
AC 2011-1743: TEACHING COLLEGE ALGEBRA AND TRIGONOMETRY WITH SUPPLEMENTAL INSTRUCTION AT A COMMUNITY COLLEGE

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Teaching College Algebra and Trigonometry with Supplemental Instruction at a Community College

Abstract

During the spring of 2009, using support from a grant obtained by a major university, supplemental instruction (SI) was integrated into one section of College Algebra and Trigonometry at a community college. This course was selected because it was considered a gateway course, a course essential to success in engineering and technology at the community college. In the fall of 2009, the SI section of College Algebra and Trigonometry was repeated with a different instructor and SI was added to two additional sections of other math courses.

The paper will discuss the development of the SI section of College Algebra and Trigonometry and the adjustments to the traditional model of SI made necessary by the unique circumstances of a community college where most students spend very limited hours on campus because of heavy outside work schedules and where there are no upper level undergraduates or graduate students available to function as student leaders.

An internal evaluator at the community college examined the initial offering of the SI section of College Algebra and Trigonometry and concluded that it demonstrated the clear effectiveness of the SI approach when compared with non-SI sections at the community college. The internal evaluator also conducted an evaluation of another SI section of College Algebra and Trigonometry and two other SI math courses offered during the spring of 2010.

Details of these evaluations are included in the paper. The 2010 evaluation was more extensive and includes a student survey, student open-ended responses from the survey, and open-ended responses from an SI Leader.

The paper includes a discussion of the diffusion and expansion of the SI model to other courses at the community college along with the attendant problems and solutions and concludes with a look ahead.

Introduction

Northern Essex Community College (NECC) is one of fifteen state-supported community colleges in Massachusetts. NECC offers comprehensive academic programs of study leading to the Associate in Arts degree, the Associate in Science degree and Certificates of program completion. Students achieve the skills required to successfully transfer to a baccalaureate program at a four year institute, or become an integral part of the highly skilled Massachusetts work force.

The NECC student body is a complex group. Many students come to the College directly after high school, while others bring a variety of living and work experiences to their studies. The average age ranges from 25 years old in the day classes to approximately 31 years old in the evening courses. Some students take conventional college programs, planning to transfer to a

four-year institution after graduation, while other students sign up for associate degree or certificate programs leading directly to employment in specialized career fields. Also, significant numbers of students at NECC enroll in developmental and second language courses to upgrade their skill sets before pursuing a degree program.

The genesis of SI at NECC began in fall of 2008 with Northeastern University's invitation to attend an SI workshop. SI provides peer-facilitated study sessions led by competent undergraduate SI leaders who attend scheduled classes with students and then help the students to practice and discuss course materials in a series of review sessions. Sessions are open to all students who are enrolled in the course and want to improve their understanding of the material, as well as improve their grades. In the fall of 2008, two of the four co-authors of this paper, with financial support from Northeastern University's STEP UP National Science Foundation grant, attended a workshop on SI held at Boston University.

After completing the one-day workshop, the two community college professors felt that SI would be beneficial to community college students because of their past experiences using student tutors and informal study groups. However, they felt that the traditional SI model used at the four-year institutions which employed peer-facilitated study sessions led by qualified and trained undergraduate SI leaders who had attended classes with students and encouraged students to practice and discuss course concepts in the sessions would have to be altered for the community college. This modification was due to the extremely limited availability of classroom space at the community college as well as the scheduling challenges for community college students who typically commute to school and often juggle jobs and family obligations in addition to their educational pursuits. Students at four-year institutions generally live on or near campus, have more free time and don't usually have demanding work or family concerns, all of which makes scheduling SI sessions much easier. In addition, four-year schools often have extra classroom space or other facilities where students can meet regularly. Therefore, a different model needed to be created if SI was to be successful at the two year campus.

The idea of implementing SI was discussed with the college's administration. They were excited about the concept and encouraged the authors to develop a plan to offer a SI section specifically designed for NECC. The key components to the plan developed during the fall of 2008 were determining the proper course, scheduling the SI session, recruiting students to be enrolled and finding appropriate SI Leaders to facilitate the session.

