EDCP 342A Mathematics Education: Curriculum and Pedagogy Secondary
DRAFT April 2012

Description
This course is an introduction to teaching mathematics in secondary schools in British Columbia. Its aim is to help new teachers learn how to develop as excellent secondary math teachers, giving you the chance to become familiar with the provincial curriculum and methods of teaching mathematics. The course should also give you the chance to become part of the ongoing conversation about mathematics teaching and learning.

Course Objectives:
The course aims to:

- question your own teaching practices to create the best learning experiences
- develop your skills as a humane, skilled teacher who is a good listener
- improve your abilities to communicate mathematics in many modes and forms to stimulate learners' interests and meet their need
- expand your curiosity about mathematics, teaching and learning
- become a lifelong learner and contributor to the community of math educators.

By the end of the course teacher candidates should gain:

- familiarity with the new BC/WNCP math curriculum (and Grade 10 provincial exams)
- working knowledge of textbooks and resources available
- experience using tech resources like Geometer's Sketchpad, Geogebra, smartboards and graphing calculators
- familiarity with the BCAMT, as a reader and contributor to its journal and listserv
- familiarity with the NCTM, including its standards documents and journals
- competence in teaching math concepts with clarity, engagement, enthusiasm, art
- familiarity with cross-disciplinary approaches integrating mathematics with history, arts and culture, science and technology, multisensory and multimedia approaches
- experience using project work in math class, building a repertoire of project ideas.

All work in this course addresses the three principles of learning for the BC curriculum:
•*Learning requires the active participation of the student*
•*People learn in a variety of ways and at different rates*
•*Learning is both an individual and a group process.*

COURSE STRUCTURE

Module A (Weeks 1 -3): Connections, assumptions, images of teaching

This first module is designed help us get to know each other and to ground and frame issues introductory to the course. One of your first tasks as a new teacher is to imagine the kind of teacher you want to be, and connect with your personal history as a math teacher and learner.
In this module, your *Assignment #1: 'Conversations with math teachers and students'* assignment is due, and you will have set up your course weblog portfolio.

Module A objectives:
•Become familiar with the course structure and resources.
•Participate in building a classroom community.
•Begin a weblog portfolio of short written pieces that will document your learning process throughout the course.
•Examine personal assumptions that underlie your philosophy of teaching and learning.
•Locate and frame issues related to the teaching and learning of mathematics, drawing on personal experience, your questions regarding math education, and conversations with secondary school teachers and students.
•Examine scholarly evidence and opinion to challenge, situate, extend and/or support your framed issues and images in mathematics education.

Module B (Weeks 4 – 7) The curriculum: Supporting students' learning

In this module, we will take both a wide and a close-up view of the BC provincial math curriculum: what we are mandated to teach, why the curriculum has taken its present shape, and how we might support students' mathematical thinking and learning. We will examine the differences between *telling what we know* and *supporting student learning* by helping novice learners think mathematically, and extend and refine mathematical concepts and fluency.
We will focus on:
•The structure of the BC secondary math curriculum (now the WNCP curriculum).
•Background to the philosophical commitments of the BC math curriculum, including a look at the NCTM Standards.
•Curricular mandates for teaching methodologies, modes of assessment and evaluation, and equity issues.
•Recommended resources available to secondary mathematics teachers: textbooks and other books, websites, math software, films, games, graphing calculators.
•The BC Association of Mathematics Teachers and its journal and listserv as a forum for the exchange of ideas, questions and resources.
• Provincial exams, and changes to these.
You will work with a group of your peers on *Assignment #2: to design a lesson plan and lead a 15-minute 'microteaching' lesson.* Self and peer assessment will help identify areas of strength and those needing development in your teaching practice. Near the end of this module, you will submit your in-progress weblog portfolio for interim feedback.

Module C (Weeks 8 – 11 and exam period)
Beyond the basics: Extension and enrichment

"But *why* do we have to learn this?" Every high school math teacher has heard this cry. Mathematics is an abstract subject, and even students who enjoy it may have difficulty articulating its connections with other areas of life, its fascination and beauty. As math teachers we owe it to all our students to make connections, find and develop fascinating activities, foster a sense of the beauty in patterns, and place math in the context of human meaning-making.

