MATH RESEARCH AND PREPARING FOR MATH SUCCESS

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THE INTEGERS

$\ldots -3, -2, -1, 0, 1, 2, 3, \ldots$

THE ADDITIVE BUILDING BLOCK IS 1

What is/are the multiplicative building blocks?

2=2
6=2x3
8=2x2x2
10=2x5
105=3x5x7

The Multiplicative building blocks are primes.

Primes are only divisible by themselves and 1.

How many are there?

How are they distributed? Are there lots of them close together or are they far apart?

Do they have any special shapes or properties?

There are infinitely many primes.

PROOF: Suppose there are only finitely many primes: $2, 3, 5, 7, \ldots, p_n$. Let's multiply them all together: $\mathrm{P} = 2*3*5*7*\cdots*p_n$. This product P is divisible by every single prime!

Let's now consider $\mathrm{P}+1$. Every number has prime factors, so there is some prime l that divides $\mathrm{P}+1$. We listed all the primes earlier, so l must have been in our list. Thus, l divides P and $\mathrm{P}+1$. Hence l divides $(\mathrm{P}+1)-\mathrm{P}=1$. This is a contradiction!

We conclude that making a finite list of all the primes must not have been possible. Therefore, there are infinitely many primes. Q.E.D.

Example: $\boldsymbol{P = 2*3*5 = 30,}$ $\boldsymbol{P+1 = 31}$

MORE QUESTIONS

How are the infinitely many primes distributed?

Can I find big primes that are close to each other? Are there bounded gaps between primes?

2 is the only even prime. (Bad Joke: Because of this 2 is the oddest of all primes.) So, after 2, the closest two primes can be is 2 apart. We call such primes *twin primes.* Are there infinitely many twin primes?

$$1^2 + 1 = 2, \quad 2^2 + 1 = 5, \quad 4^2 + 1 = 17, \quad 6^2 + 1 = 37, \ldots$$

$$2 + 1 = 3, \quad 2 * 3 + 1 = 7, \quad 2 * 3 * 5 + 1 = 31, \quad 2 * 3 * 5 * 7 + 1 = 211, \ldots$$

$$2^2 - 1 = 3, \quad 2^3 - 1 = 7, \quad 2^5 - 1 = 31, \quad 2^7 - 1 = 127, \ldots$$

Mathematical Literacy

- One of the biggest factors impeding student success is a lack of fluency in fundamental mathematical ideas. Students need to understand concepts like **fractions**, **functions**, and **manipulating both sides of an equality with algebra**.

Mathematical Literacy

$$\frac{1}{2}+\frac{1}{5}=???$$

$$\frac{5}{10}+\frac{2}{10}=\frac{7}{10}$$

$1^2+1=2,\quad 2^2+1=5,\quad 4^2+1=17,\quad 6^2+1=37,\ldots\quad (2k)^2+1$

Let $\pi(x)$ be the function that counts the number of primes up to x. How does $\pi(x)$ behave as we vary x?

$2^2-1=3,\quad 2^3-1=7,\quad 2^5-1=31,\quad 2^7-1=127,\ldots\quad 2^p-1$

Mathematical Literacy

- One of the biggest factors impeding student success is a lack of fluency in fundamental mathematical ideas. Students need to understand concepts like **fractions**, **functions**, and **manipulating both sides of an equality with algebra**.

- These concepts need to click. Students who have a deep understanding of these relatively basic concepts have the foundation to do very well in STEM.

Life is richer when you are mathematically literate!

