# EE 16B | Designing Information Devices and Systems II
## Spring 2017

### Calendar

The schedule is tentative and still subject to change.

<table>
<thead>
<tr>
<th>Wk</th>
<th>Date</th>
<th>Lecture Topic</th>
<th>Section</th>
<th>Lab</th>
<th>Homework</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>01/17 Tu</td>
<td>Circuits/Intro</td>
<td></td>
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<tr>
<td></td>
<td>01/19 Th</td>
<td>Circuits - transistors</td>
<td>Section 0B: KVL, KCL, op-amps review</td>
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<tr>
<td>1</td>
<td>01/24 Tu</td>
<td>Circuits - RC transients</td>
<td>Section 1A: Digital logic and number representation</td>
<td>Introduction to Debugging</td>
<td>Homework 1</td>
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<tr>
<td></td>
<td>01/26 Th</td>
<td>Circuits - 2nd order ODEs</td>
<td>Section 1B: RC circuits</td>
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<td>2</td>
<td>01/31 Tu</td>
<td>Circuits – inductors and 2nd order ODEs</td>
<td>Section 2A: 2nd order ODEs</td>
<td>Analog-Digital Converters I</td>
<td>Homework 2</td>
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<td></td>
<td>02/02 Th</td>
<td>Circuits - transfer functions</td>
<td>Section 2B: RLC circuits</td>
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<tr>
<td>3</td>
<td>02/07 Tu</td>
<td>Circuits - filters and bode plots</td>
<td>Section 3A: Complex numbers</td>
<td>Analog-Digital Converters II</td>
<td>Homework 3</td>
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<td></td>
<td>02/09 Th</td>
<td>Circuits – frequency response of filters</td>
<td>Section 3B: Transfer functions</td>
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<tr>
<td>4</td>
<td>02/14 Tu</td>
<td>Circuits - bode plots</td>
<td>Section 4A: Bode plots</td>
<td>Mystery Circuit and Mic Board Assembly</td>
<td>Homework 4</td>
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<td></td>
<td>02/16 Th</td>
<td>Control - state space representation</td>
<td>Section 4B: RLC and transfer function practice</td>
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<tr>
<td>5</td>
<td>02/21 Tu</td>
<td>Control - linearization and stability</td>
<td></td>
<td>Color Organ: Part I</td>
<td>Homework 5</td>
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<td></td>
<td>02/23 Th</td>
<td>Control – stability cont’d</td>
<td>Section 5B: Linearization</td>
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<tr>
<td>6</td>
<td>02/28 Tu</td>
<td>Control – controllability</td>
<td>Section 6A: System stability conditions</td>
<td>Color Organ: Part II</td>
<td>Homework 6</td>
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<td></td>
<td>03/02 Th</td>
<td>Control - state feedback control</td>
<td>Section 6B: Controllability</td>
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<td>7</td>
<td>03/07 Tu</td>
<td>Control – controller canonical form; outputs and observers</td>
<td>Section 7A: Feedback control</td>
<td>Mic Circuit</td>
<td>Homework 7</td>
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<td></td>
<td></td>
<td>Control – observability and observers</td>
<td>Section 7B: Block</td>
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<tr>
<td>Week</td>
<td>Date</td>
<td>Topic</td>
<td>Lecture Material</td>
<td>Homework</td>
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<tr>
<td>0</td>
<td>03/14</td>
<td>SVD – overview</td>
<td>Section 8A: Controller canonical form &amp; observers</td>
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<td>8</td>
<td>03/16</td>
<td>SVD - procedure</td>
<td>Section 8B: SVD</td>
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<td>9</td>
<td>03/21</td>
<td>SVD – geometric interpretation</td>
<td>Introduction to Controls: Part II</td>
<td>Homework 9</td>
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<td>9</td>
<td>03/23</td>
<td>K-means</td>
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<td>10</td>
<td>03/28</td>
<td>Spring break – NO LECTURE</td>
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<td>10</td>
<td>03/30</td>
<td>Spring break – NO LECTURE</td>
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<td>11</td>
<td>04/04</td>
<td>Sampling/Interpolation - polynomial</td>
<td>Introduction to Controls: Part III</td>
<td>Homework 10</td>
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<td>11</td>
<td>04/06</td>
<td>Interpolation and sampling theorem</td>
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<td>12</td>
<td>04/11</td>
<td>Sampling/Interpolation - aliasing and</td>
<td>SVD/PCA</td>
<td>Homework 11</td>
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<td>12</td>
<td>04/13</td>
<td>control</td>
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<td>13</td>
<td>04/18</td>
<td>DFT continued</td>
<td>Advanced Controls</td>
<td>Homework 12</td>
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<td>13</td>
<td>04/20</td>
<td>LTI systems</td>
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<td>14</td>
<td>04/25</td>
<td>LTI systems and DFT</td>
<td>Integration</td>
<td>Homework 13</td>
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<td>14</td>
<td>04/27</td>
<td>Wireless</td>
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<td>15</td>
<td>05/02</td>
<td>Review I</td>
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<tr>
<td>15</td>
<td>05/04</td>
<td>Review II</td>
<td></td>
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**Weekly Schedule**