In this module, we will examine a variety of extensions and enrichment activities that can help answer the question "why learn math?":
• project work in secondary math classrooms
• connections with the history of math, science and technology, the arts and culture
• using multisensory, multimodal resources

• math contests & games
• math fairs & field trips
We will host at least two guest speakers as part of this module.

In this module, you will complete *Assignment #3: 'Doing & assessing a math project'* (individually or as part of a group, depending on your choice of project). Your work in the course will culminate in *Assignment #4: Individual unit plan*, Ideally, you will be able to use this immediately in your long practicum. Also due is the *completed weblog portfolio of short written pieces,* assembled throughout the course. This must be completed by a final entry analyzing your thinking throughout the course, in which you critically examine what you've written. This weblog portfolio should be a useful resource for developing your overall e-portfolio for the teacher education program.

COURSE OUTLINE

Week 1 -- Module A	
Topic	**Images of Teaching Secondary Mathematics (1): Program expectations, modeling, reflecting upon our own experiences as learners and teachers**
Guiding Questions	What are the expectations for teacher candidates' learning process in this course? What is meant by 'modeling', and how is it incorporated in teacher education classes? How can we experience teaching and learning in our dual, simultaneous roles as active learners and reflective teachers? As an example of modeling: since most of us have experienced 'the lecture' as a customary mode of mathematics teaching, how could we make even lectures an interactive, participatory learning experience for our students?
Required reading	Skemp, R. (1976). Relational understanding and instrumental understanding. *Mathematics Teaching 77* (20-26).
Required writing	Personal response to the ideas in the Skemp article.
Week 2 -- Module A	
Topic	**Images of Teaching Secondary Mathematics (2): Fluency, understanding, assessment in mathematics**
Guiding Questions	What constitutes mathematical understanding? Is there a distinction between 'doing mathematics' (algorithmically or by rote memorization) and understanding mathematics? How are fluency and understanding related in mathematics learning? Is one necessarily prior to the other – and if so, which comes first? How can we know whether our students are developing mathematical understanding and/or mathematical fluency? Mathematical assessment in secondary schools traditionally involves quizzes and tests. What other forms of assessment, formal and informal, might be useful in helping us understand and diagnose our students' fluency and

	understanding?
Required reading	Thurston, W. P. (1994). On proofs and progress in mathematics. *Bulletin of the American Mathematical Society 30* (2), 161-177.
In-class activities	Viewing film: NCTM on alternative assessment in secondary mathematics classrooms – group problem-solving test. Debate: Are marks accurate?
Required writing	Personal writing on your two most memorable math teachers – memorable in positive and/or negative ways.
Week 3 -- Module A	
Topic	**Images of Teaching Secondary Mathematics (3)**
Guiding Questions	What are your goals for yourself as a mathematics teacher? What kind of teacher do you imagine yourself to be? What are your worries about yourself as a mathematics teacher? How have your experiences as a student of mathematics affected your images of mathematics teachers and learners? How can one learn to be a good mathematics teacher for all (or most) students – not only those who are like oneself? How can we offer variable entry points for learners with varied approaches, backgrounds and interests in mathematics?
Suggested References	Small, M. (2009). Good questions: Great ways to differentiate mathematics instruction. New York, NY: Teachers College Press. Small, Marian and Lin, Amy. (2010). *More good questions: Great ways to differentiate secondary mathematics instruction.* New York, NY: Teachers College Press. Prestage, S. & Perks, P. (2001). *Adapting and extending secondary mathematics activities: New tasks for old*. London. Fulton Publishers.
Required writing	Personal writing: Letters from two of your students ten years from now. Assignment 1: Conversation with a math teacher and a math student.
Week 4 -- Module B	
Topic	**The curriculum (1): Supporting student learning through lesson planning**
Guiding Questions	What is meant by lesson planning? Are there essential elements to every lesson, or do these vary? Is there a template (or are there templates) to guide new teachers in lesson planning? How to evaluate a given lesson planning scheme? Must secondary mathematics lessons follow the stereotypical pattern

