Differential Equations - Advanced Problem Set 10

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Directions: Do the following book problems
NOTE: In the 3rd edition of the book this is chapter 5.6.

Section 5.7 Problem 15

Applied Problem:

The following system of ODS models Anteaters ($A-1$) and Ants (A_2). They are an interacting species since the anteaters eat the ants.

$$\frac{dA_1}{dt} = k_1 A_2 - C$$
$$\frac{dA_2}{dt} = -k_2 A_1 + \cos(2\pi t) + 1$$

Here k_1 is the rate at which an anteater can turn the energy of eating ants into new (baby) anteaters, C is the natural yearly death of our anteaters, k_2 is the rate at which an anteater eats an ant, and the $\cos(2\pi t)+1$ terms is a cyclical birth rate for the ants.

1. From this system of equations, draw the compartmental diagram. This is going backward from what we did in lecture.
2. Write this system of equations in matrix form.
3. Let $k_1 = 1/4$, $k_2 = 1/4$ and $C = 2$.
4. Solve the system of equations using the eigenvalue method and MUC. If you want you can use python but this should be doable by hand.
5. Assume that to start you have $A_1(0) = 10$ and $A_2(0) = 40$, what happens to the system as time goes on? You can plot the solution to see this.

Other Notes: