Southern Connecticut State University

MAT 140–Computational Tools for Mathematics and the Sciences

## Description

* 1. **Catalog Description**: Introduction to computer software as it may be used in the mathematical and scientific disciplines. Includes selected topics from: uses of spreadsheets, computer algebra, interactive geometry, vector graphics, document preparation, modeling, and computational mathematics.
  2. **Expanded Description**: Students will solve a large number and variety of routine and exploratory problems related to mathematics and the sciences using appropriate computer software. The mantra “use the right tool for the job” will echo throughout the course. The focus of the course will be on how and when to use various computational tools. While most of the problems will be motivated by the desire to answer a practical question, certain questions will be motivated solely out of mathematical curiosity. Questions will be drawn from algebra, statistics, geometry, numerical methods, discrete math, and related applications.

## Credit

* 1. MAT 140 carries three (3) semester hours of college credit.
  2. MAT 140 satisfies the Tier I technological fluency requirements.

## Prerequisite

The prerequisite is one of MAT 100, MAT 102, or placement beyond these courses. Specifically, competency in high school algebra is required.

## Format

* 1. MAT 140 is a hands-on course that will be equal parts lecture and laboratory exploration.

Should be taught in a computer lab

* 1. A laptop computer is recommended.

## Technological Fluency Components

1. Tier 1 tech fluency learning outcomes are indicated in bold throughout the outline and pertain to the LEP document and the university tech fluency affinity group checklist.
2. Instructors have numerous ways to include embedded competencies. The most direct is **critical thinking**, as problem solving is at the core of almost all areas of the course. Examples of such competencies are found as students identify theorems in the discovery with geometric software and analyze data sets with spreadsheet. The embedded competencies are not limited to critical thinking as it is expected instructors will incorporate **information literacy** and **interpersonal effectiveness** throughout the course with document preparation skills.
3. Depending on the data sets and models the instructor uses within the course, students might experience any of the discussion of values throughout the course. However it is inescapable for the course to not discuss **rational thought** through problem solving and analysis of computer based outputs in each of the areas of the course.

## Outline

The specific competencies that will be discussed are

* 1. Document Preparation (throughout the course, but concentrated during a contiguous 10% of the course)
     1. Typesetting mathematics **I.abcf II.a**
     2. Format and structure of memoranda, reports, classroom materials, journal articles, presentations, etc. that include mathematical content **I.abcdef II.a III.a IV.a**
     3. Produce and edit graphical content appropriate for inclusion in a mathematical document **I.abcf II.a III.a**
     4. Technology to enhance presentations **I.c, III.a**
  2. Symbolic computer algebra (25%)
     1. Exact computation **II.a**
     2. Simplifying algebraic expressions **II.a**
     3. Solving equations **II.a**
     4. Graphing functions of one variable **I.f II.a**
     5. Use the skills listed above to solve word problems **IV.a**
     6. Storing and recalling functions; use of functions for stored list **I.d**
  3. Spreadsheets (25%)
     1. Visualizing data sets **I.ef**
     2. Basic statistical computations and their meanings **IIa.**
     3. Exploration of applied discrete mathematical systems such as consumer loans and population dynamics **IV.a**
  4. Interactive Geometry (20%)
     1. Geometric constructions **II.a**
     2. Theorem discovery through interaction and analysis
     3. Demonstrations
  5. Vector graphics (20%)
     1. Creating graphs of functions **I.f II.a**
     2. Creating diagrams **I.f II.a**
     3. Exporting from a drawing program (e.g. figures and graphs) **II.a**
     4. Importing graphics into a report or other document **I.f II.a**

## Goals

* 1. Communicate mathematical ideas effectively, and explain mathematics both verbally and in writing.
  2. Demonstrate the ability to use and understand multiple representations (including graphical, numerical and analytical) of mathematical concepts.
  3. Understand and appreciate connections among different areas of mathematics and with other disciplines.
  4. Utilize appropriate technology to develop models for solving problems and analyzing new situations.
  5. Create vector graphics of functions and other figures.
  6. Understand the difference between a mathematical model and the real-world.
  7. Understand the uses and limitations of a mathematical model.

## Outcomes

Students passing MAT 140 should be able to do each of the following tasks.

* 1. Determine which computational tool is the most appropriate to use for a given task.
  2. Create histograms and boxplots, and calculate basic statistical measures using a spreadsheet.
  3. Complete basic algebraic manipulations using a computer algebra system.
  4. Write about mathematics using a mathematical typesetting engine.
  5. Understand the difference between raster and vector graphics, and when and how to use each.
  6. Create geometric constructions electronically.
  7. Use interactive geometry to discover geometric relationships.
  8. Demonstrate competency in production of graphics suitable for insertion into other documents.

## Waiver Policy

There is no waiver policy for MAT 140.

1. **Preparation and Approval** Prepared on 28 April 2015. Modified on 12 October 2018 Approved by the MDCC on . Approved by the department on .

