

Name: \_\_\_\_\_

Student #: \_\_\_\_\_

University of Toronto  
Faculty of Applied Science and Engineering

APS111 Engineering Strategies and Practice  
Course Coordinator: Prof. S. McCahan

Midterm Examination  
October 28, 2003

This is a 1 hour and 50 minute exam. The midterm is closed book and closed notes. The only permissible aid is a single, 8.5"x11", aid sheet. Answer all parts of all questions. Your answers must be well structured, clear, concise, and complete in order to obtain the maximum credit. The mark values for each question are given to help you allocate your time. You may write your answers directly on this sheet, or in the booklet provided. For short answer questions an **approximate** (not required) length is given in parentheses with the question.

At the end of the midterm period please submit: this sheet, your answer booklet(s), and your aid sheet.

Please **write clearly**. We cannot give you marks if we cannot read your work.

Exam: 3 pages

3 questions

To get full credit you must **answer all parts of all questions**

## Question 1: The design process

5 parts, 35 points

After graduation you get a job working as a design engineer with a small consulting company. Your first client is Sarah Doe who lost the use of one of her arms in an accident. She enjoys cooking, but has found that her disability sometimes makes it difficult to perform tasks in the kitchen quickly and easily.

Client statement:

“I really like to bake, but the hardest part is mixing the ingredients. Like for instance, making whip cream is very difficult because I have to whisk quickly with my good hand but then the bowl doesn’t stay still and it is very tiring. What I really want is a mechanical eggbeater I can use. I know the only mechanical device possible is one of those mechanical eggbeaters with the grip at the top and the turning handle, but I can’t use it because this thing requires two good hands. Can you make a device that will hold the gripping handle tightly in place for me? Then I can turn the handle with my good hand and beat things.”

a) Identify problems with the client statement

Clearly we are missing information about the client, her age, where she lives, etc. However, let’s just focus on the client’s statement for the moment. Briefly (one sentence each), give **two** specific problems with this client statement.

b) From the client statement one of the other engineers on your team develops the list below. The first four items are identified as objectives. Identify the other items, E through L, by putting an O for objective, a C for constraint, an F for function, or an X if it is none of these, next to each item.

- |  |                             |
|--|-----------------------------|
| A. The artefact should be reliable.  | <u>Objective</u>            |
| B. The artefact should be easy to use with one hand.                                       | <u>Objective</u>            |
| C. The artefact should be inexpensive.   | <u>Objective</u>            |
| D. The artefact should be safe to use.   | <u>Objective</u>            |
| E. The artefact shall not cost more than \$20.   | <u>                    </u> |
| F. The artefact should be easy to clean.   | <u>                    </u> |
| G. The artefact should convert power to a whipping action.                                 | <u>                    </u> |
| H. The artefact should be made of metal.   | <u>                    </u> |
| I. The artefact must not require more than one hand to use.                                | <u>                    </u> |
| J. During whipping, the artefact should not cause the bowl to move in an uncontrolled way. | <u>                    </u> |
| K. The artefact should use gears to adjust the torque/speed ratio.                         | <u>                    </u> |
| L. The artefact should be recycle-able when it is thrown away.                             | <u>                    </u> |

### Question 1; continued

- c) The list, A through L, does include some function(s) of the artefact. Give one other unintended function that the eggbeater may have. Hint: Think about the eggbeaters you analyzed in class. (1 or 2 sentences)
- d) Why is it important to list this unintended function when considering the design of an artefact for Ms. Doe? (3 sentences or so, be specific about this case, i.e. this unintended function that you have written in part c)
- e) Briefly (bullet points) give the next 5 steps (or actions) you and your team might take to address Ms. Doe's design need.

### Question 2: Module 2

4 parts, 25 points

Note: for short answer questions the number of sentences given in parentheses is an approximate, suggested length. It is not the required length for the answer.

- a) Consider the mechanical eggbeater analyzed in tutorial. What would happen if the turning handle on the mechanical eggbeater were shorter? Would it be easier or harder to use the beater? Why? (3 sentences, be specific)
- b) In tutorial you analyzed two of three mechanical products: a can opener or a corkscrew, and an eggbeater. Give one example where an inclined plane is used in one of these three products. (1 sentence)
- c) What is wrong with perfectly symmetric pushbars on doors? (3 sentences)
- d) A swimsuit that copies the surface (skin) characteristics of a shark to reduce drag is most likely an example of which of the following type of analogies used in synectics?
  - a. Fantasy analogy
  - b. Personal analogy
  - c. Symbolic analogy
  - d. Direct analogy

**Question 3: Module 1**

1 part, 40 points

**Long answer question**

Compare and contrast the design process, the team development process, and the writing process. For example the design process has a goal or objective, as do the team and writing processes. Please note that this portion of the exam will be marked for the clarity, conciseness and logical flow of the writing as well as the content. It is strongly recommended that you write a brief outline for yourself before you begin writing the full text of your response. This outline should be in your examination booklet should you choose to do it.