The Math Options at CSUSM

Math at CSUSM

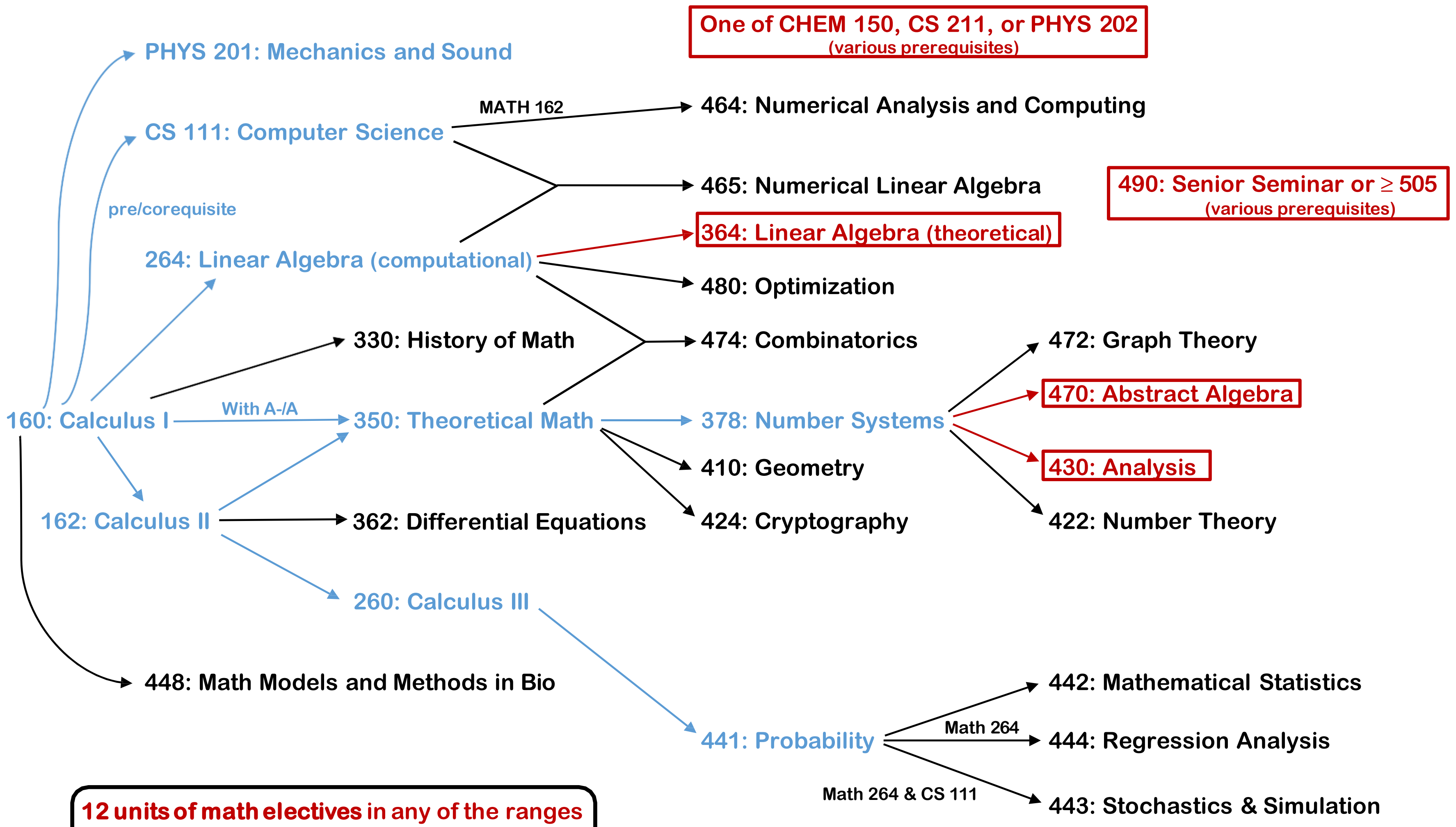
Algorithmic Option: Prepare for data-driven careers, Intertwined with Computer Science

General Option: Graduate School, Flexibility and a focus on mathematical thinking

Applied Option: Work with/in scientific fields, Can focus on Physics, Bio, or Chem.

