CGS agenda Item: 21-39
Effective Spring 2022

Eastern Illinois University

New/Revised Course Proposal Format

(Approved by CAA on 4/3/14 and CGS on 4/15/14, Effective Fall 2014)

Banner/Catalog Information (Coversheet)

1. **_x___New Course or _____Revision of Existing Course**
2. **Course prefix and number:** _MAT 5230 _____
3. **Short title:** _Knots and Tangles_____
4. **Long title:** _Algebraic Theory of Knots and Tangles_____
5. **Hours per week:** _3_ Class _0_ Lab _3_ Credit
6. **Terms:** ___ Fall ___ Spring ___ Summer _x_ On demand
7. **Initial term**: ___ Fall _x_ Spring ___ Summer Year: _2022_
8. **Catalog course description:** Rational tangles and continued fractions, algebraic knot theory, bracket polynomials, Conway's Theorem.
9. **Course attributes:**

   General education component: _N/A_____

   ___ Cultural diversity ___ Honors ___ Writing centered ___ Writing intensive ___Writing active
10. **Instructional delivery**

    Type of Course:

    _x_ Lecture ___ Lab ___ Lecture/lab combined ___ Independent study/research

    ___ Internship ___ Performance ___ Practicum/clinical ___ Other, specify: _____

    Mode(s) of Delivery:

    _x_ Face to Face _x_ Online ___ Study Abroad

    ___ Hybrid, specify approximate amount of on-line and face-to-face instruction_____
11. Course(s) to be deleted from the catalog once this course is approved.
    _____N/A_____
12. **Equivalent course(s):** _N/A_____

    a. **Are students allowed to take equivalent course(s) for credit?** ___ Yes _x_ No
13. **Prerequisite(s):** __MAT 3530_____

    a. **Can prerequisite be taken concurrently?** ___ Yes _x_ No

    b. Minimum grade required for the prerequisite course(s)? _C_

    c. **Use Banner coding to enforce prerequisite course(s)?** _x_ Yes ___ No

d. **Who may waive prerequisite(s)?**

___ No one _x_ Chair _x_ Instructor ___ Advisor ___ Other (specify)

14. Co-requisite(s): __N/A_____

15. Enrollment restrictions

a. **Degrees, colleges, majors, levels, classes which <u>may</u> take the course:** _____Graduate students in Mathematics and Mathematics Education_____

b. **Degrees, colleges, majors, levels, classes which may <u>not</u> take the course:** __Everyone else_____

16. Repeat status: _x_ May not be repeated ___ May be repeated once with credit

17. Enter the limit, if any, on hours which may be applied to a major or minor: _3_

18. Grading methods: _x_ Standard ___ CR/NC __ Audit ___ ABC/NC

19. Special grading provisions:

_N/A_ Grade for course will <u>not</u> count in a student's grade point average.

_N/A_ Grade for course will <u>not</u> count in hours toward graduation.

_N/A_ Grade for course will be removed from GPA if student already has credit for or is registered in: _____

_N/A_ Credit hours for course will be removed from student's hours toward graduation if student already has credit for or is registered in: _____

20. Additional costs to students:

Supplemental Materials or Software____N/A_____

Course Fee _x_No ___Yes, Explain if yes_____

21. Community college transfer:

___ A community college course may be judged equivalent.

_x_ A community college course may <u>not</u> be judged equivalent.

Note: Upper division credit (3000+) will <u>not</u> be granted for a community college course, even if the content is judged to be equivalent.

Rationale, Justifications, and Assurances (Part I)