## Preparers

Prepared by Leon Brin and Joseph Fields Modified by Braxton Carrigan,

# **LEP Course Proposal**

**MAT 140–Computational Tools for Mathematics and the Sciences**

1. **Course Information**
   1. Department: Mathematics
   2. Course Code & Number: MAT 140
   3. Course Title: Computational Tools for Mathematics and the Sciences
   4. Course Description: Introduction to computer software as it may be used in the math- ematical and scientific disciplines. Includes selected topics from: uses of spreadsheets, computer algebra, interactive geometry, vector graphics, document preparation, modeling, and computational mathematics.
   5. Prerequisite: MAT 100
   6. Recommended Textbook:
   7. Date course planned to be first offered:

# **Rational for Course**

To give mathematics majors or students who have an interest in mathematical subjects a Tier 1 Technological Fluency course that was more oriented towards using mathematical software.

# **Learning Objectives**

* 1. Communicate mathematical ideas effectively, and explain mathematics both verbally and in writing.
  2. Demonstrate the ability to use and understand multiple representations (including graphical, numerical and analytical) of mathematical concepts.
  3. Understand and appreciate connections among different areas of mathematics and with other disciplines.
  4. Utilize appropriate technology to develop models for solving problems and analyzing new situations.
  5. Create vector graphics of functions and other figures.
  6. Understand the difference between a mathematical model and the real-world.
  7. Understand the uses and limitations of a mathematical model. Students passing MAT 140 should be able to do each of the following tasks.

1. Determine which computational tool is the most appropriate to use for a given task.
2. Create histograms and boxplots, and calculate basic statistical measures using a spreadsheet.
3. Complete basic algebraic manipulations using a computer algebra system.
4. Write about mathematics using a mathematical typesetting engine.
5. Understand the difference between raster and vector graphics, and when and how to use each.
6. Create geometric constructions electronically.
7. Use interactive geometry to discover geometric relationships.
8. Demonstrate competency in production of graphics suitable for insertion into other docu- ments.

# **Meeting LEP Tier 1 Technological Fluency Requirements**

1. **Course Schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| Week | Weekly Schedule | TF Key Elements /  Embedded Competen- cies | Learning Activities /  Assessment Activities |
| 1 | Typesetting mathematics I.abcf II.a For-  mat and structure of memoranda, reports, classroom materials, journal articles, pre- sentations, etc. that include mathemat- ical content I.abcdef II.a III.a IV.a Pro- duce and edit graphical content appropri- ate for inclusion in a mathematical docu- ment I.abcf II.a III.a |  | **learning activities:**  In-class activities and lessons, hands-on exer- cises **assessment ac- tivities:** Projects, dis- cussions and quizzes |
| 2 | Typesetting mathematics I.abcf II.a For-  mat and structure of memoranda, reports, classroom materials, journal articles, pre- sentations, etc. that include mathemat- ical content I.abcdef II.a III.a IV.a Pro- duce and edit graphical content appropri- ate for inclusion in a mathematical docu- ment I.abcf II.a III.a |  | **learning activi-**  **ties: assessment activities:** |
| 3 | Technology to enhance presentations I.c,  III.a |  | **learning activi-**  **ties: assessment activities:** |
| 4 | Exact computation II.a |  | **learning activi-**  **ties: assessment activities:** |
| 5 | Simplifying algebraic expressions (CAS)  II.a |  | **learning activi-**  **ties: assessment activities:** |

|  |  |  |  |
| --- | --- | --- | --- |
| Week | Weekly Schedule | TF Key Elements /  Embedded Competen- cies | Learning Activities /  Assessment Activities |
| 6 | Solving equations II.a Graphing functions  of one variable I.f II.a |  | **learning activi-**  **ties: assessment activities:** |
| 7 | Use the skills listed above to solve word  problems IV.a |  | **learning activi-**  **ties: assessment activities:** |
| 8 | Storing and recalling functions; use of func-  tions for stored list I.d Visualizing data sets I.ef |  | **learning activi-**  **ties: assessment activities:** |
| 9 | Basic statistical computations and their  meanings IIa. |  | **learning activi-**  **ties: assessment activities:** |
| 10 | Exploration of applied discrete mathemat-  ical systems such as consumer loans and population dynamics IV.a Geometric con- structions II.a |  | **learning activi-**  **ties: assessment activities:** |

|  |  |  |  |
| --- | --- | --- | --- |
| Week | Weekly Schedule | TF Key Elements /  Embedded Competen- cies | Learning Activities /  Assessment Activities |
| 11 | Theorem discovery through interaction and analysis. Demonstrations using inter- active geometry |  | **learning activi-**  **ties: assessment activities:** |
| 12 | Creating graphs of functions I.f II.a Creat-  ing diagrams I.f II.a |  | **learning activi-**  **ties: assessment activities:** |
| 13 | Exporting from a drawing program (e.g.  figures and graphs) II.a Importing graphics into a report or other document I.f II.a. |  | **learning activi-**  **ties: assessment activities:** |
| 14 | A very light introduction to more advanced mathematics using numerical computing  e.g. MATLAB covering e.g. numeri- cal analysis, discrete mathematics, compu- tational mathematics, random processes.  III.a |  | **learning activi-**  **ties: assessment activities:** |
| 15 | A very light introduction to more advanced mathematics using numerical computing  e.g. MATLAB covering e.g. numeri- cal analysis, discrete mathematics, compu- tational mathematics, random processes.  III.a |  | **learning activi-**  **ties: assessment activities:** |

1. **Assessment of Student Learning** Students will be assessed according to the above course schedule table.