	many of us became accustomed to in high school – or can things be different? What are the criteria for a good or successful lesson? What is the relationship between what we plan and what we actually end up doing? Are there support systems in place to help new math teachers in lesson planning?
Required action	Class members join the BC Association of Mathematics Teachers (BCAMT) listserv and join in on peer discussions where appropriate. Individual microteaching assignment: Plan a 5-minute lesson on a familiar (non-mathematical) topic, to be assessed by self and a small group of peers.
Required reading	Robinson, H. (2006). Using research to analyze, inform and assess changes in instruction. In Van Zoest, L. R. (Ed.), *Teachers engaged in research: Inquiry into mathematics classrooms, Grade 9-12.* Charlotte, NC: Information Age Publishing.
Required writing	Group in-class writing on our class blog on what it takes to plan a good lesson: your group's design for a lesson planning template.
Week 5 – Module B	
Topic	**The curriculum (2): Influences shaping the BC mathematics curriculum**
Guiding Questions	What are the sources for the topics and approaches to mathematics in the BC provincial curriculum? Has the curriculum changed in recent years – and if so, why? What is meant by the NCTM Standards, and what is their relationship to the BC math curriculum? Are secondary math curricula the same worldwide, and have they changed over time? What are some of the societal, educational and mathematical influences that guide curriculum decisions?
Required reading	NCTM Standards Executive Summary (available at http://www.nctm.org/uploadedfiles/math_standards/12752_exec_pssm.pdf) Gerofsky, S. (2008). Entry on Mathematics Education, from Mathison, S. & Ross, E. W. (Eds.) *Battleground schools.* Westport, CN: Greenwood Press, 391-400.
Required writing	Two-column problem solving solution to a non-standard math problem from Mason, J. et al. (1989). *Thinking mathematically.* Reading, MA: Addison-Wesley.
Week 6 – Module B	
Topic	**The curriculum (3): Close-up on the BC math curriculum**
Guiding Questions	Where can one find information on the current BC math curriculum? What is the structure of the three-strand mathematics program? Which courses are required for post-secondary entrance and for particular trades and professions? Is streaming a good or a bad idea, and why? What are the general assumptions about teaching, learning and mathematics embedded in the curricular documents? What support do curriculum documents offer in terms of lesson and unit planning, useful resources and pedagogy? What is meant by IRPs and

	PLOs, and how can they guide our teaching? Which mathematics provincial exams are still current, and what do they look like? What resources will help us prepare our students for these exams?
Required reading	BC mathematics curriculum documents, Grades 8 – 12 (available at http://www.bced.gov.bc.ca/irp/subject.php?lang=en&subject=Mathematics) Simmt, E. (2001). Citizenship education in the context of school mathematics. Available at http://www2.education.ualberta.ca/css/css_35_3/ARcitizenship_education.htm.
Required writing	Group in-class writing on our blog exploring IRPs in the three strands of the BC mathematics curriculum.
Required action	Assignment 2: Group microteaching assignment. Work collaboratively to plan and teach a 15-minute lesson on a topic form the math IRPs, to be assessed by self and peers.
Week 7 – Module B	
Topic	**The curriculum (4): Close-up on textbooks**
Guiding Questions	Which textbooks and series are currently in use in BC schools? How were these written/ selected? How can we make an assessment of competing textbook series if we are asked to advise on textbook selection in our schools? What criteria would we use to select a textbook? What is the future of textbooks with the advent of e-books, teacher-generated wikis and interactive multimedia websites? What other kinds of resources are available to math teachers to supplement and enliven our classes?
Required reading	Samples from the mathematics textbook series currently in use in BC schools. (We will have a cart of these borrowed on short-term loan from the UBC Education Library.) Whiteley, W. (1999). The decline and rise of geometry. In the *Proceedings of the Canadian Mathematics Education Study Group.*
Required writing	Group in-class writing to our class blog on criteria for textual and content assessment of current textbooks and e-textbooks.
Week 8 – Module C (after 2-week practicum)	
Topic	**Beyond the basics (1): History of mathematics and project work in math class**
Guiding Questions	How can the history of mathematics be incorporated into contemporary mathematics classes? Is history relevant to our students? What resources can help mathematics teachers bring topics from the history of mathematics into students' exploration of math? Is there a place for project work in secondary mathematics classes? What might those projects look like? What makes a good math project, and what criteria could we use for assessment of project work?