The weekly schedule includes various classes, lectures, and office hours. Students should consult the schedule for specific times and locations for each event.

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The image contains a detailed weekly schedule with time slots and details for lectures, discussions, and office hours. The schedule is color-coded for easy reference.
Resources

Midterms
Midterm 1 (solutions)

Lecture Videos
Note that you need to be logged into your @berkeley.edu account to view these videos.
Lecture 0A
Lecture 0B
Lecture 1A
Lecture 1B
Lecture 2A
Lecture 2B
Lecture 3A
Lecture 3B
Lecture 4A
Lecture 4B
Lecture 5A
Lecture 6A
Lecture 6B
Lecture 7A
Lecture 7B
Lecture 8A
Lecture 8B

Video Notes
Intro to transistors and digital logic
RC transients
Second-order circuits
Differential equations
Linearization
Observers and observability

Lab
Lab outline and overview
Oscilloscope cheatsheet
Intro to circuits debugging
Controls primer
Project deliverables
Project grading

Circuits
Charge
Current
Voltage
Kirchhoff's laws
Paralleled and series resistors
Voltage and current dividers
Thevenin/Norton equivalent circuits and source transformation

Linear Algebra
Eigenvalues and eigenvectors
Change of basis and diagonalization
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DFT
Interactive guide to the DFT
Another textbook chapter (starts on page 144)
Fourier visualizations

PCA, SVD
SVD flag example A tutorial on PCA
A linear algebra review that concludes with SVD
An article about SVD and its applications
Image processing with the SVD
Visualization of the PCA
Visualization of k-means

Frequency Response and Impedance

Controls
Murray and Aström
Franklin, Powell, and Workman

Policies

Grade Breakdown
- Homework: 10%
- Labs: 30%
- Midterm 1: 15%
- Midterm 2: 15%
- Final: 30%

Homework Party
Every week there will be a "homework party." This is completely optional. GSIs will be present in shifts as will some readers. Students are expected to help each other out, and if desired, form ad-hoc "pickup" homework groups in the style of a pickup basketball game.

Homework Grading
The primary way that the homework will be graded is by yourselves. Homework is always due Wednesdays at 17:00. You need to turn in both your code in the form of an ipynb file and a .pdf file consisting of your written-up solutions that also includes a "printout" of your code.

After the HW deadline, official solutions will be posted online and then you will be expected to read them and enter your own scores and comments for every part of every problem in the homework on a simple coarse scale:
0 = didn't attempt or very very wrong,
2 = got started and made some progress, but went off in the wrong direction or with no clear direction,
5 = right direction and got halfway there,
8 = mostly right but a minor thing missing or wrong,
10 = 100% correct.

Note: all partial credit must be justified with a comment. If you are really confused about how to grade a particular problem, you are given a limited number of "I don't know" skips that you can use on every assignment. You always get at least two, and more if the HW has lots of parts. This is not supposed to be a stressful process and the skips are there to let you not obsess about how to grade any one part.

Your self-grades will be due Friday at 23:59 after the homework deadline and if you don't properly enter any grades by the self-grading deadline, you are giving yourself a zero on that assignment. Just doing the homework is not enough, you have to do the homework, turn it in on time, read the solutions, do the self-grades, and turn them in on time. Unless all of these steps are done, you get a zero for that assignment. We will be dropping your lowest-scored homework from your final grade calculation, so getting a single zero on a HW is not the end of the world.

