You may take this exam at a time and place of your convenience. No portion of this exam requires internet access.

Please treat this exam as a (self-administered) in-class examination rather than a take-home; it is intended to be completed in single sitting lasting approximately 2 hours. You may give yourself additional time, within reason, to complete the work, but you should not take the exam over several sessions or use more than double the allotted time.

This exam is not intended to be an open book exam – it should test what you actually know, not how fast you can look things up – but you may make limited use of written resources to jog your memory provided that you carefully and completely document each instance of this use. (As a rule of thumb, no additional time is provided for use of resources.)

If there is something unclear about the exam, you may try to contact me. I can generally be reached between 7:30am weekdays/9:30 am weekends and 10:30pm by some means, including a phone call at home. If you cannot reach me, simply make a reasonable assumption and document that assumption in writing on your examination. Otherwise, you should not discuss this exam with anyone until Tuesday November 15.

Please write your name on every page of this exam and on any additional pages that you wish to turn in. Please also number any additional pages. Be sure that the entire exam is stapled securely before you turn it in.

After you have completed the exam, please copy the following statement onto the final page of your exam, filling in the appropriate times and dates, and sign your name:

I began this exam at <fill in time and date> and completed it at <fill in time and date>. I have neither given nor received unauthorized assistance during the completion of this work. I agree not to discuss this exam in any way until Tuesday November 15.

Please sign your name to indicate that you have abided by all rules and conducted yourself according to the Olin College Honor Code. If you cannot write out this phrase and sign your name to it, please explain. ¹

Your exam should be turned in to Holly Bennett in OC360 or the HFID box in the library by the end of Monday, 14 November.

DO NOT TURN THIS PAGE UNTIL YOU ARE READY TO BEGIN

¹ This text courtesy of Professor Sarah Spence.
**Instructions:**

Concise, accurate answers are better than long semi-accurate answers. The amount of space provided is meant to act as a guideline for the length of your answer.

I recommend that you quickly look through all the questions first and then begin answering them. Some questions are worth more points than others, so budget your time accordingly. There are 6 questions worth 100 points total. Partial credit will be awarded.

**PLEASE INDICATE THE TIME AT WHICH YOU BEGIN THIS EXAM:**

Questions:

1. **[10 Points] Pithy Sayings**

   (a) Why does Jakob Nielsen say both "Users are not Designers" and "Designers are not Users"? What does each contribute to the design process? Be specific; give an example of something about users that is not generally true of designers and an example of something about designers that is not generally true of users.
(b) Alan Cooper says (apparently quoting John Irving): “The wonder of a
dancing bear is not that the bear dances well, but that it dances at all.”
Explain the relevance of this quotation to (Cooper’s opinion of) the current state
of (software design). Be specific; give an example.
2. [20 points] Appliance Design

For this question, consider the following photographs of a stovetop and its controls. These images are also on the last page of this exam so they can be torn off and viewed separately.

Figure 2.1 shows the full stovetop. The remainder of this question will concern itself with the rear left burner (controlled by the second knob from the left) and the front right burner (controlled by the last knob on the right).

Figure 2.2 shows the controls for the two left burners. The rear left burner – the control on the right – is turned on. Note the red lights immediately above and below the control and the glowing burner. The corresponding red lights are not lit for the left front burner (left control in this figure).

Figure 2.3 shows the left burners and controls after the rear burner has been turned off. Note that the burner no longer glows and the upper red light has gone out, but the lower red light is lit to show that the burner is hot. (The round white light on the backplane is flash reflection.)

Finally, Figure 2.4 shows a close up of the rear left burner control in the “hot” mode, i.e., as in figure 2.3 (but without the nasty flash). The round white light on the backplane is also lit in this image.
(a) The stovetop control panel contains two indicator lights for each burner. One is above the knob; this light goes on whenever the burner control switch is in an “on” position, as in figure 2.2, and off when the knob is in the “off” position, as in figures 2.3 and 2.4. The second indicator light is below the knob. This light stays on whenever the burner is hot. (The burner generally remains hot for some time after the knob has been turned to the off position, as in figure 2.4.)

