



Lahore University of Management Sciences

**MATH 320 – Algebra**  
**Tentative course syllabus and**  
**course policy draft**  
Fall 2020 - 2021

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Course URL (if any)	Math.lums.edu.pk/moodle

Course Basics				
Credit Hours	4			
Lecture(s)	Nbr of Lec(s) Per Week	2 (TR)	Duration	100 min (10:30 AM-12:20 PM)
Recitation/Lab (per week)	Nbr of Lec(s) Per Week		Duration	
Tutorial (per week)	Nbr of Lec(s) Per Week		Duration	

Course Distribution	
Core	Math Majors
Elective	
Open for Student Category	All students
Close for Student Category	None

**This class will be held virtually via Zoom due to the COVID-19 pandemic. Please read this syllabus carefully as it contains extensive information about how the class will proceed. Ignorance of the policies and timelines of this course contained in this syllabus will not be considered a valid excuse at any time.**

**COURSE DESCRIPTION**

The last two centuries have seen many branches of mathematics emerge. Abstract Algebra is one such branch. Because of its vast applications in various disciplines of mathematics apart from other subjects like Physics, Chemistry, Statistics and Computer Science, it becomes opportune to include this and related topics in undergraduate curriculum. The aim of this course is to introduce students to the basic concepts of Abstract Algebra. To this end we will study Group Theory in depth, followed by a brief introduction to Rings (and Fields depending on the time frame in the online medium). This course is very important as it is a prerequisite for many advanced level courses in Pure Mathematics.

**COURSE PREREQUISITE(S)**

Math 204 (Introduction to Formal Mathematics)    OR    Consent of the instructor.



## COURSE OBJECTIVES

- At the successful completion of the course students will be able to:
- Use and apply important basic notions of Group theory.
  - Complete and analyze the classification of finite abelian groups of order less than 20 in particular and groups of any order in general.
  - Explain introductory topics in the theory of Rings and Fields.
  - Build their ability to write mathematical proofs.
  - Demonstrate the applications of important theorems like Lagrange theorem, Cayley's theorem and Sylow's theorem.
  - Analyze important recurring examples of groups such as Symmetric groups and Dihedral groups, and the ubiquitous notions of Algebra such as equivalences and Group actions.

## COURSE RULES AND POLICIES

### Communication

- All emails** sent to the instructor or TAs must have a **subject line** of the following format (examples):  
"MATH 320--URGENT—connectivity issues"  
"MATH 320—NOT URGENT—question about the average score in quiz 02"
- All emails** must be signed with name and **roll-number**.
- I will communicate with students by email. If you send me a Whatsapp message or text message, I will not respond unless it relates to a connectivity issue in accessing email or any other emergency.
- If you email me asking me a question that is already answered in the syllabus, I will not answer your email. If you try and get the TA to ask me that question, I will simply not answer their email either.
- Also do not flood my inbox to ensure that I have received your submission in your LMS Dropbox. I will not respond to such emails. If it is successfully uploaded you should be able to see in your LMS Dropbox folder.

### Email response policy

I will try my best to respond to emails as soon as possible. However, in some situations it might take up to 24 hours for me to respond.  
I will not usually respond to emails over the weekend. I will also not send out emails to the class on Saturday or Sunday unless absolutely necessary.

### Announcements

All announcements will be posted on LMS. **It is your responsibility** to regularly check the LMS site for this course.

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## Lecture format

- i) **All lectures will be conducted live via zoom** and will last one hour 20 minutes. The remaining 20 minutes at the end of each class will be reserved for
  - Questions students may have related to the content taught in current class or in the previous ones.
  - Occasionally continuing with delivery of course content in the absence of questions.
- ii) You can use the chat box to raise questions during the lecture if you want.
- iii) **All lecture videos will be made available via a Youtube link on lecture day.**

## Grading Breakup

Assignments:	2.5 x 4 = 10%
Quizzes:	15 x 2 = 30 %
Midterm Examination:	30%
Final Examination:	30%

**Note that this is tentative and subject to change within the first few weeks of the course.**

## Grading policy

- This course will be relatively graded via the grader app on Zambeel.
- I will be assigning marks for graded components at my own discretion. Please don't mail me or ask the TA's to mediate unless there is a calculation error.
- You may contest your exams at the announced time, but be mindful of the fact that this may increase or decrease your marks.
- Please don't email me at the end of the semester to ask me to adjust the cut-offs or to change your grades (without any justification) in order to get a higher grade. I will not entertain any such requests for two reasons:
  - i) it will be unfair to everyone who does not send such emails, and
  - ii) it will undermine the integrity of the course.

## Dates for graded components

The date for assignments, quizzes and exams will be strictly adhered to and late submissions will not be entertained, unless faced with some unforeseen circumstances.

These are mentioned in the description of assessments.

If you have accessibility issues or any other emergency, please email the instructor regarding graded instruments ASAP.

## Mode of submission for graded components

You will be given time to turn in your assignments, quizzes and exams in LMS dropbox.