Just as we encourage you to use a study group for doing your homework, we strongly encourage you to have others help you in grading your assignments while you help grade theirs. This will also help you avoid self-favoritism.

The readers are going to be grading and sending you occasional comments. Because we have reader grades, we will
Just as we encourage you to use a study group for doing your homework, we strongly encourage you to have others help you in grading your assignments while you help grade theirs. This will also help you avoid self-favoritism.

The readers are going to be grading and sending you occasional comments. Because we have reader grades, we will catch any attempts at trying to inflate your own scores. This will be considered cheating and is definitely not worth the risk. Your own scores will be used in computing your final grade for the course, adjusted a bit by taking into account reader scores so that everyone is effectively fairly graded on the same scale. (E.g. if we notice that you statistically tend to shade 8s into 5s or a bit much as compared to the readers looking at your homeworks, we will apply a correction to pull your scores up a bit.)

If you have any questions, please ask on Piazza.

Extra credit will be available for many creative activities including helping us debug issues with the class and coming up with constructive solutions. (For example: creating practice problems with solutions, providing patches to bugs in labs and homeworks, etc.) Talk with your GSI in person or post on Piazza if you want to get feedback from the entire class.

Course Communication
The instructors and TA will post announcements, clarifications, hints, etc. on Piazza. Hence you must check the EE16B Piazza page frequently throughout the term. (You should already have access to the EE16B Spring 2017 forum. If you do not, please let us know.) If you have a question, your best option is to post a message there. The staff (instructors and TAs) will check the forum regularly, and if you use the forum, other students will be able to help you too. When using the forum, please avoid off-topic discussions, and please do not post answers to homework questions before the homework is due.

If your question is personal or not of interest to other students, you may mark your question as private on Piazza, so only the instructors will see it. If you wish to talk with one of us individually, you are welcome to come to our office hours. Please reserve email for the questions you can’t get answered in office hours, in discussion sections, or through the forum.

It can be challenging for the instructors to gauge how smoothly the class is going. We always welcome any feedback on what we could be doing better. If you would like to send anonymous comments or criticisms, please feel free to use an anonymous remailer like this one to avoid revealing your identity.

Collaboration
You are encouraged to work on homework problems in study groups of two to four people; however, you must always most students can distinguish between helping other students and cheating. Explaining the meaning of a question, discussing a way of approaching a solution, or collaboratively exploring how to solve a problem within your group is an interaction that we strongly encourage. But you should write your homework solution strictly by yourself so that your hands and eyes can help you internalize this material. You should acknowledge everyone whom you have worked with or who has given you any significant ideas about the homework. This is good scholarly conduct.

Don’t Be Afraid to Ask for Help
Are you struggling? Please come talk to us. We would much rather deal with misunderstanding early on, and we can help. Even if you are convinced that you are the only person in the class that doesn’t understand the material, and that it is entirely your fault for having fallen behind, please overcome any feelings of guilt and ask for help as soon as you need it -- we can almost guarantee you’re not the only person who feels this way. Don’t hesitate to ask us for help -- we really do care that you learn!

Advice
The following tips are offered based on our experience.

Do the homeworks! The homeworks are explicitly designed to help you learn the material as you go along. Although the numerical weight of the homeworks is not huge, there is usually a strong correlation between homework scores and final grades in the class.

Take part in discussion sections! Discussion sections are not auxiliary lectures. They are an opportunity for interactive learning. The success of a discussion section depends largely on the willingness of students to participate actively in it. As with office hours, the better prepared you are for the discussion, the more you are likely to get out of it.

Form study groups! As stated above, you are encouraged to form small groups (two to four people) to work together on homeworks and on understanding the class material on a regular basis. In addition to being fun, this can save you a lot of time by generating ideas quickly and preventing you from getting hung up on some point or other. Of course, it is your responsibility to ensure that you contribute actively to the group, passive listening will likely not help you much. And recall the caveat above that you must write up your solutions on your own. You are strongly advised you to spend some time on your own thinking about each problem before you meet with your study partners; this way, you will be in a position to compare ideas with your partners, and it will get you in practice for the exams. Make sure you work through all problems yourself. Some groups try to split up the problems (“you do Problem 1, I’ll do Problem 2, then we’ll swap notes”), not only is this a punishable violation of our collaboration policies, it also ensures you will learn a lot less from this course.