

University of Toronto
Faculty of Applied Science and Engineering
APS111H1S - Engineering Strategies and Practice I
Course Instructor: Farzan Sasangohar
Communication Instructor: Dr. Maria Cioni
Final Examination

April 29th, 2015
2:00pm – 4:30pm

Full Name: _____ Student Number: _____

Final Examination Instructions

1. This is a Type A: Closed book examination, no aids permitted.
2. Ensure that you have all 12 pages of this final exam.
3. You have 2 hours and 30 minutes to complete this exam.
4. Read each question carefully and answer in the space provided.
5. Marks for each question are indicated in square brackets [].
6. All questions must be answered in full sentence/paragraph structure using good engineering writing.
7. Attempt all questions in the space provided.
8. **Question 8 is the only question that is to be completed in the exam booklet.**

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Total
20	20	6	8	5	20	7	50	136

Question 1: [20 Marks]

Clearly circle TRUE or FALSE in response to each statement. If the answer is false, then revise the statement to provide the correct answer.

1. [TRUE or FALSE]: The PEO Code of Ethics states that the following an Engineer's duty is first and foremost to his/her client.
2. [TRUE or FALSE]: Budget allocations could be described using the political level of the Human-tech ladder.
3. [TRUE or FALSE]: Toronto's target 70 waste diversion is an example of a "reuse" approach.
4. [TRUE or FALSE]: Weighted decision matrices are used to compare functions to objectives.
5. [TRUE or FALSE]: "Rent" is an example of an external cost.
6. [TRUE or FALSE]: The Gap identifies what is missing in the client's world.
7. [TRUE or FALSE]: The Iron Ring represents a Professional Engineering license.
8. [TRUE or FALSE]: In a graphical decision matrix, each objective is compared with a constraint.
9. [TRUE or FALSE]: The Communications Triangle considers genre, purpose and critical thinking.
10. [TRUE or FALSE]: Service environment is not a description of how the design should meet the environment.

Question 2: [20 marks]

(a) Describe the difference between a client statement and a problem statement. [3 Marks]

(b) A design team has come up with 40 design alternatives. Describe the techniques that the team would use to arrive at the recommended design. [5 Marks]

(c) What is the difference between external and internal costs. Provide an example to support your answer. [3 Marks]

(d) Explain the three “Rs” of Design for Environment. [3 Marks]

(e) What are metrics and what do they measure in the design process? [3 Marks]

(e) Pick 3 pieces of technology you use. Identify their functional basis. [3 Marks]

Question 3 [6 Marks]

Table 1 outlines a Weighted Decision Matrix for a design project. Analyze the results and answer the following questions:

- 3.1) Which design, would you recommend to the client at this time? Justify your answer using a complex credible argument. [2 marks]
- 3.2) How well does the recommended design meet the objectives and constraints? [2 marks]
- 3.3) What could you suggest to the design team as possible feedback for another design iteration? [2 marks]

Table 1: Weighted Decision Making Matrix

Constraints	Design #1	Design #2	Design #3	Design #4
C1	o.k.	o.k.	o.k.	fail
C2	o.k.	o.k.	o.k.	o.k.
C3	o.k.	o.k.	o.k.	o.k.
Objectives				
O1	$.35 \times .60 = 21\%$	$.35 \times .05 = 1.75\%$	$.35 \times .05 = 1.75\%$	$.35 \times .90 = 31.5\%$
O2	$.30 \times .60 = 14\%$	$.30 \times .80 = 24\%$	$.30 \times .90 = 27\%$	$.30 \times .90 = 27\%$
O3	$.20 \times .70 = 18\%$	$.20 \times .90 = 18\%$	$.20 \times .20 = 4.0\%$	$.20 \times .20 = 4.0\%$
O4	$.10 \times .30 = 3\%$	$.10 \times .90 = 9.0\%$	$.10 \times .05 = 0.5\%$	$.10 \times .05 = 0.5\%$
O5	$.05 \times .05 = 0.25\%$	$.05 \times .90 = 4.5.0\%$	$.05 \times .25 = 1.25\%$	$.05 \times .25 = 1.25\%$
Totals	56.3%	57.3%	34.5%	64.25%

Question 4: [8 marks]

Imagine we have three alternatives for lighting an area to get 100,000 hours of operation: Incandescent bulbs, LED bulbs and compact fluorescent bulbs. 60 watt Incandescent bulbs cost \$1.63 each and last for 2,000 hours. Equivalent output Light Emitting Diode (LED) bulbs are 9.5 watts, cost \$15.97, and last for 25,000 hours. Equivalent output compact fluorescent bulbs are 13 watts, cost \$7.97 and last for 10,000 hours. The price of electricity we will assume is \$0.055 per kWh.

