

CALCULATOR PROGRAMMING: Course of Studies for a Thirty Hour Course

This course of studies based on the book, *Inside Your Calculator* (hereafter *IYC*), is designed for a series of 30 one hour classes. Its goals for participating students include:

- Gain experience and expertise with calculator functioning
- Learn to associate mathematical ideas with calculating processes
- Learn to program calculators to solve significant problems
- Gain understanding of how calculators process information
- Review and extend the ideas of pre-calculus mathematics
- Gain appreciation for the power of calculators

The contents for course reading assignments are all in the text *IYC* or on the website:

www.buffalo.edu/~insrisg/InsideYourCalculator.

Homework exercises and practice tests are also found on that website or may be accessed directly from:

www.acsu.buffalo.edu/~insrisg/LINKS/Exercises.htm.

Testing

A few words about tests are in order. One of the problems students have with tests, especially in a course from an instructor with whom they are unfamiliar, is that they have no idea what to expect. I cannot include test exercises here because this is an open file and students could simply download them. I am, however, developing a series of *practice* tests that should, if you follow their format reasonably, serve two purposes:

1. They provide a model for your own tests.
2. They expose the students to the kind of questions you will be asking, thus giving them a basis for their review of the material covered.

I suggest that, when you announce an upcoming test, you encourage students to use the associated practice test in their preparation. You should consider also adding questions that more nearly suit your personal course goals. Then you may even include a few of the same questions on your class test to reinforce the value of student review with the practice exams.

I recommend, especially early in the course, asking very straightforward questions on these tests in order to give your students confidence as well as to provide you insight into basics that they have not yet mastered.

Finally, we teachers usually think of tests as a means of ranking students. An at least equally important value of tests is your use of them to modify your instruction. If your students are almost all failing to answer specific questions, that should indicate areas you should take into account, for example, through review.

Now we can turn to the organization of your course. The syllabus that follows should serve only as an outline that you should modify to suit your interests and goals and the specific interests and goals of your students.

Course Syllabus

This syllabus is based on the author's experiences working with this content and these calculators. It should be modified to suit your local conditions.

Session 1. Introduction

Class activities: Inventory student calculators. Basic key access (use some of the examples from Chapter 1 exercise 1. See Homework exercises.) Calculator control structures (Appendix A pages 183-185). Introduce the *IYC* website and its use:

www.acsu.buffalo.edu/~insrisg/InsideYourCalculator.htm

Assigned reading: Appendix A. Students with TI-89, TI-92 or Casio calculators should download the substitute Appendix A from the *IYC* website and study that substitute.

Homework exercises: Chapter 1 exercises 1-2.

Session 2. Communicating with Your Calculator: 1

Class activities: Calculator keys as black boxes. How to enter, edit and run a simple program (use the COSDEG example of *IYC* page 9.) Go over Chapter 1 exercise 7.

Assigned reading: Chapter 1.

Homework exercises: Chapter 1 exercises 3-6.

Session 3. Communicating with Your Calculator: 2

Class activities: Introduce exercises 8 and 9 (to be on homework) and work on exercise 10.

Assigned reading: Chapter 2, pages 19-25.

Homework exercises: Chapter 1 exercises 8, 9.

Session 4. Algorithms and Programs: 1

Class activities: The use of `Disp` and `Pause` in a program to display information while the program is running. Introduce integer division.

Assigned reading: Chapter 2, pages 25-31.

Homework exercises: Chapter 2 exercises 1-3.

Session 5. Algorithms and Programs: 2

Class activities: Introduce binary numeration.

Assigned reading: Chapter 2, pages 31-39.

Homework exercises: Chapter 2 exercises 4 and 5. (Be sure to read the text that precedes exercise 5.)

Session 6. Algorithms and Programs: 3

Class activities: Work out the algorithms for conversion between binary and decimal. Begin work on Chapter 2 exercise 6.

Assigned reading: Appendixes B and E.

Homework exercises: Chapter 2 exercises 6 and 7a. Review for Quiz 1.

Session 7. Integer Powers: 1

Class activities: Quiz 1. Work on Chapter 2 exercises 7b and c. Discuss the rules for

processing powers $a^x \times a^y = a^{x+y}$, $a^x \div a^y = a^{x-y}$, $a^x \times b^x = (ab)^x$, $a^0 = 1$, etc. Introduce duplication and mediation (pages 44-46.)

Assigned reading: Chapter 3 pages 40-46.

Homework exercises: Chapter 3 exercises 1-4.

Session 8. Integer Powers: 2

Class activities: Return and review Quiz 1. Introduce the programs POSIPOW (page 41) and QINTPOW (page 44).

Assigned reading: Finish Chapter 3.

Homework exercises: Chapter 3 exercises 5-7.

