes and integers modulo n)
7	Multiplicative group of integers modulo n, group homomorphism, isomorphism	1,4,8,9,10	Sections 4.4-5.1
8	Classify cyclic groups, order formula, Coset, index	1,9,8,10,11	Section 5.2
9	Lagrange Theorem and its corollaries, Leonardo Theorem	1,3,8,9,	Sections 5.3-5.4, Chapter 6 and Game (Coset)
10	Permutation group	4,5,7,9	Sections 7.1-7.3
11	Permutation group, alternating subgroup	4,5,7,9	Sections 7.4-7.5 and Game (permutation group and coset)
12	Cayley Theorem, puzzles	8,10	Sections 8.1-8.2
13	Quotient group	4,8,10,11,12	Chapter 9

* Refer the numbering of the sections and chapters to my lecture note.