Scheduling and Recruiting

Because the Northeastern University STEP-UP grant supporting the effort was focused on STEM (Science, Technology, Engineering and Math) students, NECC STEM students were targeted for enrollment. The plan was to focus on a gateway course for these types of majors. At the community college, many STEM students start at the developmental math level, such as Basic Algebra I and II before they progress to more challenging, college-level math courses. To help

STEM students transition from developmental math to college math, College Algebra & Trigonometry, the first college-level math course for STEM majors, was chosen to be the course in which to implement SI. The first pilot section was scheduled for the spring of 2009.

Once the targeted audience and selected course were established, the plan focused on the scheduling of the SI session. This was the most difficult task and there were many ideas on how and when to schedule it. It was finally decided to hold the SI session on Fridays from 8 AM to 9:50 AM. This time complemented the regular class time scheduled for Monday and Wednesday 8AM to 9:50 AM. It was hoped that this time slot would make it easy for SI students to remember and block off on their schedules.

One challenge encountered was that on the NECC master schedule, the college could not list the SI session time because that would indicate an additional two hours of contact time for a four-credit course. Therefore, there was no open enrollment for the SI course. The instructor and selected student advisors had to enroll students into the course one-on-one. The maximum number of students was capped at 24. In order to help with recruitment and to give students a better understanding of the benefits of SI, a letter from the course instructor was sent out to all STEM students:

This letter is to inform you about a unique opportunity available to NECC students planning on taking College Algebra & Trigonometry, (MAT130), in the Spring of 2009. During that semester, I will be leading a special Supplemental Instruction (SI) program that will be offered Monday, Wednesday and Friday from 8 AM to 10 AM. SI is a series of review sessions for students who want to advance their understanding of math and improve their grades. It will be designated as *MAT130SI*. The Monday & Wednesday sessions are facilitated by me, the instructor. Friday's additional session will be facilitated by the SI leaders, competent, skilled NECC students who have previously passed MAT130.

Friday's SI session is a great chance to get together with people in your class to compare notes, discuss important math concepts, develop strategies for problem solving and test yourselves before I do. At each session, you will be guided through math concepts by SI leaders who are NECC students prepared to share with you what they have learned about how to study successfully for math courses. These students have a solid knowledge of the course content and are excited to help guide you through it.

The SI leaders will be in class with you during my sessions. They will not lecture; rather their responsibility is to help you think about the lecture you hear, the text book you read, the calculator and software simulator you use and the math problems you try to solve. Their job is to pull it all together from their perspectives during Friday's SI session so that you can learn it more proficiently.

Just as important, the SI sessions will integrate "how-to-learn" with "what-to-learn." Students attending SI sessions will discover appropriate application of study strategies for mathematical problem solving as they review content material. Students will also have the opportunity to become more actively involved in the subject matter as the SI leaders use the math text,

supplementary worksheets, calculators, software simulation and lecture notes as vehicles for learning instruction. All SI sessions are peer facilitated by the SI leaders, not faculty.

I encourage you to take advantage of this special opportunity and sign up early for the *MAT130SI* section offered this coming Spring, 2010.

The letter and recruitment effort were very successful. The course reached its maximum enrollment within two weeks of the start of registration for the spring semester.

During the recruitment process, SI Leaders were being sought. The plan was to find competent, skilled NECC math students who had previously passed College Algebra & Trigonometry. The search led to two engineering students working in the Math Tutoring Center. They were both in their final semester at the community college and were taking both Calculus III and Differential Equations. They were the ideal SI Leader candidates to facilitate the SI sessions and once they were recruited, the plan was finalized and ready for implementation in the spring of 2009.

The SI Section

The curriculum for the SI version of College Algebra & Trigonometry was identical to the traditional sections of the course. A sample of the course syllabus is provided in the appendix. The only difference between the SI section and the traditional sections was the additional two-hour Friday SI session to be held at the same hours as the Monday and Wednesday sessions and in the same classroom as on Monday and Wednesday. The Monday and Wednesday sessions were facilitated by the instructor. The additional session on Friday was facilitated by the two SI Leaders. The SI sessions were not mandatory for students, but were designed as a series of review gatherings for students who wanted to accelerate their understanding of math and improve their grades. The SI session provided an opportunity for students to get together with other people in their class to compare notes, discuss important math concepts and develop strategies for problem solving. During each SI session, students were guided through the math concepts by enthusiastic SI Leaders who were prepared to share what they had learned about how to successfully learn and apply mathematics.