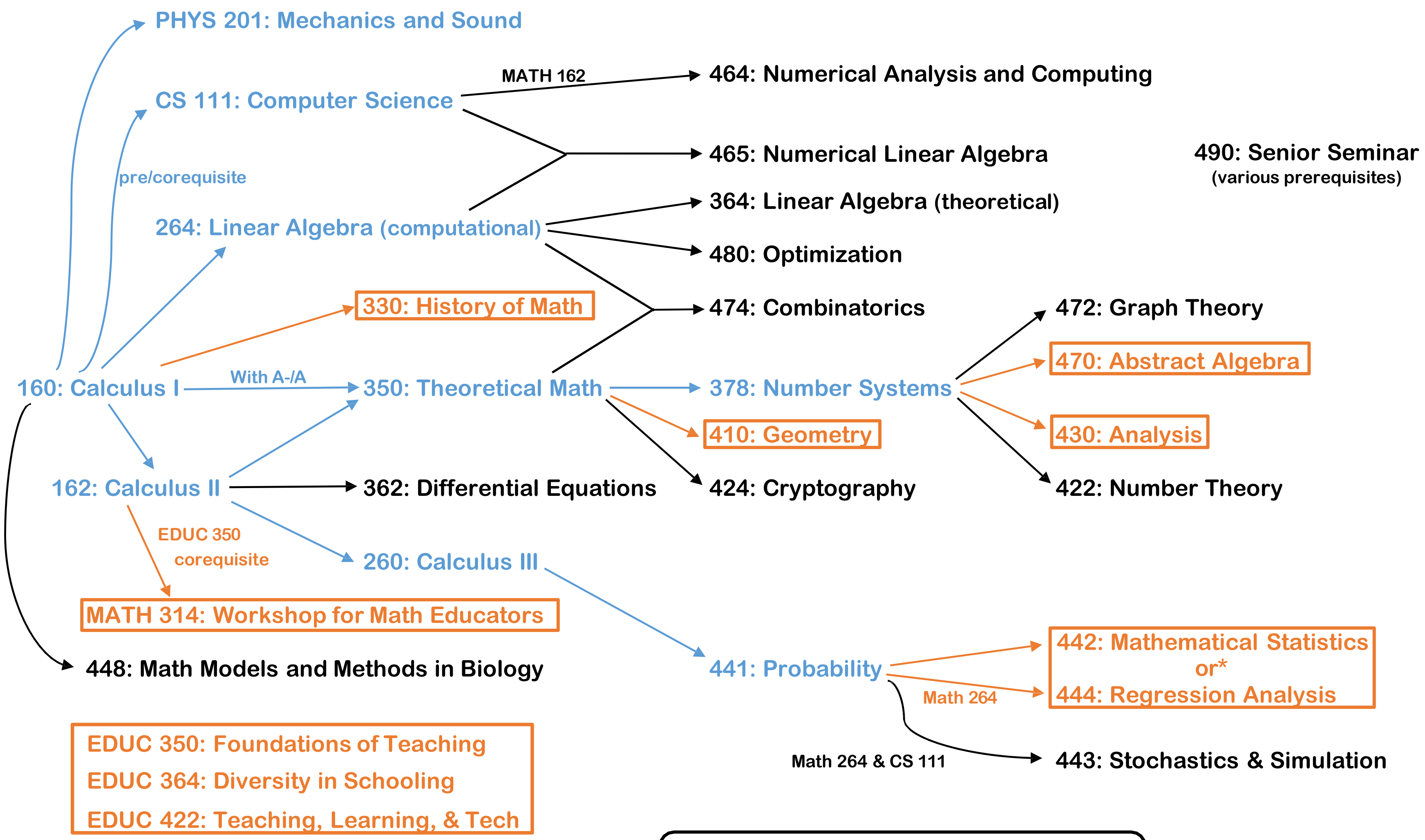
Education Option: Teaching, Focus on pedagogy and foundations

Mathematics Core + General Option + Possible Electives



12 units of math electives in any of the ranges
330, 362, 410–499, or ≥ 505.

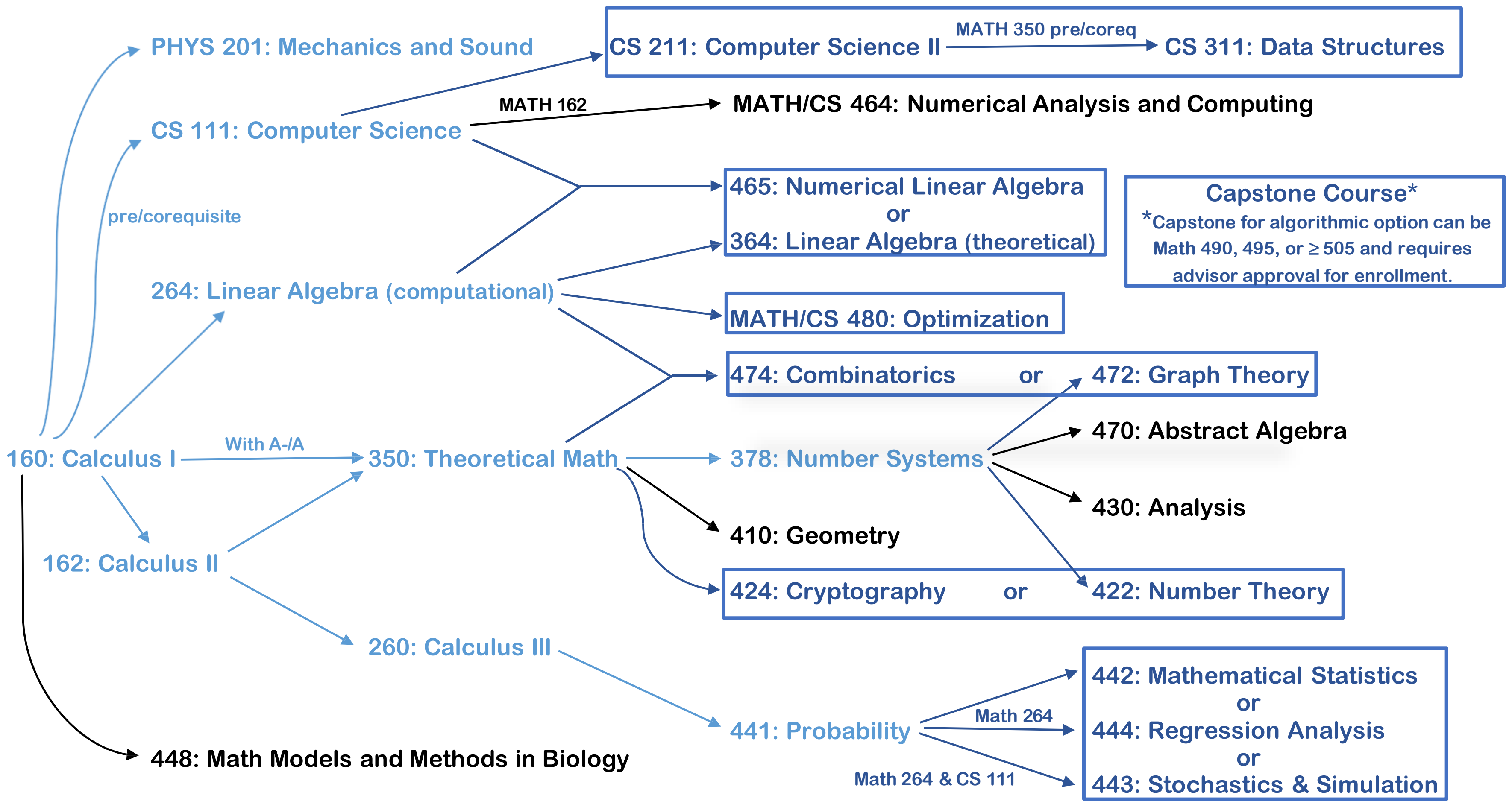
Mathematics Core + Education Option + Possible Electives



Six units of math electives in any of the ranges 350–399, 410–499, or ≥ 505.

*In place of MATH 442/444 students can substitute MATH 242: Stats and an additional 3 units of MATH electives numbering 410–499 or ≥ 505.

