Assignment 6: Assigned Wed 05/07. Due Wed 05/14

1. **Section 6.8** 1*, 6, 7*, 8, 13
2. **Section 7.1** 9
3. **Section 7.2** 4, 6, 12, 13
4. **Section 7.3** 10
5. **Section 7.5** 7

Assignment 7: Assigned Wed 05/14. Due Wed 05/21

1. **Section 8.1** 6*, 10, 13
2. **Section 8.2** 8, 11, 12
3. **Section 8.3** 2, 3 [If you see this reaction (or a video of it), you know this phenomenon occurs: The transition between colors is rapid, followed by a longer period where the color 'holds'.]
4. **8.7** 2, 3
5. In class, we checked that the fixed point (x^*, y^*) of the oscillating chemical reaction is unstable for b small, and stable for b large. For a Hopf bifurcation, we need to additionally check that this is a spiral. Verify this.

Assignment 8: Assigned Wed 05/21. Due Wed 05/28

1. **Section 9.1** 4
2. **Section 9.2** 1, 2
3. **Section 9.3** 3, 4, 5, 8*, 9
4. **Section 9.5** 5
5. (a) Consider a large (say $10,000$) number of points in a sphere of small radius (say 1) centered at some fixed point (say $(-3, -44, 17)$). Plot on the same graph these points, and the solution of Lorenz equations after long time (say 30 seconds) with the above points as initial data. For clarity, color the initial points blue, and the final points red. [If $10,000$ points takes too long, then try a smaller number of points. Be sure you solve the Lorenz equations for long enough for you to see chaotic behaviour though. With the numbers above, and standard values of b, σ and r, 30 seconds should be plenty.]
   (b) To see the 'contraction in phase space' up close, repeat the previous part but only solve the Lorenz equations for a short amount of time (e.g. 1 second).
6. (a) Numerically solve the Lorenz system with error .001 and .0001 respectively, for *the same initial data*. Plot the (absolute value) of the difference between the two solutions.
   (b) Repeat the above subpart for a non-chaotic ODE (say the Volterra-Lotka system).

Assignment 9: Assigned Wed 05/28. Due Wed 06/04

1. **Section 11.1** 6
2. **Section 11.2** 5c, 6
3. **Section 11.3** 1, 2, 4, 10b
4. **Section 11.4** 5, 7, 8

$\star$ 5. Show that the Serpinsky triangle has zero area. [HINT: Compute the area of the removed triangles]