Suggested References	Edwin A. Abbott (2007). *Flatland*. NY: Dover. ISBN: 978-0486272634 Hans Magnus Enzensberger (2000). *The number devil: A mathematical adventure*. NY: Owl Books (Henry Holt). ISBN: 978-0805062991 Leon Harkleroad. (2006). *The math behind the music.* Cambridge University Press & Mathematical Association of America (Outlooks series). ISBN: 978-0521009355 William P. Berlinghoff & Fernando Q. Gouvea. (2002). *Math through the ages: A gentle history for teachers and others.* Farmington, ME: Oxton House.(paperback) ISBN: 978-1881929215
In-class activities	Guest speaker on using the history of mathematics in secondary teaching
Required actions	Assignment 3: Doing and assessing a math project
Week 9 – Module C	
Topic	**Beyond the basics (2): Technology, manipulatives and embodied mathematics**
Guiding Questions	What technologies (digital and otherwise) are useful in supporting mathematics teaching and learning? What resources and practices are currently used in BC classrooms – and what further developments can we imagine? Is mathematics a solely abstract, mental (plus pencil and paper) activity, or is there a role for embodiment, visualization, and other multisensory, multimodal means for developing mathematical understanding? Is mathematical understanding really congruent to 'being able to produce multiple representations of mathematical concepts and understand their equivalence'? Is abstract understanding 'better' than embodied ways of knowing – or is there an interplay between these modes?
In-class activities	Guest speaker on technology in secondary mathematics classes. Film: BBC/ Open University film on Dave Hewitt: 'Thinking of a number' & 'Rulers'
Week 10 – Module C	
Topic	**Beyond the basics (3): Mathematics & the arts, introduction to unit planning**
Guiding Questions	Is there a relationship between mathematics and the arts, as there is between math and the sciences? How can mathematical relationships and concepts be expressed through music, sculpture, painting, poetry and other art forms? What is a unit of work in secondary mathematics? Is it necessarily identical to a chapter in the math textbook? What are important elements of a successful unit, and how does one plan a unit of work? Are there templates available to aid in unit planning?

Suggested References	The Canadian National Mathematics Performance Festival/Contest, available at www.mathfest.ca. Bridges Math & Art website and conference proceedings, available at <http://bridgesmathart.org/>. Film: Between the Folds (on origami and mathematics, physics and sculpture) http://www.pbs.org/independentlens/between-the-folds/. Vi Hart's musical, animated and drawn mathematical explorations: http://vihart.com/everything/.
In class activities	Writing a mathematical poem Building a geometric sculpture Group work on developing unit planning strategies
Week 11 – Module C	
Topic	**Beyond the basics (4): Ongoing professional development and sharing of resources**
Guiding Questions	How can we continue to support one another as peers beyond the end of this course? How do we keep our curiosity, interest and initiative alive as we become more experienced teachers? How might we open a dialogue with peers and mentors to address difficulties in our teaching and to keep our students interested in discovering the beauty of mathematics?
In-class activities	Resource sharing 'math party': films, books, websites, music, mathematical games and lesson ideas.
Required writing	Assignment 4: Unit plan (due during exam period)

Assignments and personal blog:
There are four assignments and a portfolio for this course:

Assignment 1: Conversation with math teachers and students Working in an assigned group of three, you will work collaboratively to create a list of five 'burning questions' you would most like to ask high school math teachers and students. Each group will visit teacher(s) and student(s) at a local secondary school (pre-arranged by the instructor or group members) and converse around the question topics. Groups will report back verbally in class about what they learned. Each teacher candidate will include in their portfolio their list of questions and a 400-600 word individual report on their learning.

Assignment 2: Group lesson plan & microteaching
Working in an assigned group of three, you will design a lesson plan incorporating multiple approaches to a particular topic in the mathematics curriculum. Each group will present a 15-minute 'microteaching' of their topic to peers in class. Feedback: self- and peer-evaluation of the lesson plan and microteaching.

Assignment 3: Doing and assessing a math project
You will select one from a list of projects suitable for secondary school math students and carry out the project (individually or as a group, as appropriate). You will also design your own math project. Each student will write a two-page (approximately 500 word) reflective journal entry and critique reflecting their experience in doing the project, the potential mathematics learning involved, and the place that the projects might have in classroom teaching and learning. This assignment will be assessed on the product of the project work (analysis, written and graphic display, performance as appropriate), the quality of the new project design, and on the quality of the journal entry and critique.