Mathematics Core + Algorithmic Option + Possible Electives

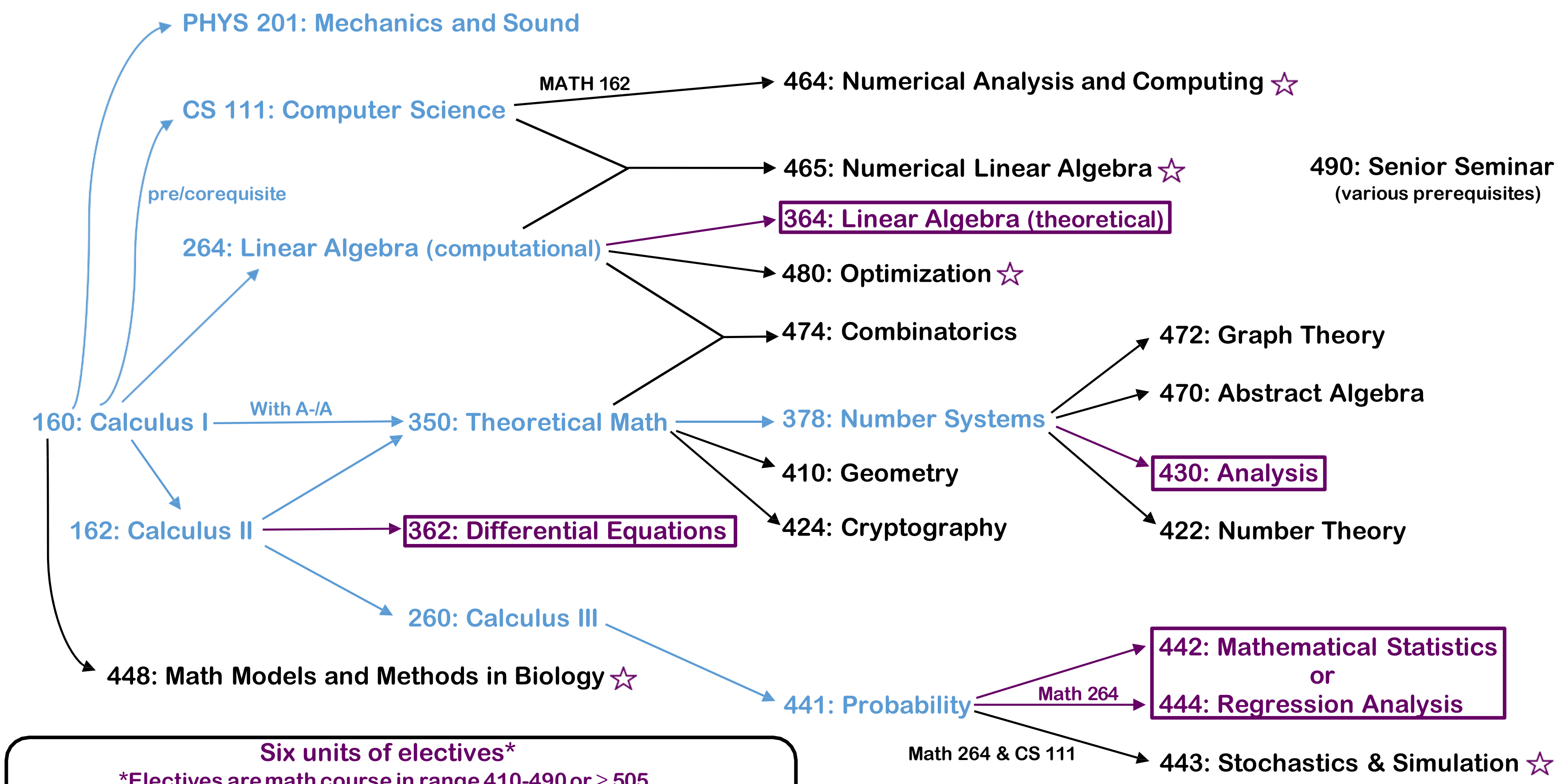


Six units of electives†

†Electives for the algorithmic option are

Math 410-490, Math 505 and higher, and CS 440, 464, 471, 473, and 478.

Mathematics Core + Applied Option + Possible Electives



Six units of electives*

*Electives are math course in range 410-490 or ≥ 505.
With Math advisor approval, Physics emphasis may sub a PHYS course ≥ 400,
and Chem/Bio emphasis may sub a CHEM/BIO course ≥ 400.
☆ Electives must include at least one of Math 443, 448, 464, 465, or 480.

Physics Emphasis†

PHYS 202 (4)
PHYS 203 (4)
PHYS 270 (3)
PHYS 320 or 321 or 323 or 324 (3)

Chemistry/Biology Emphasis†

Chem 150 + Chem 150L (4+1)
Chem 160 (3), Chem 201 + Chem 201L (3+1)
Biol 210 (4)
Biol 211 (4), Biol 212 (3), Biol 215 (4)

†Students choose an emphasis and take 11-13 credits from among the boxed courses. Credits are indicated with parentheses.
Bolded courses are prerequisites, but not all prerequisites are indicated.

California State University
SAN MARCOS

Student Support

Math Department

College of STEM