(Exemplar) Syllabus
Math 115
College Algebra

Contact Information:
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Required Materials: Textbook, scientific or graphing calculator.

Course Description and Objectives:

Catalog Description: Functions including polynomial, rational, exponential, and logarithmic and their graphs including translations, relfections and symmetry. Systems of equations.

Prerequisite: Appropriate placement test score or Math 111 (099).

Math 115 is a Foundational Studies course in the Mathematics category. Upon completion of the Foundational Studies program, you will meet all of the following Foundational Studies Learning Objectives (FSLO).

1. Locate, critically read, and evaluate information to solve problems.
2. Critically evaluate the ideas of others.
3. Apply knowledge and skills within and across the fundamental ways of knowing (natural sciences, social and behavioral sciences, arts and humanities, mathematics and history)
4. Demonstrate an appreciation of human expression through literature and fine and performing arts.
5. Demonstrate the skills for effective citizenship and stewardship.
6. Demonstrate an understanding of diverse cultures within and across societies.
7. Demonstrate the skills to place their current and local experience in a global, cultural, and historical context.
8. Demonstrate an understanding of the ethical implications of decisions and actions.
9. Apply principles of physical and emotional health to wellness.
10. Express themselves effectively, professionally, and persuasively both orally and in writing.

Math 115 meets two of the general Foundational Studies Learning Objectives: locate, critically read, and evaluate information to solve problems, and apply knowledge and skills within and across the fundamental ways of knowing (particularly mathematics). In addition, there are three Applied Skills Learning Objectives (ASLO) that will be met in each Foundational Studies Course:

1. Developing critical thinking skills

2. Developing information literacy skills
3. Including a graded writing component

The mathematics category does not require a graded writing component.

Finally, this course meets the specific Learning Objectives for the Mathematics (MLO) category of Foundational Studies:

1. Solve for multiple unknowns from available information using appropriate methods
2. Represent and solve real-world problems employing appropriate mathematical models;
3. Answer questions using advanced mathematical techniques; and
4. Interpret and explain the results of advanced mathematical analysis.

Advanced mathematical techniques and advanced mathematical analysis refers to techniques at the level of a college-level algebra or trigonometry course. Since this course is College Algebra, the mathematical techniques and analysis that you will be learning satisfy this requirement.

You will meet these learning objectives through both the content and the homework assignments you will complete. The exams are used to assess your knowledge of the content and assess the level at which you have met the learning objectives for the course. You will develop critical thinking skills through solving application problems. The mathematical content of the course, sample problems, and the specific learning objectives met are listed in the tentative schedule.

Course Requirements and Grading:

Homework Quizzes: I will assign homework regularly. Although I will not collect the homework, I will give a short quiz with problems taken directly from homework each day. You will be able to use the homework you have completed during the quiz. This component will be worth 25% of your course grade. I will drop your two lowest quiz scores. I will NOT give make-up quizzes.

The homework assigned will help you meet all of the learning objectives of the course. As you complete homework you will solve for multiple unknowns from available information using methods appropriate to the problem. Some of these problems will be purely computational in nature; i.e. will ensure that you “practice” algebraic manipulations that are necessary to the more advanced techniques and applications. Others will be “story problems” requiring you to critically read and evaluate information in order to solve the problem. Many of these types of problems will be real-world problems requiring the application of a mathematical model to represent the problem. Since this is a college level course, you will need to use advanced mathematical techniques in order to successfully model and solve the type of problems posed. Finally, as part of the solution to the problems, you will need to interpret and explain your solutions. These solutions will result from advanced mathematical analysis at the level of college-level algebra since this is a College Algebra course. It is through completion of your homework that you will meet the foundational studies learning objectives appropriate to this course.

Exams: I will give three in-class exams during the semester. Each exam will be worth 15% of your course grade. Make-up exams will only be given under extraordinary circumstances and only if I am informed in advance and agree that a make-up is warranted.

Comprehensive Final Exam: I will give a comprehensive final exam at the regularly scheduled final examination time for this course. The final exam will be worth 30% of your course grade.

