HOMEWORK ASSIGNMENTS THROUGH WEEK 10
Last update: Wednesday, Nov. 6, 2019.

All assignments are from the required text by Farlow, Hall, McDill and West (except for a few “home-made” problems written right on this sheet). Answers to all problems must be justified—unexplained numerical answers will get no credit. Calculations must be done by hand unless you are given specific instructions to do otherwise. Remember that you are practicing up for the exams.

Week 1 homework due Tuesday, Sept. 10

- Sec. 3.2, pp. 143–145: 5, 6, 8, 12, 13, 14, 16, 19, 21, 22, 26, 30, 33, 34, 73
- In problems 5, 6, 8 supply details of solving the equations as well as “matching.” Use the row operation notation on p. 134 of the text correctly to explain each step of row-reduction needed to reduce the matrices in problems 12, 13, 14, 16, 19, 21, 22 to reduced row echelon form. In 33, 34 we give you a pass to use the \texttt{rref} command on your calculator, but other than that all work must be done by hand. Furthermore, in answering 26, 30, 33, 34 don’t just discuss solutions—find all of them. In the case of more than one solution give the answer in the form demonstrated in Ex. 7 on pp. 139–140.

Week 2 homework due Tuesday, Sept. 17

- Sec. 3.1, pp. 127–130: 2, 4, 5, 6, 7, 12, 14, 18, 22 (Problem 18 is equivalent to Problem 15 of §3.3.)
- Sec. 3.2, pp. 143–145: 1, 2, 4, 66 (To do 66 you may use your calculator to calculate \texttt{rref} but then in case of infinitely many solutions you must write out the set of solutions following the pattern Ex. 7 on pp. 139–140.)
- Sec. 3.4, pp. 164–167: 1, 2, 3, 4, 12, 13, 16, 17, 18, 41, 42 (When/if using row operations, use the notation from p. 134 of the text. In 41 and 42, write out the determinants carefully but then you can evaluate them with your calculator.)
- Problem 15 from Sec. 3.4 is not assigned but you must know what it says.
- Sec. 3.4, pp. 164–167: 46, 50 (“least squares”) The method for solving 50 also works for solving 46 and is easy to remember.
- Sec. 2.2, pp. 70–73: 1, 2, 6, 8, 16, 18 (We use only the integrating factor method to solve first order linear differential equations in this course, meaning: same as Example 2 on p. 69 of the text.)

Week 3 homework due Tuesday, Sept. 24

- Sec. 3.3, pp. 154–156: 1, 2, 6, 7, 10, 13, 14, 20, 21 (Problems 20 and 21 use the important formula $x = A^{-1}b$ which you must know.)
- Sec. 3.3: 15 is not assigned but you must know it!
- Sec. 1.1 (No homework is assigned from this section. But you should know the vocabulary in boxed examples 2 and 3, and know the names of the differential equations in boxed examples 4–8.)
- Sec. 1.2, pp. 20–24: 2, 3, 13, 14
- Sec. 1.3, pp. 29–32: 11, 14, 18, 32, 34
- Sec. 2.2, pp. 70–73: 9, 12, 22, 23, 29, 30
- Sec. 2.4, pp. 84–87: 2(a,c), 3(a,c), 6
Week 4 homework due Tuesday, Oct. 1

- Sec. 1.2, pp. 20–24: 16–21 (matching)
- Sec. 1.3, pp. 29–32: 25–30 (more matching)
- Sec. 2.3, pp. 77–80: 4,5,6,7,17,31,36
- Sec. 2.4, pp. 84–87: 16,18
- Home-made problem 1: Solve the initial value problem

\[
\frac{dy}{dt} = (y + 1)(y - 3), \quad y(0) = 1
\]

and sketch the solution on the same axes with the direction field of the differential equation and the equilibrium solutions. For each equilibrium solution say whether it is stable or unstable. Great accuracy of the sketch is not required but you do have to get the signs of the slopes exactly right.

Week 5 homework due Tuesday, Oct. 8

Midterm I, Oct. 1

- Sec. 4.1, pp. 205–210: 2,3,4,15,16,17,24,25,26,40,41,42,43
- Your answers to 40,41,42,43 should each be justified by relating numerical details of the IVP to features of the graphs using new vocabulary in Sec. 4.1, e.g., period, circular frequency, and so on.

Week 6 homework due Tuesday, Oct. 15

- Sec. 4.2: pp. 222–229: 1,2,3,5,7,11,16,17,19,22
- Sec. 4.3: pp. 238–243: 1,2,3,7,11,12,13,16,64(a,b)
- Ignore the instruction “give a basis...” in 4.3: 1,2,3,7.
- Sec. 3.6: p. 191: 7–11, 64
- You may use the \texttt{rref} button under the “full disclosure” rule for your work in Sec. 3.6 but you must still explain in words how you get your final answers.
- For problem 64 in Sec. 3.6 to speed things up I tell you that the result of reducing the augmented matrix to RREF form is as follows:

\[
\begin{bmatrix}
1 & 0 & 2 & 1 & 3 & 0 \\
0 & 1 & -2 & -3 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0
\end{bmatrix}
\]

Note added Wed., Oct. 9: Dimension is defined to be the number of vectors in the basis. So to answer that part of the question just count!
- There are no problems assigned in the homework like problem 2 on worksheet 9964 but you are nonetheless responsible for this material on tests. We are going to steadily build up skill with complex numbers every week.
Week 7 homework due Tuesday, Oct. 22