**Make sure you turn them in as a single PDF file.**

Please arrange for the possibility to make one PDF from photos of answer sheets, on your device beforehand. **I will not entertain individual images of answer sheets.**

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## **Harassment Policy**

Harassment of any kind is unacceptable, whether it be sexual harassment, online harassment, bullying, coercion, stalking, verbal or physical abuse of any kind. Harassment is a very broad term; it includes both direct and indirect behaviour, it may be physical or psychological in nature, it may be perpetrated online or offline, on campus and off campus. It may be one offense, or it may comprise of several incidents which together amount to sexual harassment. It may include overt requests for sexual favours but can also constitute verbal or written communication of a loaded nature. Further details of what may constitute harassment may be found in the LUMS Sexual Harassment Policy, which is available as part of the university code of conduct.

LUMS has a Sexual Harassment Policy and a Sexual Harassment Inquiry Committee (SHIC). Any member of the LUMS community can file a formal or informal complaint with the SHIC. If you are unsure about the process of filing a complaint, wish to discuss your options or have any questions, concerns, or complaints, please write to the Office of Accessibility and Inclusion (OAI, [oai@lums.edu.pk](mailto:oai@lums.edu.pk)) and SHIC ([shic@lums.edu.pk](mailto:shic@lums.edu.pk))—both of them exist to help and support you and they will do their best to assist you in whatever way they can.

**To file a complaint, please write to [harassment@lums.edu.pk](mailto:harassment@lums.edu.pk).**

## **Help related to equity and Belonging at SSE**

SSE's Council on Equity and Belonging is committed to devising ways to provide a safe, inclusive, and respectful learning, living, and working environment for its students, faculty, and staff.

For help related to any such issue, please feel free to write to any member of the school council for help or feedback.

You are also welcome to write to me directly as I am also a member of the council.

## **Mental Health Support at LUMS**

For matters relating to counselling, kindly email [student.counselling@lums.edu.pk](mailto:student.counselling@lums.edu.pk), or visit <https://osa.lums.edu.pk/content/student-counselling-office> for more information.

You are welcome to write to me or speak to me if you find that your mental health is impacting your ability to participate in the course. However, should you choose not to do so, please contact the Counselling Unit and speak to a counsellor or speak to the OSA team and ask them to write to me so that any necessary accommodations can be made.

**If you have any issue or you are uncomfortable with the framework or polices laid out in this syllabus/ outline please opt out of this course.**

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## Contents of the syllabus

**Note** that this is tentative and subject to change as the course progresses.

Week	Content	Reading/ Reference
<b>1</b>	Basic axioms of the notion of Group, examples of groups, Dihedral groups, Symmetric groups.	Chapter 1: Introduction to Groups Book: Abstract Algebra, 3 <sup>rd</sup> Edition David S.Dummit, Richard M.foote
<b>2</b>	Examples continued: Symmetric groups, Matrix groups, Quarternions. Homomorphisms.	Chapter 1: Introduction to Groups Book: Abstract Algebra, 3 <sup>rd</sup> Edition David S.Dummit, Richard M.foote
<b>3</b>	Isomorphisms. Group Actions. Subgroups.	Chapter 1: Introduction to Groups Book: Abstract Algebra, 3 <sup>rd</sup> Edition David S.Dummit, Richard M.foote
<b>4</b>	Subgroups and examples continued. Centralizers, Normalizers, Kernels. Cyclic subgroups.	Chapter 2:Subgroups Book: Abstract Algebra, 3 <sup>rd</sup> Edition David S.Dummit, Richard M.foote
<b>5</b>	Cyclic subgroups, lattices of subgroups. Quotient group.	Chapter 2: Subgroups Chapter 3 : Quotient groups and Homomorphisms. Book: Abstract Algebra, 3 <sup>rd</sup> Edition David S.Dummit, Richard M.foote
<b>6</b>	Lagrange theorem, Isomorphism theorems. Alternating groups.	Chapter 3 : Quotient groups and Homomorphisms. Book: Abstract Algebra, 3 <sup>rd</sup> Edition David S.Dummit, Richard M.foote
<b>7</b>	Group actions and permutation representations. Left multiplication and Cayley's theorem. Conjugation and class equation.	Chapter 4: Group actions Book: Abstract Algebra, 3 <sup>rd</sup> Edition David S.Dummit, Richard M.foote
<b>8</b>	Automorphisms. Sylow's theorem.	Chapter 4: Group actions Book: Abstract Algebra, 3 <sup>rd</sup> Edition David S.Dummit, Richard M.foote
<b>9</b>	Simplicity of Alternating groups. Direct products. Fundamental theorem of finitely generated abelian groups.	Chapter 4: Group actions Chapter 5: Direct and semi-direct products Book: Abstract Algebra, 3 <sup>rd</sup> Edition David S.Dummit, Richard M.foote
<b>10</b>	Table of groups of small order. Semi direct products.	Chapter 5: Direct and semi-direct products Book: Abstract Algebra, 3 <sup>rd</sup> Edition David S.Dummit, Richard M.foote