The exams are given to assess your understanding of the course material and to evaluate your learning.

Attendance: Although attendance is not a weighted portion of your course grade, you are expected to be in class each day on time and prepared. Failure to adhere to these guidelines will result in a reduction in your final grade.

Grading Scale: Following is an approximate grading scale used for this course.

A	93 – 100%
A-	90 – 92%
B+	87 – 89%
B	83 – 86%
B-	80 – 82%
C+	77 – 79%
C	73 – 76%
C-	70 – 72%
D+	67 – 69%
D	63 – 66%
D-	60 – 62%
F	Below 60%

Tentative Weekly Schedule

Weeks 1 & 2: Review of prerequisite material

This will include basic algebraic operations, and the solution of linear and quadratic equations and inequalities.

Weeks 3 & 4: Graphs and Functions

We will combine functions using basic operations and function composition, find inverse functions when they exist, graph functions and graph transformations of functions. These transformations will include translations, reflections, and stretching and shrinking. Although you will have seen some of these topics in your previous mathematics courses, you will acquire a more theoretical and in-depth understanding of functions, their graphs, and their inverses (if they exist). You will be asked to answer complex questions regarding functions and their applications and you will be expected to move fluently between graphical representations, tables, formulas,

and verbal explanations. The skills and understanding you develop here will be applied throughout the remainder of the course. By the end of these two weeks, you will have acquired the skills to solve problems such as:

> An oil well off the Gulf Coast is leaking, with the leak spreading oil over the water's surface as a circle. At any time, *t*, in minutes, after the beginning of the leak, the radius of the circular oil slick on the surface is $r(t) = 4t$ feet. Let $A(r) = \pi r^2$ represent the area of a circle of radius r. Find $(A \circ r)(t)$. Interpret $(A \circ r)(t)$. What is the area of the oil slick after 3 minutes?

and

> Explain how the graph of $y = -2\sqrt{x+2} - 3$ can be obtained from the graph of $y = \sqrt{x}$.

As you solve these sorts of problems, you will be meeting FSLO 1 &3, ASLO 1, and MLO 2, 3 & 4.

Weeks 5, 6, & 7: Polynomial and Rational Functions

You will learn how to graph polynomial and rational functions, find rational and complex zeros, find asymptotes, and apply these to real-world problems that require solving polynomial and rational equations as part of their solution. For example, you will learn to solve problems such as:

> The rational function defined by $d(x) = \frac{8710x^2 - 6940x + 470{,}000}{1.08x^2 - 324x + 82{,}200}$ can be used to accurately model the braking distance for automobiles travelling at *x* miles per hour, where $0 \le x \le 70$.
>
> a. Graph the function and use the graph to estimate *x* when $d(x) = 300$.
> b. Create a table that shows the values of $d(x)$ when *x* is equal to 20, 25, 30, 25, 40, 45, 50, 55, 60, 65, and 70.
> c. If a car doubles its speed, does the stopping distance double or more than double? Explain.
> d. Suppose the stopping distance doubled whenever the speed doubled. What type of relationship would exist between the stopping distance and the speed? Explain.

> Find all the zeros of $f(x)$, given that $f(x) = x^3 + 8x^2 + 25x + 26$.

> The polynomial function defined by $f(x) = \frac{\pi}{3}x^3 - 5\pi x^2 + \frac{500\pi d}{3}$ can be used to find the depth that a ball 10 cm in diameter sinks in water. The constant *d* is the density of the ball, where the density of water is 1. The smallest positive zero of $f(x)$ equals the depth that the ball sinks. Approximate this depth for each material and interpret the results.

a. A wooden ball with $d = .8$
b. A solid aluminum ball with $d = 2.7$
c. A spherical water balloon with $d = 1$

In one study, freshwater mussels were used to monitor copper discharge into a river from an electroplating works. Copper in high doses can be lethal to aquatic life. The table lists copper concentrations in mussels after 45 days at various distances downstream from the plant. The concentration C is measured in micrograms of copper per gram of mussel x kilometers downstream.

x	5	21	37	53	59
C	20	13	9	6	5

a. Make a scatter diagram of the data.
b. Use the regression feature of a calculator to find the best-fitting quadratic function for the data. Graph the function with the data.
c. Repeat part (b) for a cubic function.
d. By comparing graphs of the functions in parts (b) and (c) with the data, decide which function best fits the given data. Explain.
e. Concentrations above 10 are lethal to mussels. Find the values of x (using the cubic model) for which this is the case.