In this question, you should explain how the design of these indicator lights supports the user and/or how the design could be improved. Identify **two (2)** specific aspects of the design of these lights that illustrate either good or bad usability. (You may choose one good and one bad aspect, or both may be the same polarity.) In each case, indicate the feature of the button design that is either good or bad and cite the design principle that justifies your judgement. Be as specific as possible. Try to choose examples that demonstrate two different aspects of design.
(b) On this same stovetop, the front right burner can operate as a small burner or as a large one. (When "small", only the center portion turns on; see figure 2.1, in which a darker, smaller circle is visible inside the larger circle of the front right burner.)

**Identify one specific way** in which the control for this burner (shown to the left, in figure 2.5) either supports or fails to support the cognitive load of the user of this burner.
(c) **Suggest a redesign** of one of the features that you have critiqued in the previous portions of this question. Explain how your redesign would support the user in a way that the current design does not. (Even if your prior answers included only ways in which the design of the stove is usable, you should attempt to find an improvement that can be made to the design.)
3. [10 points] More Controls

(a) The radio power and volume in a 1997 Dodge Grand Caravan are controlled by a single button. Pushing the knob turns the radio on or off. When the radio is on, rotating this knob clockwise raises the volume; rotating it counterclockwise lowers it. However, rotating the volume knob when the power is off does not affect the volume at which the radio will be turned on. **Name the design principle** this exemplifies and **explain why it is a good idea**.

(b) When the radio is turned off, rotating the volume knob counterclockwise **does** change the volume of the radio when it is turned on (specifically, it lowers the volume at which the radio will be turned on). **Does this violate the design principle** you named above? Why or why not?
4. [30 points] Heuristic Evaluation and Redesign

Unlike Olin’s ECE and ME majors, the Engineering major does not have a fixed set of requirements that every student must satisfy. Therefore, each Engineering major is required to turn in a plan of study describing how s/he intends to complete the “concentration” component of the program. This proposal must include:

- For students in **pre-approved concentrations**, how you will fulfill the concentration requirements (i.e., which courses should count towards your concentration)
- For **E:SELF** students, a list of courses that constitute your "concentration" PLUS a paragraph describing how this concentration meets requirements for breadth, depth, coherence, and rigor and relates to your Engineering major.

Students are also given the following advice:

**Generally, an engineering concentration should comprise no fewer than 24 credits and no more than 32 credits of coursework in a single discipline or multidisciplinary field.** Up to four of these credits may be in an area, such as advanced mathematics, appropriate to support further study in the chosen area. This coursework is expected to be supplemented by additional material in the general Olin requirements -- including Olin's foundation curriculum and the SCoPE and OSS programs -- so as to comprise a complete engineering education. **All E students are required to meet the general Olin requirements including the minimum credit requirements in Engineering, Math, Science, AHS, and Entrepreneurship.**

The plan of study should include any information needed by the Engineering Program Group to verify the requirements in bold face in this paragraph.

At the end of this exam, you will find a two page document prepared by the Engineering Degree Committee (now defunct) to solicit this plan of study from students last spring.

Current sophomores will need to declare a major in the next two months. Given the current state of technology, there is some desire to put this process online. One proposal² is to **use the existing form to solicit plans of study from these current sophomores.** Specifically, a pdf version of the form would be put online and students would be required to turn in a filled out **printed copy** of the form.

²
Fortunately, this proposal is extremely unlikely to actually be adopted in the manner described here. However, for the purposes of this exam you should consider the proposal as presented. Your role is to help identify reasons why this process/form is not a good one and to suggest alternatives that might improve the user experience. (The class of 2008 thanks you.)

Specifically, you should **critique the form** – conducting a heuristic evaluation – with an eye to its usability in this manner and **for this purpose** and then answer the questions on the following pages.

**NOTE:** Nielsen’s heuristics and severity ratings are provided below. You may use other heuristics should you find those more suitable, but please identify them clearly.

