ORIGINAL COURSE IMPLEMENTATION DATE: September 2006
REVISED COURSE IMPLEMENTATION DATE: September 2022
COURSE TO BE REVIEWED (six years after UEC approval)**:** February 2028
Course outline form version: 09/08/2021

OFFICIAL UNDERGRADUATE COURSE OUTLINE FORM

Note: The University reserves the right to amend course outlines as needed without notice.

Course Code and Number: MATH 345	**Number of Credits:** 3 Course credit policy (105)
Course Full Title: Modern Geometries **Course Short Title:**	
Faculty: Faculty of Science	**Department (or program if no department):** Mathematics & Statistics

Calendar Description:

Students will study problems and constructions in Euclidean and non-Euclidean geometries, such as projective geometry, spherical geometry, and hyperbolic geometry. Topics include the parallel postulate and its consequences, transformations, symmetries and applications.

Prerequisites (or NONE):	MATH 211, MATH 221, and MATH 265.
Corequisites (if applicable, or NONE):	NONE
Pre/corequisites (if applicable, or NONE):	NONE

Antirequisite Courses *(Cannot be taken for additional credit.)*

Former course code/number:

Cross-listed with:

Equivalent course(s):

(If offered in the previous five years, antirequisite course(s) will be included in the calendar description as a note that students with credit for the antirequisite course(s) cannot take this course for further credit.)

Typical Structure of Instructional Hours

Lecture/seminar	50
Total hours	**50**

Scheduled Laboratory Hours

Labs to be scheduled independent of lecture hours: ☒ No ☐ Yes

Course Details

Special Topics course: **No**
(If yes, the course will be offered under different letter designations representing different topics.)

Directed Study course: **No**
(See policy 207 for more information.)

Grading System: **Letter grades**

Delivery Mode: **May be offered in multiple delivery modes**

Expected frequency: **Every other year**

Maximum enrolment (for information only)**: 36**

Prior Learning Assessment and Recognition (PLAR)

PLAR is available for this course.

Transfer Credit *(See **bctransferguide.ca**.)*

Transfer credit already exists: **No**

Submit outline for (re)articulation: **No**
(If yes, fill in transfer credit form.)

Department approval	**Date of meeting:**	November 2021
Faculty Council approval	**Date of meeting:**	February 4, 2022
Undergraduate Education Committee (UEC) approval	**Date of meeting:**	February 25, 2022

Learning Outcomes *(These should contribute to students' ability to meet program outcomes and thus Institutional Learning Outcomes.)*

Upon successful completion of this course, students will be able to:

1. State precise definitions of fundamental concepts in the geometries studied.
2. Compare and contrast the main principles/theorems of Euclidean and non-Euclidean geometries.
3. Apply definitions and theorems to prove geometrical results.
4. Classify transformations and symmetries in different geometries.
5. Discuss properties of various transformations, including invariants.
6. Discuss the general notions of distance and geodesics, independent of any particular geometry.
7. Use concrete models to demonstrate geometric concepts, such as the meaning of parallelism in various geometries.
8. Display effective mathematical communication in both written and oral formats, for example through presentation of high-quality mathematical proofs of basic theorems in geometry.
9. Discuss geometry across cultures and societies.

Recommended Evaluation Methods and Weighting *(Evaluation should align to learning outcomes.)*

Final exam:	40%	Quizzes/tests:	20%	[click to select]	%
Assignments:	25%	Project:	15%	[click to select]	%

Details: Project might include a written report and/or an oral presentation component.

NOTE: The following sections may vary by instructor. Please see course syllabus available from the instructor.

Texts and Resource Materials *(Include online resources and Indigenous knowledge sources. Open Educational Resources (OER) should be included whenever possible. If more space is required, use the Supplemental Texts and Resource Materials form.)*

	Type	Author or description	Title and publication/access details	Year
1.	Textbook	P.J. Ryan	Euclidean And Non-Euclidean Geometry: An Analytic Approach. Cambridge University Press	1996
2.	Textbook	J. Stillwell	The Four Pillars of Geometry. Springer	2005
3.	Textbook	Carroll and Rykken	Geometry: The Line and the Circle. MAA Press	2018
4.	Textbook	D.A. Brannan, M.F. Esplen, J.J. Gray	Geometry, 2nd edition. The Open University	2012

Required Additional Supplies and Materials *(Software, hardware, tools, specialized clothing, etc.)*

Possible computer software: Geometer's Sketchpad, NonEuclid (freeware), Maple

Course Content and Topics

Euclidean geometry:

- Euclid's Elements, basic constructions, axiomatic approach
- The parallel postulate, angles, and the Pythagorean theorem
- Isometries: reflections, rotations, and translations
- Symmetries
- n-dimensional Euclidean space
- vectors and Euclidean space
- affine geometries and transformations

Projective geometry:

- Projective coordinates
- Projective line, plane, and n-space
- Projective transformations
- Cross-ratio and linear fractional functions
- Perspective drawing, Desargues' theorem
- Projective arithmetic
- Homogeneous polynomials, algebraic curves

Hyperbolic geometry:

- Parallels in hyperbolic geometry Area and angular defect
- Circles and distance Poincare's model
- Hyperbolic transformations

Spherical geometry:

- Geodesics on spheres
- Spherical triangles
- Spherical symmetries
- Application: mapmaking

Other geometries:

- Fractal geometry
- Spacetime geometry