Assignment 4: Unit plan
As a culminating assignment for the course, teacher candidates will work individually to develop a plan for a unit of 10 lessons that will incorporate the principles of learning, using multiple entry points, project work, curricular integration and multiple forms of assessment.

Portfolio of short written pieces:
(In-progress portfolio due in week 6; completed portfolio due during exam period)
Teacher candidates will compile a portfolio of short written pieces produced in course activities. This portfolio will be presented electronically as a weblog ('blog'), and will include responses to articles and videos, an initial math teaching 'autobiography', a two-column mathematical problem-solving journal, and short creative writing and reflection pieces. Many of these will be written as in-class assignments.

The in-progress portfolio will allow for instructor feedback on work to date. The completed portfolio will include a final entry analyzing your thinking throughout the course, in which you critically examine what you've written. In this final entry, you will be asked to notice what you were paying attention to as the course progressed, and to look for patterns or themes in your thoughts and experiences as a developing new math teacher. The portfolio will be evaluated for completeness and depth of thought exhibited in the writing.

Plagiarism
Please consult UBC's Regulation on Plagiarism at http://www.vpacademic.ubc.ca/integrity/policies.htm. As presented in the UBC Calendar, plagiarism is a serious "form of academic misconduct in which an individual submits or presents the work of another person as his or her own". Plagiarism involves taking the words, ideas or research of another without properly acknowledging the original author. You need to become familiar with the different forms that plagiarism can take, including accidental and intentional plagiarism. For more information see www.library.ubc.ca/home/plagiarism/for-students.doc. Whether intentional or not, plagiarism is a form of cheating that can lead to a failing grade for the course and to suspension from the University. Acknowledge your sources, including the Internet, using APA Style (American Psychological Association).

Students with Disabilities Please consult UBC's Academic Policy for Students with Disabilities at http://www.universitycounsel.ubc.ca/policies/policy73.pdf. Please let us

know (or have the UBC Disability Resource Center let us know) if you have a disability documented with the UBC Disability Resource Centre and/or if you need any special accommodations in the curriculum, instruction, or assessment of this course to enable you to fully participate. We will respect the confidentiality of any information you share and support you so that your learning needs are met.

Abbott, E. A. (2007). *Flatland*. NY: Dover. ISBN: 978-0486272634

Berlinghoff, W. P. & Gouvea, F.Q. (2002). *Math through the ages: A gentle history for teachers and others.* Farmington, ME: Oxton House.(paperback) ISBN: 978-1881929215

Enzensberger, H. M. (2000). *The number devil: A mathematical adventure*. NY: Owl Books (Henry Holt). ISBN: 978-0805062991

Gerofsky, S. (2008). Entry on Mathematics Education, from Mathison, S. & Ross, E. W. (Eds.) *Battleground schools.* Westport, CN: Greenwood Press, 391-400.

Harkleroad, L. (2006). *The math behind the music.* Cambridge University Press & Mathematical Association of America (Outlooks series). ISBN: 978-0521009355

Mason, J., Burton, L. & Stacey, K. (1982). *Thinking mathematically*. Reading, Mass.: Addison-Wesley. ISBN: 978-0201102383

Prestage, S. & Perks, P. (2001). Adapting and extending secondary mathematics activities: New tasks for old. London. Fulton Publishers.

Robinson, H. J. (2006). Using research to analyze, inform, and assess changes in instruction. In Van Zoest, L. R. (Ed.), Teachers engaged in research: Inquiry into mathematics classrooms, Grades 9-12. Greenwich, Conn.: Information Age Publishing.

Simmt, E. (2001). Citizenship education in the context of school mathematics. Available at http://www2.education.ualberta.ca/css/css_35_3/ARcitizenship_education.htm

Skemp, R. (1976). Relational understanding and instrumental understanding. *Mathematics Teaching 77* (20-26).

Small, M. (2009). Good questions: Great ways to differentiate mathematics instruction. New York, NY: Teachers College Press.

Small, Marian and Lin, Amy (2010). *More Good Questions: Great Ways to Differentiate Secondary Mathematics Instruction.* New York, NY: Teachers College Press.

Thurston, W.P. (1994). On proofs and progress in mathematics. *Bulletin of the American Mathematical Society 30* (2), 161-177.

Whiteley, W. (1999). The decline and rise of geometry. In the *Proceedings of the Canadian Mathematics Education Study Group.*