MATH 5301: Regular Polytopes
Sul Ross State University ~ Rio Grande College
Spring 2017

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Course Description MTH 5301 is intended as an introduction to regular polytopes, including regular polygons and polyhedra, rotation groups, tessellations and honeycombs, regular polytopes of higher dimension, Euler's formula, and Coxeter groups.

Course Objectives Students will explore the theory of regular polyhedra; use dimensional analogies to develop conceptions of dimensions greater than three; explore humanistic aspects of the theory of regular polytopes; develop higher-level mathematical reading skills; and use dynamic geometry software to render and explore complex three-dimensional objects.

Class Time Wednesday, 6:00 – 8:45 p.m.

Class Location Del Rio 106; Eagle Pass D202; Uvalde B108

Required Text H. S. M. Coxeter, *Regular Polytopes*, ISBN 0486614808
Alan Holden, *Shapes, Space, and Symmetry*, ISBN 0486268519

Office Hours M/W 11:30 – 2:00; T/Th 2:00 – 4:30

Course Policies

Attendance Policy

Attendance is mandatory. You will be held responsible for all material covered in class or in the reading assignments. If you have to miss a class, it is your responsibility to obtain all notes, assignments, and announcements from someone else in the class. Make-up exams will be given only in the event of an emergency, in which case written justification and/or documentation must be provided and approved.

Communication

I will post course documents, reminders, announcements, and assignments on the Blackboard system. You will also submit homework on Blackboard. I may also occasionally send announcements via e-mail. You should make sure you know how to access and use these tools. E-mail is the best way to contact me.

You are welcome to stop by my office if you wish to speak about the content or your progress in the course. I am here to help you. Ask questions in class, call me, e-mail me, or come to my office. If you don't communicate with me, then I can't help you.

Homework

You will turn in homework assignments several times a week. Exercises will be prepared as GeoGebra files or Microsoft Word documents and turned in via Blackboard. You will need to use a recent version of Word, such as is available on school computers.

It is imperative that you read the text as we progress through the class.

Exams

There will be one midterm exam. Its tentative date is March 8. This is subject to change. You will be notified of a change at least one week in advance. Make-up exams will be given only in the event of an emergency, in which case written justification and/or documentation must be provided and approved.

The final exam is scheduled for May 10. It will be comprehensive.

Grading Policy

Your grades will be weighted as follows:

Homework	30%
Midterm Exam	30%
Final Exam	40%

Subject Outline

I. Polygons and Polyhedra: *regular polygons – polyhedra – the Platonic solids – graphs and maps – Euler's formula – regular maps – configurations*

II. Regular and Quasi-Regular Solids: *regular polyhedra – reciprocation – quasi-regular polyhedra – radii and angles – Descartes' formula – Petrie polygons – the rhombic dodecahedron and triacontahedron – zonohedra*

III. Rotation Groups: *congruent transformations – transformations in general – groups – symmetry operations – the polyhedral groups – the five regular compounds – coordinates – finite rotation groups*

IV. Tessellations and Honeycombs: *regular tessellations – quasi-regular and rhombic tessellations – rotation groups in two dimensions – coordinates – lines of symmetry – space filled with cubes – other honeycombs – proportional numbers of elements*

V. The Kaleidoscope: *reflections – the fundamental region and generating relations – representation by graphs – Wythoff's construction – Pappus's observation – the Petrie polygon and central symmetry*

VI. Star Polyhedra: *star polygons – stellation – faceting – the general regular polyhedron – isomorphism – enumeration – Schwarz's triangles*

VII. Ordinary Polytopes in Higher Space: *dimensional analogy – pyramids, dipyramids, prisms – the general sphere – polytopes and honeycombs – regularity – symmetry groups – Schlaffli's criterion – enumeration – the characteristic simplex*

VIII. Truncation: *the simple truncations of the general regular polytope – Cesaro's construction for* {3,4,3} *– coherent indexing – the snub* {3,4,3} *– Gosset's constructoin for* {3,3,5} *– partial truncation – coordinates*

Schedule

This schedule is tentative only. The unit numbers refer to the above outline.

January 18	Unit I
January 25	Units I – II
February 1	Unit II
February 8	Units II – III
February 15	Unit III
February 22	Units III – IV
March 1	Unit IV
March 8	Midterm Exam; Unit V
March 22	Units V – VI
March 29	Unit VI
April 5	Units VI – VII
April 12	Unit VII
April 19	Units VII – VIII
April 26	Unit VIII
May 3	Course Overview
May 10	Final Exam

Americans With Disabilities Act

Sul Ross State University is committed to equal access in compliance with the Americans With Disabilities Act of 1973. It is the student's responsibility to initiate a request for accessibility services. Students seeking accessibility services must contact Kathy Biddick, Student Services Administrative Secretary.