UNIVERSITY OF THE FRASER VALLEY

ORIGINAL COURSE IMPLEMENTATION DATE: September 2006
REVISED COURSE IMPLEMENTATION DATE: September 2019
COURSE TO BE REVIEWED: (six years after UEC approval) December 2024
Course outline form version: 09/15/14

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 (if title exceeds 30 characters): 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 a C or better in MATH 265.
Corequisites (if applicable, or NONE):	
Pre/corequisites (if applicable, or NONE):	

Equivalent Courses (cannot be taken for additional credit)
Former course code/number:
Cross-listed with:
Equivalent course(s):
Note: Equivalent course(s) should be included in the calendar description by way of a note that students with credit for the equivalent course(s) cannot take this course for further credit.

Transfer Credit
Transfer credit already exists: ☐ Yes ☒ No

Transfer credit requested (OReg to submit to BCCAT):
☐ Yes ☒ No (if yes, fill in transfer credit form)

Resubmit revised outline for articulation: ☐ Yes ☒ No

To find out how this course transfers, see **bctransferguide.ca**.

Total Hours: 50
Typical structure of instructional hours:

Lecture hours	50
Seminars/tutorials/workshops	
Laboratory hours	
Field experience hours	
Experiential (practicum, internship, etc.)	
Online learning activities	
Other contact hours:	
Total	**50**

Special Topics
Will the course be offered with different topics?
☐ Yes ☒ No

If yes, different lettered courses may be taken for credit:
☐ No ☐ Yes, repeat(s) ☐ Yes, no limit

Note: The specific topic will be recorded when offered.

Maximum enrolment (for information only): 36

Expected frequency of course offerings (every semester, annually, every other year, etc.): Semi-annually

Department / Program Head or Director: Ian Affleck	**Date approved:**	September 26, 2016
Faculty Council approval	**Date approved:**	October 5, 2018
Campus-Wide Consultation (CWC)	**Date of posting:**	November 16, 2018
Dean/Associate VP: Lucy Lee	**Date approved:**	October 5, 2018
Undergraduate Education Committee (UEC) approval	**Date of meeting:**	December 14, 2018

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.

Grading system: Letter Grades: ☒ Credit/No Credit: ☐ Labs to be scheduled independent of lecture hours: Yes ☐ No ☐

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 %	Midterm exam: 35 %	Practicum: %
Quizzes/tests:	Lab work: %	Field experience: %	Shop work: %
Other: %	Other: %	Other: %	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