New York City College of Technology

The City University of New York

DEPARTMENT: Mathematics

INSTRUCTOR: Professor Andrew Douglas

COURSE: MEDU 2010

TITLE: Technology in Mathematics Education

DESCRIPTION: Students will examine the rationale and pedagogy for the effective use of technology in the middle and high school mathematics classrooms. The technologies considered may include graphing calculators, computer algebra systems, spreadsheets, and dynamic geometry software.

CREDIT HOURS: 1 cl hrs, 2 lab hrs, 2 cr

PREREQUISITES: MEDU 1021 and MAT 1475

TEXTS:

   [1] Gerard A. Venema. "Exploring Advanced Euclidean Geometry with GeoGebra." MAA, 2013.
   [2] NCTM Principles and Standards for School Mathematics, 2010.

ADDITIONAL REFERENCES:

   [3] New York State Common Core Learning Standards for Mathematics
       http://www.p12.nysed.gov/ciai/common_core_standards/pdfdocs/nysp12cclsmath.pdf
   [4] Mathematics Education Handbook
       https://sites.google.com/site/andrewfdouglas/Fundamentals.pdf
   [5] Texas Instruments Graphing Calculator Activity Repository
       http://education.ti.com/en/us/activity/search/subject
   [6] GeoGebra Tube (a repository of lesson plans and activities for GeoGebra).
       https://tube.geogebra.org
   [7] Samples of Applet Construction using GeoGebra
       www3.ul.ie/cemtl/Booklets/Examples_Web.pdf
   [8] A. Douglas. Maple Worksheets. https://sites.google.com/site/andrewfdouglas/medu-2010

REQUIRED SOFTWARE AND HARDWARE: GeoGebra, Maple, Graphing Calculator

LEARNING OUTCOMES: Upon successful completion of the course, students should be able to:

   1. Solve a wide range of mathematical problems using technology

2. Use technology to assist in making and testing conjectures
3. Prove mathematical theorems with technology
4. Create programs or applications to perform mathematical functions, and solve mathematical problems
5. Create mathematics lesson plans, consistent with the CCSSM standards and NCTM technology principle, that effectively incorporate technology
6. Support and critique the use of technology in the 7-12 mathematics classroom using theory and research from mathematics education journals

INSTRUCTIONAL OBJECTIVES For successful completion of the course, students should be able to:	ASSESSMENT
Solve a wide range of mathematical problems using technology	• Student created lesson plans • Student presentations • Student guided, in-class lessons • Final exam
Use technology to assist in making and testing conjectures	• In class discussions • Assignments • Student guided, in-class lessons • Final Exam
Use technology to assist in making and testing conjectures	• Assignments, group work, final exam.
Create programs or applications to perform mathematical functions	• Assignments, group work, final exam.
Create programs or applications to solve mathematical problems	• Assignments, group work, final exam.
Prove mathematical theorems with technology	• Assignments, group work, final exam.
Create mathematics lesson plans, consistent with the CCSSM standards and NCTM technology principle, that effectively incorporate technology	• Student created lesson plans • Student guided, in-class lessons • Final exam

GENERAL EDUCATION LEARNING OUTCOMES	ASSESSMENT
Gather, interpret, evaluate, and apply information discerningly from a variety of sources.	Classroom discussion, writing assignments, student presentations, tests, exams.
Understand and employ both quantitative and qualitative analysis to solve problems.	Classroom discussion, writing assignments, student presentations, tests, exams.

Employ scientific reasoning and logical thinking.	Classroom discussion, writing assignments, student presentations, tests, exams.
Acquire tools for lifelong learning.	Classroom discussion, writing assignments, student presentations, tests, exams.
Work with teams. Build consensus and use creativity.	Classroom discussion, writing assignments, student presentations, tests, exams.
Use creativity to solve problems.	Assignments, group work.

GRADING PROCEDURE:
- Final Exam 20%
- Term test 10%
- Class participation 10%
- Unit plan and presentation 30%
- Portfolio 10%
- Homework and assignments 10%
- Research on Technology in Mathematics Education Presentation 10%

TEACHING AND LEARNING METHODS:
- Guided discussion
- Guided problem solving/discovery
- Group work
- Student guided lessons

WEEKLY COURSE OUTLINE:

SESSION	TOPIC	REFERENCE
INTRODUCTION		
1,2	• NCTM standards and technology • CCSSM and technology • Review of writing lesson plans and unit plans • Review of Bloom's Taxonomy	[2], [3], [4]. [8]
UNIT I. DYNAMIC GEOMETRY SOFTWARE:GEOGEBRA		
3	Review of Elementary Euclidean Geometry	[1]
4-5	Introduction to GeoGebra • The GeoGebra toolbar • Simple constructions and the drag test • Measurement and calculation • Enhancing sketches	[1]
6-8	The Classical Triangle Centers • Concurrent lines • Medians and the centroid • Altitudes and orthocenter • Perpendicular bisectors and circumcenter • The Euler line	[1]
9-10	Advanced Techniques in GeoGebra	[1]

	• User defined tools • Check boxes • The Pythagorean Theorem • Proofs without Words	
11-13	Constructing GeoGebra Applets • Constructing a Straight Line Graph Applet • Constructing a Quadratic Graph Applet • Constructing a Scalar Product Applet	[7]
UNIT II. COMPUTER ALGEBRA SYSTEMS: MAPLE		
14-17	• Introduction to Maple • Finding roots of polynomial with Maple • Optimization with Maple • Creating diagrams with Maple • Animation in Maple • Programming in Maple	[8]
UNIT III. GRAPHING CALCULATORS		
18-21	Common Core aligned activates with Graphing Calculators. The activities may include: • Spreading Doom: Modeling the spread of the 2004 Mydoom virus • Creating Boxes: Maximizing volume • Intersecting the Solution: Solving systems of equations graphically • The Pythagorean Theorem • Ratios within Similar Figures • Dilations with Matrices	[5]
UNIT IV. PRESENTATIONS: THEORY AND RESEARCH ON TECHNOLOGY IN THE MATHEMATICS CLASSROOM		
22-24	Each student picks an article on technology in mathematics education from one of the journals listed below. Each student will give a 20-minute class presentation. The article must be pre-approved by the instructor. • Journal for Research in Mathematics Education • Educational Studies in Mathematics • Mathematics Teacher • Mathematics Teaching in Middle School • For the Learning of Mathematics • Research in Mathematics Education • Mathematics Education Research Journal • The Australian Mathematics Teacher • College Mathematics Journal • Journal of Mathematics Education at Teachers College	
UNIT V. ADDITIONAL TECHNOLOGY		
25-26	We will survey additional technology that may be implemented in the mathematics classroom. Examples may include:	

	• YouTube videos (e.g., Khan Academy, Numberphile, TED talks) • IPads • Smartphone applications	
STUDENT PRESENTATIONS, REVIEW AND EXAM		
27-28	Student presentations of Unit Plans	
29-30	Review and Final Exam	

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