1. ___Course is required for the major(s) of _____
   ___Course is required for the minor(s) of _____
   ___Course is required for the certificate program(s) of _____
   _x_ Course is used as an elective
2. **Rationale for proposal** : EIU does not presently offer a class which covers knot theory. This has been successfully taught as a topics class in three separate semesters. This topic is easily accessible to any student with an undergraduate education in mathematics; for example, it offers a context in which the topic of abstract algebra is applied in a concrete way. A simplified version of the topic can be presented to high school students, making this a suitable topic for Mathematics Education students.
3. **Justifications for (answer N/A if not applicable)**
   Similarity to other courses: N/A
   Prerequisites: This class requires background knowledge in the area of group theory, as is provided by an undergraduate abstract algebra class.
   Co-requisites: N/A
   Enrollment restrictions: This is a graduate level class, and requires a strong undergraduate background in mathematics.
   Writing active, intensive, centered: N/A
4. **General education assurances (answer N/A if not applicable)**
   General education component: N/A
   Curriculum: N/A
   Instruction: N/A
   Assessment:N/A
5. **Online/Hybrid delivery justification & assurances (answer N/A if not applicable)**
   Online or hybrid delivery justification: Students taking this class are frequently located off-campus. Other similar classes have been offered online successfully.
   Instruction: Online delivery of the class will be facilitated through the EIU Learning Management System. Materials will include professor-recorded videos, notes, discussions and other components. Faculty teaching the class online will have the appropriate OCDi training.
   Integrity: The EIU LMS allows for exams to be proctored, for example using Respondus. Assignments will be checked for integrity using available tools.

Interaction: The EIU LMS allows for homework to be submitted and discussion boards to be posted on. The professor will give feedback and interact with students via these methods, online office hours, and online class meetings if and when necessary. The discussion board tools also allow students to interact between themselves in an online class.

Model Syllabus (Part II)

Please include the following information:

1. Course number and title

MAT 5230 Algebraic Theory of Knots and Tangles

2. Catalog description

Rational tangles and continued fractions, algebraic knot theory, bracket polynomials, Conway's Theorem.

3. Learning objectives.

The student will be able to:

(a) draw the rational tangle associated to a continued fraction and find the continued fraction corresponding to a rational tangle (1,2);
(b) apply Conway's Theorem to determine whether two tangles are or are not isotopic (2,3);
(c) construct and explain an isotopy between isotopic tangles using Reidemeister moves (1,2,3);
(d) assess and critique others' arguments on whether two tangles are isotopic (2,3,5);
(e) compute and apply various invariants of knots and links (1,2,3);
(f) distinguish between invariants and be able to express what each reveals about a knot (1,2,3);
(g) perform computations with complex numbers and find the Conway number of a tangle (2,3).

4. Course materials.

The course will be based around a set of notes: "Conway's Theorem (after Goldman—Kauffman)" by Luecke and Marcotte.

Additional Texts: "The Knot Book: An Elementary Introduction to the Mathematical Theory of Knots" by Colin Adams

5. Weekly outline of content.

Week 1: Introduction to Rational Tangles

Week 2: Arithmetic of Rational Tangles

Week 3: Flips and Flypes

Week 4: Rational Tangles and Continued Fractions

Week 5: Lagrange's Identity, and the first half of Conway's Theorem

Week 6: Review and Exam 1

Week 7: Knots and Reidemeister Moves

Week 8: Isotopies; Writhe of a Knot

Week 9: The Bracket Polynomial of a Knot

Week 10: The Bracket Polynomial of a Tangle

Week 11: Complex numbers and complex-valued polynomials

Week 12: The Second Half of Conway's Theorem

Week 13: Review and Exam 2

Week 14: Knots: Colorability and other invariants

Week 15: Links: Linking number and other invariants

Week 16: Final Exam

6. Assignments and evaluation, including weights for final course grade.

   Homework 25%
   Discussions/Participation 25%
   Written Exams 50%

7. Grading scale.

   > 89.9% A, 80-89.9% B, 70-79.9% C, 60-69.9% D, < 60% F.

8. Correlation of learning objectives to assignments and evaluation.

	Homework (25%)	Discussion (25%)	Exams (50%)
(a) draw the rational tangle associated to a continued fraction and find the continued fraction corresponding to a rational tangle (1,2)	x	x	x
(b) apply Conway's Theorem to determine whether two tangles are or are not isotopic (2,3)	x	x	x

(c) construct and explain an isotopy between isotopic tangles using Reidemeister moves (1,2,3)	x	x	x
(d) assess and critique others' arguments on whether two tangles are isotopic (2,3,5)		x	
(e) compute and apply various invariants of knots and links (1,2,3)	x	x	x
(f) distinguish between invariants and be able to express what each reveals about a knot (1,2,3)	x	x	x
(g) perform computations with complex numbers and find the Conway number of a tangle (2,3)	x	x	x

Date approved by the department or school: 8/27/21
Date approved by the college curriculum committee: 9/8/21
Date approved by the Honors Council *(if this is an honors course):*
Date approved by CAA: CGS: