SYLLABUS FOR MATH 1101
Mathematical Modeling

Course Description

This course is an introduction to mathematical modeling based on the use of elementary functions to describe and explore real-world phenomena and data. Linear, exponential, logarithmic, and polynomial function models are examined closely and are applied to real-world data in course assignments and projects. Other function models may also be considered. Throughout the course, computational tools (graphing calculators, spreadsheets, etc.) are used to implement, examine, and validate these models. Students are expected to actively engage in the modeling process by questioning phenomena, collecting or creating data, and using computational tools to develop their models and evaluate their efficacy.

This course is not designed to prepare students for MATH 1113 or other math courses.

Course Materials

1. *Functions, Data, and Models*, Gordon and Gordon, The Mathematical Association of America, 2010 (ISBN-10: 0-8838-5767-7; ISBN-13 978-0-88385-767-0).
2. A Texas Instruments graphing calculator, either TI-83 or TI-84, is required.

Teaching Materials on eLC

Instructors can find lecture notes/slides, homework assignments that can be assigned as auto-graded eLC quizzes, unit reviews with practice problem sets, sample project assignments, etc. on the eLC course site "MATH 1101 Teaching Materials".

Course Outline

The course is divided into 4 units.

I. Functions; modeling with linear functions (Chapter 2 & Chapter 3 Sections 3.1 – 3.3.
   a. Function definition; domain and range
   b. Functions described by tables, graphs and formulas
   c. Increasing and decreasing functions; local and absolute extrema
   d. Concavity; inflection points
   e. Average rate of change
   f. Linear functions with applications
   g. Slope-intercept and point-slope forms
   h. Piecewise-linear functions with applications

II. Linear regression; modeling with exponential functions (Chapter 3 Section 3.4 & Chapter 5 Sections 5.1 – 5.2)
   a. Fitting linear models to data
   b. Evaluating model error; the sum of squared errors
   c. Interpreting the correlation coefficient

d. Exponential growth functions with applications
e. Growth factors and rates
f. Doubling time
g. Compound interest
h. Exponential decay functions with applications
i. Decay factors and rates
j. Half-life

III. Additional topics in exponential modeling, modeling with logarithmic functions; linear systems (Chapter 5 Sections 5.3 – 5.5 & Chapter 4 Sections 4.1 – 4.2)
a. Fitting exponential models to data
b. Continuous compounding
c. Continuous growth and decay
d. Newton's law of cooling and heating
e. Logarithmic functions with applications
f. Fitting logarithmic models to data
g. Matrices
h. Representing a system of linear equations with a matrix equation
i. Solving linear systems via matrix equations

IV. Modeling with polynomial functions (Chapter 6)
a. Quadratic functions with applications
b. Projectile motion
c. Maxima and minima applications
d. Fitting quadratic models to data
e. Interpreting the coefficient of determination
f. Polynomial functions of higher degree with applications
g. Polynomial interpolation
h. Fitting cubic and quartic models to data