Note: These are sample topics and problems to help you study for Exam II. This list is not meant to be exhaustive.

1. Know all basic trig identities, including those coming from the Pythagorean theorem, reciprocals, cofunctions and complementary angles.

2. Know how to verify trig equations.
   - Choose the most complicated side of the equation and simplify/manipulate it to look like the other side.
   - Use algebraic techniques, including common denominators, FOIL/distribute, splitting fractions, factoring, and multiplying by a conjugate.

3. Know about the graphs of $y = \sin x$ and $y = \cos x$.
   - Be able to determine the period, domain, range and intercepts.
   - Be able to draw the graphs for at least to cycles and label “key points”.

4. Be able to draw the transformed graphs:
   
   \[ y = A \sin(\omega x - \phi) + B \quad \text{and} \quad y = A \cos(\omega x - \phi) + B \quad (\text{where} \ \omega > 0) \]

   - Be able to determine the period, phase shift, vertical shift, range, domain and amplitude of the transformed function given an equation or given a graph.

   - Amplitude = $|A|$
   - Vertical shift = $B$
   - Period = $T = \frac{2\pi}{\omega}$
   - Phase shift = $\frac{\phi}{\omega}$
   - Be able to write such an equation $y = A \sin(\omega x - \phi) + B$ or $y = A \cos(\omega x - \phi) + B$ given a graph.
5. Know about the graphs of \( z = \sec x \), \( y = \csc x \), \( y = \tan x \) and \( y = \cot x \).

- Be able to determine the domain, range, and vertical asymptotes of each.
- Be able to draw each graph for at least two cycles, labeling “key points” and asymptotes.
- Know about transformations of these graphs, and be able to identify the period, horizontal shift, vertical shift, range, domain and vertical asymptotes of the transformed graph.
- Be able to draw a transformation of each graph given an equation and write a transformed equation given such a graph.
- Remember: Vertical asymptotes are vertical lines and should be written as \( x = c \) where \( c \) is a number.

6. **Simple harmonic motion** is modeled by the equations \( d = A \sin(\omega t) \) and \( d = A \cos(\omega t) \).

- \( d \) represents the distance of the object from its resting position. Units of \( d \) are distance units e.g. feet, meters, etc.
- \( t \) represents time. Units of \( t \) are time units e.g. seconds, minutes, milliseconds, etc.
- Given a simple harmonic motion model, you should be able to determine its maximum displacement, period, frequency, and whether the object starts from rest or from its maximum displacement (up or down).
- Given the maximum displacement, frequency, period and motion at time \( t = 0 \) of such an object, you should be able to write its model equation.
- The maximum displacement of the object from its resting position is the amplitude of the model function, given by \( |A| \). The units of maximum displacement are generally the same distance units as \( d \).
- The time required for one oscillation of the object is the period of the model function, given by \( T = \frac{2\pi}{\omega} \). The units of the time required for one oscillation are generally the same time units as \( t \).
- The number of oscillations per unit of time is the frequency of the moving object and is given by \( f = \frac{\omega}{2\pi} = \frac{1}{\text{period}} \). The units of the frequency are generally units of \( \frac{d}{\text{units of } t} \).
- If an object starts from rest then it is modeled by a sin function. If an object starts from its maximum displacement (up or down) then it is modeled by a cos function.
7. Know the **inverse** trig functions $\sin^{-1}\theta$, $\cos^{-1}\theta$ and $\tan^{-1}\theta$, including the domain and range of each.

8. Know when $f(f^{-1}(x)) = x$ and $f^{-1}(f(x)) = x$ for the three basic trig functions $f(x) = \sin x$, $f(x) = \cos x$ and $f(x) = \tan x$.

   **Sample problem:** Find $\tan(\tan^{-1}(7))$.

9. Be able to calculate $f(g^{-1}(x))$ and $g^{-1}(f(x))$ or determine if such functions are undefined, where $f(x)$ is one of the six basic trig functions and $g(x)$ is one of the three basic trig functions $f(x) = \sin x$, $f(x) = \cos x$ or $f(x) = \tan x$.

   **Sample problems:** Find $\sin(\cos^{-1}(0))$ and $\cot(\sin^{-1}(2))$. Find $\sin^{-1}\left(\cos\left(\frac{11\pi}{4}\right)\right)$.

10. Know how to use the **sum and difference formulas**.

    - $\sin(A + B) = \sin A \cos B + \cos A \sin B$
    - $\sin(A - B) = \sin A \cos B - \cos A \sin B$
    - $\cos(A + B) = \cos A \cos B - \sin A \sin B$
    - $\cos(A - B) = \cos A \cos B + \sin A \sin B$
    - $\tan(A + B) = \frac{\tan A + \tan B}{1 - \tan A \tan B}$
    - $\tan(A - B) = \frac{\tan A - \tan B}{1 + \tan A \tan B}$

   **Sample problem:** Show $\frac{2 \cos(A + B)}{\sin(2A)} = \cos B \csc A + \sin B \sec A$. 
11. Know how to *use* the **double-angle** and **half-angle formulas**.

- \( \sin(2\theta) = 2 \sin \theta \cos \theta \)
- \( \cos(2\theta) = \cos^2 \theta - \sin^2 \theta = 1 - 2 \sin^2 \theta = 2 \cos^2 \theta - 1 \)
- \( \tan(2\theta) = \frac{2 \tan \theta}{1 - \tan^2 \theta} \)

- \( \sin \left( \frac{a}{2} \right) = \pm \sqrt{\frac{1 - \cos(a)}{2}} \)
- \( \cos \left( \frac{a}{2} \right) = \pm \sqrt{\frac{1 + \cos(a)}{2}} \)
- \( \tan \left( \frac{a}{2} \right) = \pm \sqrt{\frac{1 - \cos(a)}{1 + \cos(a)}} \)

- In the half-angle formulas, the + or – sign is determined by the **quadrant** of \( \frac{a}{2} \).

Sample problems: Find the **exact** values of \( \sin \left( \frac{11\pi}{8} \right) \) and \( \tan \left( \frac{\pi}{12} \right) \)