

MATH 5301: Regular Polytopes

Sul Ross State University Rio Grande College

Fall 2022

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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.

Class Time Monday, 6:00 – 8:45 p.m.

Class Location Virtual

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

Course Policies

Attendance Policy

Attendance is mandatory. Students are expected to attend class in person in their classroom of registration unless permission is given for extenuating circumstances. 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.

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. You are welcome to e-mail, telephone, or text me. However you chose to contact me, please make sure to state your name at the beginning of any message.

You are welcome to stop by my office if you wish to speak about the content or your progress in the course. Sometimes meetings come up, so it's best to contact me ahead of time if you intend to travel to Uvalde to see me in person.

I am here to help you! Ask questions in class, call me, e-mail me, text me, or come to my office. If you don't communicate with me, then I can't help you.

Grading Policy

Your grades will be weighted as follows:

Homework	30%
Midterm Exam	30%

Homework

You will turn in homework assignments every week. Exercises will be prepared as GeoGebra files or Microsoft Word documents and turned in via Blackboard.

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

Exams

There will be one virtual midterm exam. You will be notified of the date least one week in advance. The final exam will also be virtual and will be comprehensive.

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 – Schläfli'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 construction for $\{3,3,5\}$ – partial truncation – coordinates*

Schedule

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

August 22	Unit I
August 29	Units I – II
September 5	Unit II
September 12	Units II – III
September 19	Unit III
September 26	Units III – IV
October 3	Unit IV
October 10	Unit V
October 17	Units V – VI
October 24	Unit VI
October 31	Units VI – VII
November 7	Unit VII
November 14	Units VII – VIII
November 21	Unit VIII
November 28	Course Overview

University Statements

Distance Education Statement: *Students enrolled in distance education courses have equal access to the university's academic support services, such as library resources, online databases, and instructional technology support. For more information about accessing these resources, visit the SRSU website. Students should correspond using Sul Ross email accounts and submit online assignments through Blackboard, which requires secure login. Students enrolled in distance education courses at Sul Ross are expected to adhere to all policies pertaining to academic honesty and appropriate student conduct, as described in the student handbook. Students in web-based courses must maintain appropriate equipment and software, according to the needs and requirements of the course, as outlined on the SRSU website. Directions for filing a student complaint are located in the student handbook.*

SRSU Disabilities Services: *Sul Ross State University (SRSU) is committed to equal access in compliance with Americans with Disabilities Act of 1973. It is SRSU policy to provide reasonable accommodations to students with documented disabilities. It is the student's responsibility to initiate a request each semester for each class. RGC students seeking accessibility services should contact Paulette Harris, Executive Assistant to the Vice President and Dean, at 830-279-3023 or email pharris@sulross.edu. Ms. Harris's office is at 2623 Garner Field Road, Uvalde, TX 78801 (this is the mailing address, too).*

University Libraries: *The Sul Ross Library offers FREE resources and services to the entire SRSU community. Access and borrow books, articles, and more by visiting the library's website, library.sulross.edu. SRSU RGC students may request InterLibrary Loans (ILLs) and book check*

outs from the Sul Ross Library to be picked up at the SWTJC library that is most convenient. Access requires your LoboID and password. Librarians are a tremendous resource for your coursework and can be reached in person, by email (srsulibrary@sulross.edu), or phone (432-837-8123).

The Southwest Texas Junior College (SWTJC) Library is also available on each campus for your physical use of the space or checking out books. Del Rio, Eagle Pass, and Uvalde students may use online resources available through SWTJC website, library.swtjc.edu. These libraries serve as pickup locations for your ILL or Document Delivery or book requests; to do so, choose the appropriate pick-up location when requesting materials from the Alpine campus.