As you solve these sorts of problems, you will be meeting FSLO 1 & 3, ASLO 1 & 2, and MLO 2, 3 & 4.

Weeks 8, 9, 10, & 11: Exponential and Logarithmic Functions

You will learn properties of these functions that you will use to graph these functions, solve equations involving these functions, and apply these functions to real-world applications such as compound interest, population growth, and radioactive decay. For example, you will learn to solve problems such as:

In 2000, India's population reached 1 billion, and in 2025 it is projected to be 1.4 billion.

a. Find values for P_0 and a so that $f(x) = P_0 a^{x-2000}$ models the population of India in year x.
b. Estimate India's population in 2010.
c. Use the model to determine the year when India's population might reach 1.5 billion.

In the central Sierra Nevada Mountains of California, the percent of moisture that falls as snow rather than rain is modeled reasonably well by the function defined by

$p(h) = 86.3 \ln h - 680$, where h is the altitude in feet, and $p(h)$ is the percent of snow. This model is valid for $h \geq 3000$. Find the percent of snow that falls at the following altitudes.

a. 3000 ft
b. 4000 ft
c. 7000 ft

Suppose an Egyptian mummy is discovered in which the amount of carbon 14 present is only about one-third the amount found in living human beings. About how long ago did the Egyptian die? Explain.

The height of a certain tree in feet after x years is modeled by the equation $f(x) = 50/(1 + 47.5e^{-.22x})$

a. Make a table for f starting at $x = 10$, incrementing by 10. What appears to be the maximum height of the tree?
b. Graph f and identify the horizontal asymptote. Explain its significance.
c. After how long was the tree 30 feet tall?

Suppose $1,000 is deposited in an account paying 4% interest per year compounded quarterly.

a. Find the amount in the account after 10 years with no withdrawals.
b. How much interest is earned over the 10-year period?

As you solve these sorts of problems, you will be meeting FSLO 1 & 3, ASLO 1 & 2, and MLO 2, 3 & 4.

Weeks 12, 13, & 14: Systems of Equations

You will learn to solve systems of linear equations, understand matrix operations, matrix inverses, solve systems of linear inequalities in two variables, and finally, you will apply this mathematical knowledge to solve real-world problems. Many real-world applications are extremely complex and result in models that cannot be represented using a single equation or inequality. In this section of the course, you will learn to solve problems involving multiple equations. Although you will mainly be dealing with solutions to systems of linear equations and inequalities, this is the first step toward dealing with systems of non-linear equations. For example, you will solve problems such as:

The age distribution in the United States has been steadily shifting. As people live longer, a larger percent of the population is 65 or over and a smaller percent is in younger age brackets. Use matrices to solve the following problems. Let $x = 0$ represent 2000 and $x = 50$ represent 2050.

(1) In 2000, 12.4% of the population was 65 or older. By 2050, this percent is expected to be 20.3%. The percent of the population age 25-34 in 2000 was 14.2%. That age group is expected to include 12.5% of the population in 2050.
   a. Assuming these population changes are linear, use the data for the 65 or over age group to write a linear equation. Then do the same for the 25-34 age group.
   b. Solve the system of linear equation from part (a). In what year will the two age groups include the same percent of the population? What is that percent?

(2) In 2000, 16.0% of the U.S. population was ge 35-44. This percent is expected to decrease to 12.3% in 2050.
   a. Write a linear equation representing this population change.
   b. Solve the system containing the equation from part (a) and the equation from problem (1) for the 65 or older age group. Give the year and percent when these two age groups will include the same percent of the population.