The SI Leaders served as mentors as well as facilitators of the Friday SI sessions. They were in class on Monday and Wednesday with the students during the instructor-led sessions. The SI Leaders did not lecture; rather their responsibility was to help students think about the lecture and problem-solving strategies presented by the instructor, the text book that the students were asked to read, the calculator and software simulator used in the class room, and the math problems to be solved. The SI Leaders' job was to pull it all together from the student perspective during Friday's SI session so that students could learn the material from their peers and the SI Leaders more proficiently.

Students who attended SI sessions received reinforcement in the appropriate application of strategies for mathematical problem-solving as they reviewed content material. Students also

became more actively involved in the learning of course material as the SI Leaders used the math text, supplementary worksheets, calculators, software simulation and lecture notes as vehicles for instruction. All SI sessions were peer facilitated by the SI Leaders, not faculty.

The SI Leaders and the instructor met once a week for an hour to review problems and concerns that might have come up during the week and to plan for the SI session. These meetings were short, but very important to keep coherence and coordination between the lecture and SI sessions. The SI Leaders were paid a stipend for their efforts using Northeastern University STEP UP grant funds. Each SI Leader spent approximately 8 hours a week (4 hours of regular class time, a 1-hour weekly meeting with the course instructor, a 2-hour SI session and 1 hour preparation time).

Student Success

The two college reports which follow indicate that the SI sections did help students succeed in College Algebra & Trigonometry and other math classes. In the Achieving the Dream report, the data focuses exclusively on the pilot SI section for College Algebra & Trigonometry held in the spring of 2009.

NECC Achieving the Dream Report – A Preliminary Look at Comparing Outcomes for Students who received Supplemental Instruction to those who did not – College Algebra & Trigonometry¹

During the Spring 2009 semester, the College ran 4 sections of College Algebra & Trigonometry. One section was selected to receive supplemental instruction (SI) and was populated with students who were most likely to benefit from the experience. The entering average cumulative GPA (4.0 scale) for the SI section was 2.47 versus 2.83 for the non-SI sections.

The course completion rate for the College Algebra & Trigonometry SI section was 61% (14 of 23 completed with A – C). This compares to a combined completion rate for the 3 non-SI sections of 44% (34 of 78 completed). As is evident in the data table below, both males and females performed better in the SI section. Both the ≤ 25 and the > 25 age groups performed better in the SI section. Hispanics and other minority groups also performed better in the SI section. The only students who did not fare well in the SI section were majority students.

There are many variables (not controlled for) which may have influenced this result. Some of these variables are: individual faculty, math ability and student motivation.

Further study is needed to measure the success of this treatment. The College will continue to monitor completion rates of courses taught with supplemental instruction. Three math classes will be run in Fall 2009 with this component and the success of these courses will be compared to like courses not receiving the treatment.

	With Supplemental Instruction			Without Supplemental Instruction		
	# Enrolled	# Complete	% Complete	# Enrolled	# Complete	% Complete
Total	23	14	61%	78	34	44%
Gender						
Female	6	3	50%	22	8	36%
Male	17	11	65%	56	25	45%
Ethnicity						
Majority (w)	9	1	11%	56	20	36%
Hispanic	10	9	90%	11	7	64%
Minority (A, B, I)	1	1	100%	7	4	57%
Other (Missing/Unknown, NRA)	3	3	100%	4	2	50%
Age						
<=25	20	12	60%	62	25	40%
>25	3	2	67%	16	8	50%
Start of Spring 2009						
Term:						
<u>Earned</u>						
<u>Credits</u>						
Sum	556			1,346		
Average	24			19		
<u>Average GPA</u>	2.47			2.83		
End of Spring 2009 Term:						
<u>Average GPA</u>	2.61			2.61		

Figure 1

The second report, from NECC's Office of Institutional Research & Planning, focuses on College Algebra & Trigonometry plus two additional math courses that included SI sections in spring 2010. Both reports showed that the student completion rate increased in College Algebra & Trigonometry by 20% or more with SI instruction.

Spring 2010 Supplemental Instruction Update- NECC Office of Institutional Research & Planning²

As is evident in the following tables, Supplemental Instruction (SI) continues to achieve excellent results when applied to both developmental and college-level math courses. The course completion rates for the three SI math sections offered in Basic Algebra II, College Algebra and College Algebra & Trigonometry were higher than those sections that did not offer the SI treatment.

