UNIVERSITY OF THE FRASER VALLEY

ORIGINAL COURSE IMPLEMENTATION DATE: September 2006
REVISED COURSE IMPLEMENTATION DATE: September 2020
COURSE TO BE REVIEWED (six years after UEC approval)**:** December 2024
Course outline form version: 05/18/2018

OFFICIAL UNDERGRADUATE COURSE OUTLINE FORM

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

Course Code and Number: MATH 339	**Number of Credits:** 3 Course credit policy (105)
Course Full Title: Introduction to Field Theory and Applications **Course Short Title:** Field Theory and Applications	
Faculty: Faculty of Science	**Department (or program if no department):** Mathematics & Statistics

Calendar Description:

An introduction to fields and rings, two of the fundamental structures of modern algebra, with special attention to applications. Applications covered include public key cryptography, error-correcting codes, and geometric construction arguments.

Prerequisites (or NONE):	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:
Dual-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 hours	50
Tutorials/workshops	
Supervised laboratory hours	
Experiential (field experience, practicum, internship, etc.)	
Supervised online activities	
Other contact hours:	
Total hours	**50**

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

Special Topics *(Double-click on boxes to select.)*
This course is offered with different topics:
☒ No ☐ Yes *(If yes, topic will be recorded when offered.)*

Independent Study
If offered as an Independent Study course, this course may be repeated for further credit: *(If yes, topic will be recorded.)*
☒ No ☐ Yes, repeat(s) ☐ Yes, no limit

Transfer Credit
Transfer credit already exists: *(See **bctransferguide.ca**.)*
☒ No ☐ Yes
Submit outline for (re)articulation:
☒ No ☐ Yes *(If yes, fill in transfer credit form.)*

Grading System
☒ Letter Grades ☐ Credit/No Credit

Maximum enrolment (for information only): 36

Expected Frequency of Course Offerings:
Semi-annually *(Every semester, Fall only, annually, etc.)*

Department / Program Head or Director:	**Date approved:**	June 18, 2019
Faculty Council approval	**Date approved:**	October 4, 2019
Dean/Associate VP:	**Date approved:**	October 4, 2019
Campus-Wide Consultation (CWC)	**Date of posting:**	November 8, 2019
Undergraduate Education Committee (UEC) approval	**Date of meeting:**	November 22, 2019

Learning Outcomes:

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

1. Establish elementary ring-theoretic and field-theoretic propositions and construct counterexamples.
2. Perform elementary number-theoretic computations and establish elementary number-theoretic propositions.
3. Define ring isomorphism and establish isomorphism or non-isomorphism between rings.
4. State and establish elementary propositions relating irreducibility, roots and factorization in polynomials rings over a field.
5. Compute GCDs, test for irreducibility and factor in a polynomial ring.
6. Construct extension fields as a quotient of a polynomial ring over the ground field and perform computations there.
7. Establish elementary propositions regarding extension fields concerning algebraicity minimal polynomial and degree.
8. Explicate the degree requirements on numbers geometrically constructible over Q and hence the impossibility of certain geometric constructions.
9. Define and determine primitive elements of a finite field and establish elementary facts about them.
10. Determine if a polynomial over a finite field is primitive and elucidate the connection with primitive elements.
11. Construct block codes as polynomial codes, use them to detect and correct errors, and prove elementary propositions regarding them.
12. Establish the existence of finite fields of prime power order.

Prior Learning Assessment and Recognition (PLAR)

☒ Yes ☐ No, PLAR cannot be awarded for this course because

Typical Instructional Methods *(Guest lecturers, presentations, online instruction, field trips, etc.; may vary at department's discretion.)*

The course will be primarily lecture-based, along with student seminar presentations.

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

Typical Text(s) and Resource Materials *(If more space is required, download Supplemental Texts and Resource Materials form.)*

	Author (surname, initials)	Title (article, book, journal, etc.)	Current ed.	Publisher	Year
1.	RS Irving	Integers, Polynomials and Rings: A Course in Algebra	☐	Springer Verlag	2004
2.	Gilbert & Nicholson	Modern Algebra and Applications	☐	Wiley	2004
3.			☐		
4.			☐		
5.			☐		

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

Typical Evaluation Methods and Weighting

Final exam:	40%	Assignments:	25%	Field experience:	%	Portfolio:	%
Midterm exam:	35%	Project:	%	Practicum:	%	Other:	%
Quizzes/tests:	%	Lab work:	%	Shop work:	%	Total:	100%

Details (if necessary):

Typical Course Content and Topics

- Review of basic number theory (primes, divisibility, modular arithmetic) (Topics covered in MATH 265)
- Rings and Fields
- Examples already known: integers, reals, matrices, polynomials, etc.
- Definitions and further examples including the integers modulo n
- Subrings/Subfields
- Polynomial rings: the algebra of polynomials (over integers, rationals, reals, complexes, finite fields), roots, factorization, irreducibility tests.
- Review of vector spaces over a field
- Extension fields: Construction via quotients of polynomial rings, Fundamental Theorem of Algebra, Splitting fields, minimal polynomials, degree of extensions Field isomorphisms
- Finite fields: Existence, construction, structure and subfield structure.
- Primitive elements, primitive polynomials Applications: Latin squares, error-correcting codes, geometric constructions