11	Introduction to rings, examples.	Chapter 7: Introduction to rings Book: Abstract Algebra, 3 <sup>rd</sup> Edition David S.Dummit, Richard M.foote
12	Ring homomorphisms and quotient rings	Chapter 7: Introduction to rings Book: Abstract Algebra, 3 <sup>rd</sup> Edition David S.Dummit, Richard M.foote
13	Ideals and their properties. Rings of fractions (if time permits).	Chapter 7: Introduction to rings Book: Abstract Algebra, 3 <sup>rd</sup> Edition David S.Dummit, Richard M.foote

Textbook(s)/Supplementary Readings	
<b>TEXT:</b> Abstract Algebra, 3 <sup>rd</sup> Edition David S.Dummit, Richard M.foote, John Wiley & Sons.	
<b>RECOMMENDED references:</b>	
-Gallion, J.A. Contemporary Abstract Algebra; 3 <sup>rd</sup> Edition D.C. Heath and Company 1990.	
-Fraleigh, J.B., A First Course in Abstract Algebra, 7 <sup>th</sup> Edition. Pearson Education 2006.	
-Herstein I. N., Topics in Algebra, 2 <sup>nd</sup> Edition, John Wiley & Sons. 1975	

## Assessments

All the assessments are described in the following table including mode of submission, dates and expectations from learners.

Note that these are subject to change at the discretion of the instructor.

		Weight (%)
Type 1	<p><b>Assignments</b>, each carrying a weight of 2.5 %, 4 in total, spread out throughout the semester. Meant for informal feedback on presentation of arguments and assessment of applications of concepts learnt until that point in the course.</p> <p><b>Mode of assessment:</b> Take home.</p> <p><b>Mode of submission:</b> written submission through LMS dropbox. Please <b>name</b> the file (example) “<b>Assignment_2_YourRollNumber</b>” and submit within the time provided for submission.</p>	10%

	<p><b>Submit your work as a single PDF file and not as a collection of individual images or photographs of your answer sheets.</b>  <b>Make sure you turn them in as a single PDF file.</b> Please arrange for the possibility to make one PDF from photos of answer sheets, on your device beforehand. <b>I will not entertain individual images of answer sheets</b></p>	
<b>Type 2</b>	<p><b>Quizzes</b> meant to assess retention of key concepts in announced quiz syllabus and their application to one or more problems.</p> <p><b>Dates:</b> 1<sup>st</sup> Oct AND 19<sup>th</sup> Nov 2020 (Thursdays)</p> <p><b>Duration:</b> 30 minutes</p> <p><b>Mode of assessment:</b> Live.</p> <p><b>Mode of submission:</b> written submission through LMS dropbox. Please <b>name</b> the file (example) “<b>Quiz_2_YourRollNumber</b>” and submit within the time provided for submission (5 minutes after exam time finishes).</p> <p><b>Submit your work as a single PDF file and not as a collection of individual images or photographs of your answer sheets.</b>  <b>Make sure you turn them in as a single PDF file.</b> Please arrange for the possibility to make one PDF from photos of answer sheets, on your device beforehand. <b>I will not entertain individual images of answer sheets</b></p>	30%
<b>Type 3</b>	<p><b>Midterm exam</b> will assess understanding of concepts, ability to reproduce/improvise on small proofs of statements explained in class, as well as applications of concepts to some problems.</p> <p><b>Date:</b> 22<sup>nd</sup> Oct 2020</p> <p><b>Duration:</b> 120 minutes</p> <p><b>Mode of assessment:</b> Live.</p> <p><b>Mode of submission:</b> written submission through LMS dropbox. Please <b>name</b> the file “<b>Midterm_YourRollNumber</b>” and submit within the time provided for submission (5 minutes after exam time finishes).</p> <p><b>Submit your work as a single PDF file and not as a collection of individual images or photographs of your answer sheets.</b>  <b>Make sure you turn them in as a single PDF file.</b> Please arrange for the possibility to make one PDF from photos of answer sheets, on your device beforehand. <b>I will not entertain individual images of answer sheets</b></p>	30%

<p><b>Type 4</b></p>	<p><b>Final exam</b> will be comprehensive and will assess understanding of concepts, ability to reproduce/ improvise small proofs of statements learnt in class, as well as applications of concepts to some problems. The portion of midterm syllabus tested will be very small compared to post-mid syllabus.</p> <p>Date: as per schedule published on Zambeel.</p> <p>Duration: 120 minutes</p> <p><b>Mode of assessment:</b> Live.</p> <p><b>Mode of submission:</b> written submission through LMS dropbox. Please <b>name</b> the file “<b>Final_YourRollNumber</b>” and submit within the time provided for submission (5 minutes after exam time finishes).</p> <p><b>Submit your work as a single PDF file and not as a collection of individual images or photographs of your answer sheets.</b></p> <p><b>Make sure you turn them in as a single PDF file.</b> Please arrange for the possibility to make one PDF from photos of answer sheets, on your device beforehand. <b>I will not entertain individual images of answer sheets</b></p>	<p>30%</p>

**If you have any issue or you are uncomfortable with the framework or policies laid out in this syllabus/ outline please opt out of this course.**