• Sec. 4.4, pp. 253–254: 9,11,13,15,21,23,41,44,45,46,47
• Sec. 5.3, pp. 324–326: 1,2,3,4,8,11,12,15,20,22,26,30
• Ignore instruction “sketch eigenspaces.”
• Sec. 5.3 notes:
  – Eigenvalues for 5.3: 20 are 1, 2, 3.
  – Eigenvalues for 5.3: 22 are -1, 0, 0.
  – Eigenvalues for 5.3: 26 are -1, 2, 4.
  – Eigenvalues for 5.3: 30 are 1, 1, 2.
• Ignore the instruction to give the dimension of the eigenspace but for problems 22 and 30 please give a basis for the 0-eigenspace and 1-eigenspace, respectively.
• In general our policy is to supply eigenvalues for three-by-three or larger matrices; we do not ask students to calculate them.

Week 8 homework due Tuesday, Oct. 29

• Sec. 4.6, pp. 270–273: 7,8,12,20,21,22
• In Probs. 7 and 8 don’t forget that the convention in the textbook is that $x > 0$ means $x$ is below the equilibrium point.
• In all cases you can get the particular solution fast using complex numbers!
• Sec. 5.4, pp. 338–341: 25, 27,29,31,33,35,37,38,39,42,44
• Hints:
  – Eigs. for prob. 35 are 0,1,2.
  – Eigs. for prob. 37 are 2,2,3. (The eigenvalue 2 is double.)
  – Eigs. for prob. 38 are 3,3,5. (The eigenvalue 3 is double.)
  – Eigs. for prob. 39 are -4,2,2. (The eigenvalue 2 is double.)
  – Eigs. for prob. 42 are -1,1,5.
  – Eigs. for prob. 44 are 1,2,3.
• Problems 49,50 from Sec. 5.4 are not assigned but you must know what they say.
• Home-made 1: Find matrix powers $A^n$ of the following matrices $A$ copied from the previous part of the homework assignment so that you already know the eigenvalues and eigenvectors:
  $\begin{bmatrix} 12 & -6 \\ 15 & -7 \end{bmatrix}$, $\begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 0 & 1 \end{bmatrix}$
Sec. 6.2, pp. 369–370: 9, 10, 26, 28, 40, 42
- Eigenvalues for problem 40 are 1, 2, 3
- Eigenvalues for problem 42 are -2, 0, 2
- Ignore the instructions to sketch solutions.

Sec. 4.7, p. 282: 31 (This is setup only, no solving.)

Home-made similar to Sec. 4.7: 31:
- Convert each of the following to a system:
  - $y'' + 4y' + 4y = 3t e^{-2t}, y(0) = 5, y'(0) = 2$
  - $y'' + 3y' + 2y = t^2 + 1, y(0) = 2, y'(0) = -4$
  - $2y'' + 10y' + 12y = 4t \sin(3t), y(0) = 1, y'(0) = -2$
- You do not have to solve the IVP’s or the systems.
- Use the formula on p. 202 but use matrix notation and letter choices as explained in class.
- Example: $3y'' + 6y' + 15y = 21 \cos(t), y(0) = -3, y'(0) = 1$ converts to

$$
\begin{bmatrix}
  u' \\
  w' \\
  u(0) \\
  w(0)
\end{bmatrix} = \begin{bmatrix}
  0 & 1 \\
  -5 & -2 \\
  -3 & 1
\end{bmatrix}\begin{bmatrix}
  u \\
  w
\end{bmatrix} + \begin{bmatrix}
  0 \\
  7 \cos(t)
\end{bmatrix},
$$

Week 10 homework due Tuesday, Nov. 12

- §6.5, pp. 401: 16, 17, 18
  - For the problems assigned in §6.5 use undetermined coefficients. (We are not using the method of decoupling in this course.)
  - Eigenvalues for 17 are 1, 1, 3.
  - Eigenvalues for 18 are 1, 2, 3.
- §6.7, pp. 418–419: 4, 6, 12, 17(a, b)
  - For problem 12 in §6.7 use the method of undetermined coefficients. (We are not using the method variation of parameters in this course.)
  - For the particular solution in problem 12 you need to guess $x = (at + b)e^{3t}$ and $y = (ct + d)e^{3t}$ because some multiplying by $t$ is necessary in this problem. This is the only “curveball” on the assignment. (**Update added on Wednesday afternoon, Nov. 6, 2019.**)
  - Problem 17(a, b) does not involve any solving, only setup and reconciling an already-worked-out answer with your setup.
- Home-made: Solve the initial value problem

$$
\begin{bmatrix}
  x' \\
  y' \\
  z'
\end{bmatrix} = \begin{bmatrix}
  1 & 2 & 0 \\
  4 & -5 & -4 \\
  -6 & 10 & 7
\end{bmatrix}\begin{bmatrix}
  x \\
  y \\
  z
\end{bmatrix} + \begin{bmatrix}
  6 \\
  0 \\
  0
\end{bmatrix},
\begin{bmatrix}
  x(0) \\
  y(0) \\
  z(0)
\end{bmatrix} = \begin{bmatrix}
  0 \\
  0 \\
  0
\end{bmatrix}
$$

- §8.1, pp. 474–475: 8, 9, 14, 15, 18, 42, 48, 52
  - For problems 8, 9 in §8.1 you can use the table of indefinite integrals at the end of the textbook but not the table of Laplace transforms. For the rest of the problems you may use the table of Laplace transforms.
- §8.2: pp. 483–484: 5, 6, 9