All Spring 2010 Sections of Specific Courses to be compared to Supplemental Instruction Section results

Name	Grades A - C	Grades A - D	Total	<u>A - C</u> Completion Rate	<u>A - D</u> Completion Rate
Basic Alg. II	288	337	547	53%	62%
College Alg.	261	294	413	63%	71%
College Alg. & Trig	76	87	123	62%	71%
Total	625	718	1083	58%	66%

Figure 2

Spring 2010 Supplemental Instruction Results

Name	Grades A - C	Grades A - D	Total	<u>A - C</u> Completion Rate	<u>A - D</u> Completion Rate
Basic Alg. II	6	6	9	67%	67%
College Alg.	19	20	20	95%	100%
College Alg. & Trig	20	23	23	87%	100%
Total	45	49	52	87%	95%

NECC Office of Institutional Research & Planning

Figure 3

Spring 2010 Completion Rates for College Algebra and Trigonometry with and without SI

In response to a request for additional data, a table³ with a more detailed comparison of the completion rates for students enrolled in the one SI section of College Algebra and Trigonometry (MAT130) and the four sections of MAT130 without SI was provided by the Office of Institutional Research & Planning in February, 2011. The table, labeled Figure 4, shows that, unlike 2009, the positive effects of SI extended across all groups, including majority males.

Spring 2010: MAT 130

	With Supplemental Instruction			Without Supplemental Instruction		
	# Enrolled	# Complete (Grades A-C)	% Complete	# Enrolled	# Complete (Grades A-C)	% Complete
Total	23	20	87%	100	56	56%
Gender						
Female	4	4	100%	39	22	56%
Male	19	16	84%	61	34	56%
Ethnicity						
Majority (w)	18	15	83%	70	41	59%
Hispanic	4	4	100%	20	9	45%
Minority*	0			7	5	71%
Unknown	1	1	100%	3	1	33%
Age						
<=25	21	18	86%	81	41	51%
>25	2	2	100%	19	15	79%

*Minority includes African-American/Black, Asian, Cape Verdean, Native Hawaiian/Pacific Islander, American Indian/Alaskan Native and Multi-Racial ethnicities

Figure 4

Student Survey

In the spring of 2010, students were given a survey to capture their feelings toward SI. The results of the survey as well as statements provided by students follow. Of the 25 students enrolled in the class, 56% of the students indicated that they had attended at least one SI session. Of the 14 students attending SI, 100% found the SI sessions “**very helpful.**” Also, 93% of the students would take another SI class and would recommend an SI course to a friend.

Student Survey Summary

Class	# of students in class	# students reporting attending an SI session	# students reporting never attending an SI session	% of students finding the SI sessions "very helpful"	% of students reported attending 5 or more sessions	% of students who would take another SI class	% of students who would recommend an SI course to a friend	SI Study Session Attendance average for the semester
Col. Alg. & Trig	25	14	1	100%	80%	93%	93%	13.8 students/session or 55%

Student Statements from Survey

Was the supplemental instruction approach (extra study sessions led by student SI leaders) used in this course helpful to you in learning? If so, please describe specific strategies (for example, group work, extra problems, extra instruction in concepts, working with student SI leaders, etc.) that helped you.

- They were helpful when I attended them.
- Because it's a math course, the extra in-class practice on difficult problems is what helped me.
- They were helpful in many ways. They gave out extra problems, went through them step by step, had group work, and explained some of the equations. It was an overall great experience.
- Yes, because of the numerous examples provided. If someone didn't understand it they will continue the process until they understood the material. The group work most definitely helped tremendously.
- I think the extra problems helped me a lot to understand the class.
- Extra problems, calculator explanations, writing out helpful equations and more.
- The extra instruction concepts and extra problems we did.
- Yes, having someone other than the teacher go over the material and offer information on how to solve current material.
- Just review specific problems that we did not quite comprehend or did not understand, extremely helpful. The SI Leaders did a great job at reinforcing what we had previously learned and would describe and explain different approaches.
- It helped because they had experience and explained it well.
- The SI Leaders provided another view on the subject. Provided a more comfortable environment, allowed group work and extra problems.

Please describe ways in which the SI approach used in this course could be improved upon to make it more effective for your learning.

- It was perfectly fine.
- They did well; I don't see any way it could be improved.
- Providing more examples that were mentioned through the non-SI sessions. Go over previous tests. Finally, maybe making the session longer.
- All math classes should have SI sections.
- It's really good with this class, can't say I would add anything to it.
- I don't know.
- Nothing from my experience, it was the best way to become highly successful in the class.
- I thought it was fine.