(a) Which alternative is the most cost-efficient choice? Justify your answer. [5 marks]

(b) How does your answer change if an employee costs you \$30/hour? Clarify your assumptions. [3 marks]

Question 5: [5 marks]

Due to recent loss of revenue airlines are under tremendous pressure to maintain their daily schedules. Pilots may lose their jobs if the airlines continue to lose customers. Pilot of the Oceanic Flight 2343 from Toronto to Miami skips 3 steps of the pre-take-off Safety Checklist related to secondary flaps to avoid further delays. The airplane crashes due to secondary flap malfunction killing all 140 passengers.

(a) What level of Vicente's Human-tech ladder could be used to describe this situation? Justify your answer. [3 marks]

(b) Provide an example from the Psychological level of Human-tech ladder that could lead to an accident. [2 marks]

Question 6: [20 marks]

(a) Give an approach to formulating a credible argument? [3 marks]

(b) What is the purpose of an oral presentation? [2 marks]

(c) Why is it important to determine a main purpose for an oral presentation? [2 marks]

(d) Give one lesson that you have learned about teamwork this term and what you would do in future to avoid or replicate the situation. Be specific. [4 marks]

(e) What is the difference between the Executive Summary and the Conclusion? [3 marks]

(d) Scenario: Your team has completed a Project Requirement Document (PR) and now you are writing the Conceptual Design Specification (CDS). Your PR comprised 1590 words. The CDS has a 3,000-word-constraint. Present a strategy for insuring that the team produces a professional concise, specific document for the client. [6 marks]

Question 7: [7 marks]

- (a) Which Act governs the engineering profession in Ontario? [2 marks]
- (b) Who is the governing body for engineers working in Ontario? [2 marks]
- (c) What are three licensing requirements to become a licensed Professional Engineer in the Province of Ontario? [3 marks]

Question 8: [50 Marks]

Read the client statement below and answer the related questions in the exam booklet using headings, subheadings, paragraphs, bullet lists, and labeled figures and tables where appropriate.

Client Statement:

IKEA, a global retailer of home furnishings, is on track to having 500 stores globally run by 200,000 employees. Steve Howard, Chief Sustainability Officer of IKEA, sees great potential in this growth, but is concerned by the potential environmental impact. A business-as-usual approach to this projected growth would mean an increase in carbon emissions from the current 30 million tons to 60 million tons. Howard says that sustainability is no longer a “nice-to-do”, but a “must-do.”

To achieve sustainable growth the company is pursuing multiple areas such as moving to 100% renewable power generation in their stores, and replacing all IKEA brand incandescent light bulbs with LED bulbs by 2016. Another area that has vast potential for improvement is in the design of new, more sustainable, products. IKEA’s Design and Product Development group is already tackling this challenge head on, but it will be overwhelmed by the amount of design required. Therefore IKEA is looking to contract out some of this design.

Those interested working for IKEA as consulting product designers should submit a design proposal which takes an existing IKEA product, and redesigns it to be more sustainable while not forcing a price increase that is beyond the premium that consumers are willing to pay. Good proposals will suggest conceptual redesigns of five different products, but recommends a final one that best meets our needs. A submission that does not demonstrate a solid understanding of our “People and Planet” philosophy will not be successful.

IKEA is interested in drawing broad scope lines as long as the link to the sustainable improvement is clear and credible. For instance they welcome designs that utilize innovative techniques for example behavioural modifications through positive social engineering, efficiency increases through biomimicry, or lead user studies.

In the exam booklet address the following questions:

8.1) Complete the Project Requirements section of the Conception Design Specifications

- Write a concise Problem Statement in your own words [5 marks]
- Identify 5 stakeholders and their concerns with the project [5 marks]
- Identify the functional basis of the design [2 marks]
- Formulate functions for the design (all relevant aspects) [3 marks]
- Formulate objectives [3 marks]
- Rank your objectives using a Pairwise Comparison Chart [3 marks]
- Formulate constraints [3 marks]

8.2) Generate and describe two **feasible** design alternatives (include a sketch if necessary) [6 marks]

8.3) Use a Weighted Decision-making Matrix to recommend one of the your two design alternatives [4 marks]

8.4) Design a metric for your top-ranked objective [3 marks]

8.5) Discuss the Economic Impact of your recommended design [4 marks]

8.6) Discuss the Human Factors of your recommended design (at least three levels of the human-tech ladder) [4 marks]

*Communication principles discussed in class including the scoping, organization, and clarity will be assessed. [5 marks].

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