**Molich/Nielsen Heuristics:**

1. Simple and Natural Dialog  
2. Speak the user's language.  
3. Minimize the user’s memory load.  
4. Consistency  
5. Feedback  
6. Clearly marked exits  
7. Shortcuts  
8. Good error messages  
10. Help and Documentation

**Nielsen’s severity ratings:**

0 = this is not a usability problem at all  
1 = cosmetic problem only—need not be fixed unless extra time is available  
2 = minor usability problem—fixing this should be given low priority  
3 = major usability problem—important to fix, so should be given high priority  
4 = usability catastrophe—imperative to fix this before project can be released
Name____________________________

(a) First, describe in a paragraph or so the main problems that you’ve identified with the use of this form for this purpose (sophomore proposed plans of study).
(b) Next, describe **the five most severe distinct problems** with the proposed form/process. In each case, list the **guideline** that is violated and **describe why**. Also indicate how severe a problem you think this is.

(1)

(2)

(3)

(4)

(5)
(c) Finally, for at least three of the problems that you have identified, indicate how you might change the course plan process/form to solve the problem. (Answers addressing all five issues will receive extra credit.)

(1)

(2)

(3)

(4)

(5)
6. **[30 points] Formal Experiment Interpretation and Design:**

A simple application was designed to explore properties of user interfaces. A participant faces a screen with seven labeled boxes at the top of the screen. An object – in this case, a heart – appears in the center of the screen. Using drag and drop, the participant moves the object into the appropriate box. This process is repeated, with each sorting action – from the appearance of the object to its placement in a bin – timed by the computer application.

![Diagram of screen with labeled boxes and heart](image)

A particular experimenter, Pat, was interested in whether auditory cues would make a difference in the ease with which this task was completed. Pat added sound effects so that every time the mouse moved into one of the target boxes, the computer made a small rising-tone noise and every time the mouse moved out of the target box, the computer made a small falling-tone noise. Pressing the mouse button – to pick up the object – generates a half-click; releasing the mouse button generates the second half of the click.

Pat ran a preliminary study with three participants. Each subject sorted twenty items without sound followed immediately by twenty items with sound. Their response times were measured by the system. Pat’s data are presented on the next pages.
Response time on sorting task (silent condition)

Response time on sorting task (sound condition)
(a) Analyze the following aspects of Pat’s experiment, explaining briefly where necessary:

Did the participants complete the task more quickly on the runs with sound?

Did Pat’s experiment use within-subject or between-subject testing to try to determine this?

What were the independent factors (variables) that Pat considered?
What were the dependent factors (variables) that Pat considered?

Did Pat’s experiment use a one-shot design or a controlled design? What if anything did Pat compare?

(b) What threats exist to the internal validity of Pat’s experiment? In other words, do you believe that Pat’s results establish that sound speeds up response time on this task? Why or why not? What alternative explanations (might) exist and does Pat rule them out? What else about Pat’s data might be cause for further investigation?
(c) Design an experiment that would better tease out causes behind the results in Pat’s data. Assume that you can have up to thirty-two (32) participants. Use the structure shown below for your experiment design.

Hypotheses:

Independent Variables, and the levels you will consider:

Dependent Variables, and the levels you will consider:
Blocking of experiment, including within-subjects versus between-subjects, which levels of each factor are used in each condition, how many participants are in each condition.

This is the end of the exam. Any remaining pages may be removed from the exam if you find them useful to have separately and need not be turned in with your exam.

Please copy the honor code declaration (from the front page of the exam) below and sign your name. Also include the time at which you completed this exam.
Before filling out this form, you should be familiar with the handout on Course Planning for Engineering Majors. You may also find it convenient to have easy access to an Olin Course Catalog and to your record of courses taken.

The first page of this form is a worksheet to help you compute the total credits you have (or will have) by taking required classes. If you have already done this computation on another form, you can substitute the other form for this page. In either case, you must fill in the totals at the top of the next page.

Tables A, B, and C represent typical enrollments for members of Olin’s first three classes.

Select the one that best fits your coursework.