A hospital dietician is planning a special diet for a certain patient. The total amount per meal of food groups A, B, and C must equal 400 g. The diet should include one-third as much of group A as of group B, and the sum of the amounts of group A and group C should equal twice the amount of group B. How many grams of each food group should be included?

To model the spring fawn count F from the adult pronghorn population A, the precipitation P, and the severity of the winter W, environmentalists have used the equation $F = a + bA + cP + dW$ where the coefficients a, b, c, and d must be determined before the equation can be used. Winter severity is scaled between 1 and 5 with 1 being mild and 5 being severe. Answer the following questions:

(1) Substitute the values for F, A, P, and W from the table for Years 1-4 into the equation $F = a + bA + cP + dW$ and obtain 4 linear equations involving a, b, c, and d.

Year	Fawns	Adults	Precipitation (inches)	Winter Severity
1	239	871	11.5	3
2	234	847	12.2	2
3	192	685	10.6	5
4	343	969	14.2	1
5		960	12.6	3

(2) Write an augmented matrix representing the system, and solve for a, b, c, and d.

(3) Write the equation for F using the values found in problem 2.

(4) Use the information in the table to predict the spring fawn count in Year 5. Compare this with the actual count of 320.

A company designs and sells two types of rings: the VIP and the SST. The company can produce up to 24 rings each day using up to 60 total hours of labor. It takes 3 hr to make one VIP ring, and 2 hr to make one SST ring. How many of each type of ring should be made daily in order to maximize the company's profit, if the profit on one VIP ring is $30 and the profit on one SST ring is $40? What is the maximum profit?

All of these problems require that you set up and solve systems of linear equations and inequalities. In solving problems involving systems of linear equations and inequalities, you must solve for multiple unknowns. Therefore you are meeting the following learning objectives as you complete problems during these weeks: FSLO 1 & 3, ASLO 1 & 2, and MLO 1, 2, 3 & 4.

Week 15: Review of Course

This week we will review for the comprehensive final exam you will take during Exam Week.

Class Policies:

Laptop Not Required for Course: Usage Permitted: While there will be no assignments or examinations for which the laptop will be used, your use of a laptop is generally permitted as long as such usage remains within the bounds of the Code of Student Conduct and it conforms to the provisions of its use as laid out in this syllabus. There may be occasions where laptop usage is forbidden and if that occurs, failure to comply with this direction will be viewed as a violation of the Code of Student Conduct.

Academic Honesty: It is imperative that you adhere to standard practices of academic honesty and integrity in this course. I encourage you to review the University's Academic Dishonesty Policy found in the Student Code of Conduct (see http://www.indstate.edu/sjp/docs/code.pdf). A violation of this policy will result in a zero for the assignment or exam in which the violation occurred. Any subsequent violation will result in a grade of F for the course.

Academic Freedom: "Teachers are entitled to freedom in the classroom in discussing their subject, but they should be careful not to introduce into their teaching controversial matter which has no relation to their subject." The preceding comes from the American Association of University Professors statement on academic freedom. Though the entire statement speaks to many issues, it is this portion on conduct of the course that is most relevant. For the purpose of Foundational Studies courses this means that faculty have the right to conduct their class in a fashion they deem appropriate as long as the material presented meets the learning objectives laid out by the entire faculty.
http://www.aaup.org/AAUP/pubsres/policydocs/contents/1940statement.htm

American with Disabilities Act Statement: "Indiana State University seeks to provide effective services and accommodation for qualified individuals with documented disabilities. If you need an accommodation because of a documented disability, you are required to register

with Disability Support Services at the beginning of the semester. Contact the Director of Student Support Services. The telephone number is 237-2301 and the office is located in Gillum Hall, Room 202A. The Director will ensure that you receive all the additional help that Indiana State offers. If you will require assistance during an emergency evacuation, notify your instructor immediately. Look for evacuation procedures posted in your classrooms."