Please indicate the reason(s) you did not attend SI sessions:

- I didn't feel it was necessary.
- I wanted to but couldn't. The session conflicted with work or other classes.

SI Leader Comments

The following comments were submitted by one of the College Algebra & Trigonometry SI Leaders at the end of the spring of 2010. They provide insight into the perspective of an SI Leader.

Supplemental Instruction Leader's Evaluation/Comments - Spring 2010

Course: College Algebra & Trigonometry

What was the most rewarding aspect of your job as a tutor or SI Leader and why?

Watching the students evolve as better students through the semester. It was a great group of students in the class, which made the experience very enjoyable. In addition, just sitting in, and viewing the ways of the classroom turned out to be very beneficial. I plan to be a part of the academia world for some time, whether as a student, teacher, or researcher I feel it is quite beneficial to be involved with the SI experience.

What was the least rewarding aspect of job as a tutor or SI Leader and why?

Honestly, I had enjoyed the experience very much. Paul Chanley was a great professor to be a SI Leader for, and Andy was a great partner. The class we had was very diverse, and allowed us to explore many different techniques to teach with.

What topics would you like to have discussed in a SI session?

This depended on the week at hand. Generally, we went over questions from homework, examples from class, more advanced mathematical applications, and calculator techniques. What was entailed was directly related to the chapter, time (whether right before a test, after test, or in between), and the classes' mood on a given session. Some weeks we were more prompt to go, go, go; and others, we played math games and conversed about the benefits of understanding mathematics, being students, and overall goals of the individuals of the class.

What do you see are the general needs of the students in your SI Study group?

We had such a big group that it's hard to pinpoint any single need. Generally, however, I'd say a developed relationship with the subject matter (in our case mathematics) was the case for most. A lot of the students didn't seem to care much for the details of math at the beginning of the semester. Many had no need, or interest for the subject. By expressing math in an applicable fashion, while expressing the beauty and benefits of gaining a thorough understanding for the mathematics, many students tended to become more involved with reason to strive.

What changes if any, would you make in the SI program for improvement?

More communication between different SI Leaders to see how their experience is playing out would have been helpful. There were times where I either questioned, or had reformed a certain aspect of a session. It really worked out being with Andy, because we were able to observe each other, and allow for constructive feedback. However, it would have been nice to hear what other teams were up to, so maybe more ideas could have been generated through more collaboration.

What are some of the comments students have made to you regarding their attendance at your SI session?

Tell you the truth it became kind of a routine for many of us. Many students would, without question, plan to go on Friday regardless of the topic at hand. It actually became such a routine for most that we would joke in passing if they had "ditched out" of a session. It was the commitment of the students that I feel really gave rise to a contagious incentive for all of us to show up, and show equal contribution.

Write any additional comments you may want to make about the SI program.

I think it is a great concept. It really is a win/win scenario no matter how it's looked at: students in a SI session get additional help from alternative perspectives; SI Leaders get an opportunity to get more involved with the school, and are giving more incentive to learn a subject matter on a level that it's able to be taught; and the professor is giving additional sources to work with (the SI Leaders) week in and week out through the semester.

Are you interested in being an SI Leader next term?

Absolutely. I look forward to approaching the class with more awareness and competence than in the previous semester. I wasn't too sure what I was in for at the beginning. Although the last semester played out quite well, I feel that this gained experience will surely make the next time around even better.

SI Section Expansion

During the development of the pilot SI section in the fall of 2008, the college was also planning for the implementation in the fall of 2009 of the Achieving the Dream (ATD) grant.

Coincidentally, one goal of the ATD grant was to put SI into practice which made the timing of the College Algebra & Trigonometry SI section perfect for a test of the SI concept. After

reviewing the preliminary results of the College Algebra & Trigonometry SI pilot section that was implemented in the spring of 2009, ATD decided to use the same model and format in the fall. As a result, two additional math classes with SI were added to NECC's fall 2009 schedule.