Copy the subtotal from table A, B, or C into the first line of Table D.

Sum the resulting columns of Table D, then enter the totals at the top of the next page.

A. If you are a member of the class of 2006 who completed ICB1 and 2 and Engineering Computing in the 2002/2003 academic year, you need to fill out this table and copy the subtotal to the first line of table D. NOTE: Signals and Systems F03/S04 is not included here; its 3 Engineering credits may be used as part of the additional coursework towards your major.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Courses</th>
<th>Credits</th>
<th>Math</th>
<th>Sci</th>
<th>Engr</th>
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<td>(choose one)</td>
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<td>WiredEn</td>
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<tr>
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<td>F03/S04</td>
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Class of 2006 Subtotal (Also copy to shaded line below)

B. If you are a member of the class of 2007 who completed ICB1 and 2 and Modeling and Control in the 2003/2004 academic year, Principles of Engineering (4 credits of Engineering), and the 4 credit Applied Math Methods class (MTH2150), simply copy these subtotals to table D.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Courses</th>
<th>Credits</th>
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</table>

Class of 2008 Subtotal (Also copy to shaded line below)

C. If you are a member of the class of 2008 and beyond, your ICBs, Design, Nature, Principles of Engineering, Linear Algebra, and Prob&Stats classes are summarized by this subtotal. Copy it to table D.

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<tr>
<th>Topic</th>
<th>Courses</th>
<th>Credits</th>
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Enter subtotal from Table A, B, or C here

<table>
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<th>Topic</th>
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<th>Credits</th>
<th>Math</th>
<th>Sci</th>
<th>Engr</th>
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<tbody>
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<td>Materials Science or Chemistry</td>
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<td>User Oriented Collaborative Design</td>
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<td>Design Depth</td>
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</table>

Total of Required Courses (Also copy to next page)
This page is where you will describe your proposed plan of study and obtain approvals for it. In the space below, please list the additional classes (not included in the required course list) that you have taken or plan to take to fulfill the credit requirements in Engineering, Math and Science. The total credits required are listed at the bottom of this table.

- You can include specific classes or, if you are not sure, a description of the kind of class you are planning to take.
- You do not need to list all of the classes that you will take, only the ones that will complete your major and the credit requirements in these fields.

<table>
<thead>
<tr>
<th>Course #</th>
<th>Course Name</th>
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<td><strong>Total</strong></td>
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<td>Required Minimum Credit Distributions</td>
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<td>≥46</td>
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</table>

The courses that you listed above, taken together with the required classes on the previous page, must constitute a major in Engineering that has breadth, depth, coherence and rigor. If you don’t think that these criteria are apparent to someone looking at your course plan, you can use the space below to explain.

If you want a concentration to appear on your diploma, please specify the name of the concentration below.

Signature of Student __________________________ Date ______

Signature of Adviser __________________________ Date ______

Printed Name & Title of Relevant Faculty Member __________________________

Signature of Relevant Faculty Member __________________________ Date ______

Approved __________________________ Date ______

ENGINEERING CONCENTRATION PROPOSAL FORM

Concentration Proposal
2. [20 points] Appliance Design

For this question, consider the following photographs of a stovetop and its controls. These images are also on the last page of this exam so they can be torn off and viewed separately.

Figure 2.1 shows the full stovetop. The remainder of this question will concern itself with the rear left burner (controlled by the second knob from the left) and the front right burner (controlled by the last knob on the right).

Figure 2.2 shows the controls for the two left burners. The rear left burner – the control on the right – is turned on. Note the red lights immediately above and below the control and the glowing burner. The corresponding red lights are not lit for the left front burner (left control in this figure).

Figure 2.3 shows the left burners and controls after the rear burner has been turned off. Note that the burner no longer glows and the upper red light has gone out, but the lower red light is lit to show that the burner is hot. (The round white light on the backplane is flash reflection.)

Finally, Figure 2.4 shows a close up of the rear left burner control in the “hot” mode, i.e., as in figure 2.3 (but without the nastiness of the flames).