Session 9. Integer Powers: 3

Class activities: Develop the program of Appendix L.

Assigned reading: Appendix T (from the website)

Homework exercises: Chapter 3 exercises 8,9.

Session 10. Integer Powers: 4

Class activities: Develop the program of Appendix T.

Assigned reading: Chapter 4 pages 51-60.

Homework exercises: Chapter 4 exercises 2-4.

Session 11. Square Root: 1

Class activities: The old school square root algorithm (pages 51-60). Develop the program of Appendix U.

Assigned reading: Appendix U, Chapter 4 pages 60-67.

Homework exercises: Chapter 4 exercises 1, 5.

Session 12. Square Root: 2

Class activities: Newton's Method: program and proof.

Assigned reading: Chapter 4 pages 68-72.

Homework exercises: Write a brief summary why the Newton's Method program works.

Review for Quiz 2.

Session 13. Square Root: 3

Class activities: Quiz 2. Recursive solution of equations. Use Chapter 4 exercise 7.

Assigned reading: Chapter 5 pages 73-77.

Homework exercises: Chapter 4 exercise 6, Chapter 5 exercises 1 and 2.

Session 14. Rational Powers: 1

Class activities: Return and review Quiz 2. Programs to calculate rational powers. Tracing programs (begin Chapter 5 exercise 4.)

Assigned reading: Chapter 5 pages 77-83.

Homework exercises: Review for Midterm Exam

Session 15. MIDTERM EXAM

Homework Exercises: Chapter 5 exercises 3-5.

Session 16. Rational Powers: 2

Class activities: Return and review Midterm Exam. Continue work on tracing programs (using Chapter 6 exercise 5.)

Assigned reading: Chapter 6 pages 84-90.

Homework exercises: Chapter 6 exercises 1-5.

Session 17. Logarithms: 1

Class activities: Review logarithm definitions and properties. Show the basic relationship that drives the program for calculating logs: $\log \sqrt{ab} = \frac{\log a + \log b}{2}$; that is, the log of a

Geometric Mean of two numbers is the Arithmetic Mean of the logs of those numbers.

Assigned reading: Chapter 6 pages 90-97.

Homework exercises: Chapter 6 exercises 6 and 7

Session 18. Logarithms: 2

Class activities: Logarithm programs.

Assigned reading: Chapter 6 pages 98-105.

Homework exercises: Chapter 6 exercise 8.

Session 19. Logarithms: 3

Class activities: Construct a slide rule (Chapter 6 exercise 9.)

Assigned reading: Chapter 7

Homework exercises: Chapter 7 exercises 1-5

Session 20. Trigonometry 1

Class activities: Go over the general plan of Archimedes approximation of π .

Assigned reading: Appendix S.

Homework exercises: Chapter 7 exercises 6 and 8.

Session 21. Trigonometry 2

Class activities: Complete Archimedes' procedure.

Assigned reading: Chapter 8 pages 117-124.

Homework exercises: Review for Quiz 3. Chapter 8 exercises 1-3

Session 22. Trigonometry 3

Class activities: Quiz 3. Review the basics of circular functions.

Assigned reading: Chapter 8 pages 124-132.

Homework exercises: Chapter 8 exercises 4 and 5.

Session 23. Trigonometry 4

Class activities: Return and review Quiz 3. Develop the program COSDEG.

Assigned reading: Chapter 8 pages 132-137.

Homework exercises: Chapter 8 exercises 6 and 7.

Session 24. Trigonometry 5

Class activities: Tracing the cosine program. Inverse operations and the ACOSDEG program.

Assigned reading: Chapter 9 pages 138-151.

Homework exercises: Chapter 9 exercises 1-6

Session 25. Complex Numbers and Polar Coordinates

Class activities: Introduce complex numbers, polar coordinates and the $r \text{ cis } \theta$ notation.

Assigned reading: Chapter 9 pages 151-158.

Homework exercises: Chapter 9 exercises 7-10

Session 26. CORDIC

Class activities: Go over the CORDIC program carefully.

Assigned reading: Chapter 10 pages 163-168.

Homework exercises: Chapter 9 exercise 11.

Session 27. CORDIC and Graphing

Class activities: Complete work on CORDIC. Introduce the calculators' graphic screen.

Assigned reading: Chapter 10 pages 168-175.

Homework exercises: Review for Quiz 4. Chapter 10 exercises 1-4

Session 28. Graphing

Class activities: Quiz 4. Graphing problems. Introduce random numbers

Assigned reading: Appendix V.

Homework exercises: Chapter 10 exercise 5, Additional Programming Exercise 23.

Session 29. Graphing and Random Numbers

Class activities: Return and review Quiz 4. Random numbers (using homework). Review for Final Examination

Session 30. FINAL EXAMINATION