The next challenge that came with this expansion was to find six competent SI Leaders and match them with the three math classes offering SI sessions. This task was difficult and time-consuming, and the responsibility of scheduling SI sections of Math, recruiting and registering students, and finding SI Leaders remained with the Math department until after the fall 2009 semester when the College decided to centralize the coordination of SI and hired a half-time professional staff member to oversee SI. Also, in the spring of 2010 the College expanded its use of SI to additional courses. By the spring of 2010, one year after the piloted math SI section, the college was offering six SI sections: three in Math; one each in Writing, Chemistry and Biology. For the spring of 2011, seven SI sessions for math courses were offered. The history of math courses using SI is as follows:

Spring 2009 (Pilot): 1 math class	Fall 2009: 3 math classes
College Algebra & Trigonometry	Basic Algebra II (ATD)
	College Algebra (ATD)
	College Algebra & Trigonometry

Spring 2010: 3 math classes	Fall 2010: 3 math classes
Basic Algebra II (ATD)	Basic Algebra II (ATD)
College Algebra (ATD)	College Algebra (ATD)
College Algebra & Trigonometry	College Algebra & Trigonometry

Spring 2011: 7 math classes
Basic Math (ATD)
Basic Algebra I (ATD)
Basic Algebra II (ATD)
Applied Technical Mathematics
College Algebra (ATD) (2 sections)
College Algebra & Trigonometry

Conclusions

While Supplemental Instruction (SI) is an established method of instruction at four-year institutions, it was a fairly new idea to NECC two years ago. The SI program which was recently established at NECC has significantly expanded from one college level math class in 2009 to fifteen SI sections in various disciplines which are being offered in the spring of 2011. Institutional data collected and analyzed supports that SI has had a significant, positive impact on student math success at the community college. Additionally, the data and feedback from students receiving SI and from SI Leaders all favor continuing SI instruction at the college. However, SI sections are more costly than non-SI sections and grants are currently being used to

support the program. As the SI program expands, securing additional funds with which to stipend the SI Leaders will be a challenge. The additional challenge of finding qualified SI Leaders has led NECC to turn to the four-year institutions for SI Leaders. In the spring of 2011, two of the SI Leaders are NECC alumni who are attending a local four-year institution. Despite the cost and the difficulty of finding SI Leaders, the SI program has proven to be such a great success for the students in the community college that its future seems assured with faculty, staff, and administration committed to the concept.

Bibliography

1. Fallon, T. "**NECC Achieving the Dream Report.**" Haverhill, MA: Northern Essex Community College, September 2009.
2. Fallon, T. "**Spring 2010 Supplemental Instruction Update.**" Haverhill, MA: Northern Essex Community College, September 2010.
3. Fallon, T. "**Spring 2010 MAT 130 Update.**" Haverhill, MA: Northern Essex Community College, February 2011.

Appendix

<p style="text-align: center;">MAT130 College Algebra & Trigonometry Northern Essex Community College Course Syllabus</p>
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Instructor: Paul Chanley

E-mail: pchanley@necc.mass.edu

Telephone: 978-556-3502

Office Hours: Posted

Office: C304Q

Fall 10 (SI Section)

COURSE DESCRIPTION: 4 credits; 4 lecture hours

Prerequisites/Proficiencies: College Reading proficiency and C or better in MAT022 or MAT115 Applied Technical Mathematics Minimum Grade: C or placement exam score

Electives: Satisfies Liberal Arts, Math, Open/Free

Description: This is the first course in a 2-semester sequence. This course and its sequel MAT140 Advanced Algebra & Trigonometry are intended as preparation for the calculus sequence. Topics include linear and quadratic modeling; solutions of equations and inequalities; symmetry and transformations of functions; trigonometric, exponential, and logarithmic functions; systems of linear equations with matrices and determinants. The TI-83, TI-83 Plus, or TI-84 Plus graphing calculator is required. Credit not given for both College Algebra and College Algebra & Trigonometry.

COURSE OBJECTIVES:

College Algebra and Trigonometry will challenge and sharpen a student's algebra techniques. It will also prepare a student to take courses (including those listed above) that require a strong algebra background. Specifically, upon completion of this course, the student should be able to express her/himself clearly and precisely using mathematical vocabulary and should be able to:

1. Solve equations involving fractional expressions
2. Add, subtract, multiply and divide complex numbers and determine the complex roots of a quadratic equation
3. Graph functions and use graphs to solve equations
4. Derive inverse and composite functions
5. Graph complex functions based on the transformations of simpler functions
6. Solve systems of linear equations (n unknowns) algebraically, graphically, matrices and by determinants
7. Determine the values of the trigonometric functions of any angle
8. Solve right triangles and application problems related to modeling with right triangles

9. Graph exponential and logarithmic functions
10. Simplify logarithms using the properties
11. Solve exponential and logarithmic equations and their applications

TOPICS:

- Review of Fundamental Concepts of Algebra
- Algebraic Equations and Inequalities
- Functions and Graphs
- Systems of Equations
- Trigonometric Functions
- Applications of Trigonometry
- Exponential and logarithmic functions

REQUIRED MATERIALS:

Textbook: Algebra and Trigonometry: Graphs and Models; 4th Edition, by Bittinger, Beecher, Ellenbogen, and Penna. Pearson Education, Inc., 2009. Also required is the MyMathLab Student Access Kit or Access Code pasted inside the textbook, if purchased from NECC College Bookstore.

Calculator: In needing to have a graphing calculator to perform computational analysis, in class, your textbook, and online are specific instructions with respect to the use of the required TI-83/TI-83 Plus/TI-84 Plus graphing calculators. If you have another type of graphing calculator, you will be responsible for its use in performing computational analysis. Make sure you have the user's manual. See instructor for suggestions.

ATTENDANCE:

Attendance is mandatory. Students are expected to attend each meeting of each class in which they are enrolled. The instructor reserves the right to assign a grade of "NP" to anyone missing more than three hours of lecture or to any student who is unlikely to pass due to missed exams or assignments. The class instructor has full and final authority to decide whether a student is permitted to make up work missed through absence, and on what terms. If a student is absent from class, he/she is responsible for the material covered, as well as any announcements made at that time (Please consult the Academic Advising Handbook). **Note:** Students are strongly encouraged to attend the Supplemental Instructor (SI) sessions.

STUDENT RESPONSIBILITIES:

All students are expected to take an active role in their learning. Notes should be taken in every class and studied before assigned problems are attempted. Homework should be done immediately after each class session. For every hour spent in the classroom, two hours of homework/studying are expected on the average. Difficulties with a particular assignment should be taken care of before the next scheduled class session. (Drop by the Math Department or the Academic Tutoring Center (C300), with your questions.) My goal is to help you have a successful semester and your active participation is a necessary step towards achieving that goal.

Difficulties with a particular assignment should be taken care of before the next scheduled class session (Drop by the Math Department area, the Math Resource Center (C300), or the Math Center (C201) with your questions).

ACADEMIC ETHICS AND PLAGIARISM:

The college expects all students to maintain high standards of academic honesty and integrity. Plagiarism in any form is not to be tolerated. Plagiarism is defined by the college to be the use of any person's work or ideas as though the work or ideas were your own, without giving the appropriate credit (Please consult the Academic Advising Handbook). Any student found in violation of this policy may be given an F for the course.

METHODS OF INSTRUCTION:

Methods of instruction will include introduction of material, use of technology in the classroom, cooperative learning, peer sharing and modeling. As always, there will be an open student dialogue in every class session. **Note:** There are two Supplemental Instruction (SI) sessions. They are scheduled for Monday & Wednesday 8:50 AM to 9:50 AM.

GRADING:

There will be four exams, daily lab assignments, and a comprehensive final examination. There will be make-up exams administered for each hourly exam with permission of the instructor. Every student is required to take the final exam. The grade for the course will be computed as follows:

Exam	60%
Projects	10%
<u>Final Examination</u>	<u>30%</u>
Total:	100%

NECC Grading Policy:

Grade	QP Value	Numeric Range/Comment
A	4.00	93-100
A-	3.70	90-92
B+	3.30	87-89
B	3.00	83-86
B-	2.70	80-82
C+	2.30	77-79
C	2.00	73-76

C-	1.70	70-72
D+	1.30	67-69
D	1.00	60-66
F	0.00	59 or less; failure; no credit earned
W	0.00	Withdrawal from course by student within withdrawal period
NW	0.00	Non-participation withdrawal grade assigned by instructor within withdrawal period
P	0.00	Pass; credit earned
I	0.00	Incomplete, in non-punitive period
AU	0.00	Audit; no credits earned

If there is a student in this class who has needs because of a documented learning disability or is Deaf or Hard of Hearing, please feel free to come to discuss this with me and/or directly contact the appropriate office below:

- Learning Accommodations Center, Behrakis One-Stop Student Services Center, SC-111 (978) 556-3654 serving students with physical disabilities, ADHD, learning disabilities, brain injury, blind or low vision and also psychiatric disabilities (through the Supported Education Program)
- Deaf and Hard of Hearing Services: (978) 556-3658(voice) or (978) 556-3673 [TTY].

DELAYED OPENING/LATE START:

If a delayed opening is announced over the television or radio, the classes scheduled before the delayed start time are cancelled. Classes beginning after the start time are held. Please contact the School Announcements number at [Redacted] or [Redacted] [TTY] for further information.

Instructor's Note: The instructor reserves the right to make changes to this syllabus at any time during the semester. A new syllabus may or may not be distributed at the discretion of the instructor.

Topical Course Outline and Assignment Schedule (odd problems only)

<u>WEEK</u>	<u>SECTION</u>	<u>TOPICS</u>	<u>ASSIGNED PROBLEMS</u>
1	1.1	Introduction to Graphing	p. 75: #1-89
	1.1	Circles	p. 77: #93-129
	1.2	Functions and Graphs	p. 91: #1-83
	1.3	Linear Functions, Slope, and Applications	p. 110: #1-77
	1.4	Equations of Lines and Modeling	p. 124: #1-57
2	1.4	Equations of Lines and Modeling	p. 125: #61-71 odd
	1.5	Linear Equations, Functions, Zeros, and Applications	p. 143: #1-57
	1.5	Linear Equations, Functions, Zeros, and Applications	p. 146: #61-109
	1.6	Solving Linear Inequalities	p. 154: #1-33
	1.6	Solving Linear Inequalities	p. 154: #37-45 odd
3		Sample Test #1 & EXAM # 1 – Chapter 1	
	2.1	Increasing, Decreasing, and Piecewise Functions; Applications	p. 175: #1-41
	2.1	Increasing, Decreasing, and Piecewise Functions; Applications	p. 178: #45-73
	2.2	The Algebra of Functions	p. 187: #1-65
4	2.3	The Composition of Functions	p. 196: #1-25
	2.3	The Composition of Functions	p. 197: #29-41
	2.4	Symmetry and Transformations	p. 214: #1-57
	2.4	Symmetry and Transformations	p. 215: #61-129
5	2.5	Variation and Applications	p. 224: #1-39 odd
	3.1	The Complex Numbers	p. 242: #1-81
	3.2	Quadratic Equations, Functions, Zeros, and Models	p. 257: #1-121
6	3.3	Analyzing Graphs of Quadratic Functions	p. 272: #1-53
	3.4	Solving Rational Equations and Radical Equations	p. 282: #1-85
	3.5	Solving Equations and Inequalities with Absolute Value	p. 287: #1-61

7		Sample Test #2 & EXAM # 2 - Chapter 2 & 3	
	5.1	Inverse Functions	p. 389: #1-101
	5.2	Exponential Functions and Graphs	p. 403: #1-89
	5.3	Logarithmic Functions and Graphs	p. 423: #1-97
8	5.4	Properties of Logarithmic Functions	p. 433: # 1-73
	5.5	Solving Exponential and Logarithmic Equations	p. 444: #1-65
	5.6	Applications and Models: Growth and Decay; Compound Interest	p. 455: #1-33
9	6.1	The Trigonometric Functions	p. 482: #1-101
	6.2	Applications of Right Triangles	p. 492: #1-37
	6.3	Trigonometric Functions of Any Angle	p. 511: #1-105
10	6.4	Radians, Arc Length, Angular Speed	p. 526: #1-77
	6.5	Circular Functions; Graphs and Properties	p. 544: # 1-53
11	6.6	Graphs of Transformed Sine and Cosine Functions	p. 562: #1-65
		Sample Test #3 & EXAM # 3 – Chapter 5 & 6	
12	9.1	Systems of Equations in Two Variables	p. 731: #1-73
	9.2	Systems of Equations in Three Variables	p. 742: #1-37
13	9.3	Matrices and Systems of Equations	p. 754: #1-41
	9.4	Matrix Operations	p. 764: #1-45
	9.5	Inverses of Matrices	p. 773: #1-41
14	9.6	Determinants and Cramer's Rule	p. 782: #1-41
	9.7	Systems of Inequalities and Linear Programming	p. 793: #1-77
	9.8	Partial Fractions	p. 803: #1-25
15		Sample Test #4 & EXAM # 4 – Chapters 9	
		Final Exam	