

University of Toronto  
Faculty of Applied Science and Engineering  
APS111T Engineering Strategies and Practice  
Course Instructor: Atoosa Nasiri  
Communication Instructor: Maria Cioni  
Final Examination  
Apr 26, 2019  
2:00 pm to 4:30 pm (2.5 hours)

Student Name:	
UTor Email:	

Please print clearly

### **Final Examination Instructions**

- Ensure that you have all 12 pages of this Final exam and the separate one-page Final Exam RFP.
- There are 100 marks in total on this exam.
- You have 2.5 hours to complete this exam.
- Write your name and UT ID or UT Email address on this booklet.
- Read each question carefully. All questions should be answered directly in this booklet in the box provided.
- There is one extra pages at the end, use them if you need more spaces.
- Write in complete sentences and complete paragraphs were applicable.
- Marks for each question are indicated in square brackets [ ].
- This is a Type A Closed book examination; no aids permitted. You are allowed a paper translation-only dictionary (no definitions).
- Where needed draw upon your own engineering expertise. You will not be required to have references as you normally would.
- At the end of the exam hand in this booklet and RFP.
- Circle the number “1.” at the start of Question 1 on page 2 for one mark.

At the Toronto-based start-up, Vision 20/20 Inc., we are in the business of creating products for the future. As such, we are seeking proposals for a security device for electric folding cars. Three such automobile designs currently exist:

- The Hiriko developed by Massachusetts Institute of Technology (MIT) and a Spanish redevelopment agency, DENOKINN [1];
- The Armadillo-T developed by the Korean Advanced Institute of Science and Technology (KAIST) [2];
- The Casple Podadera developed by the Spanish business group Casple and the designer Francisco Podadera [3].

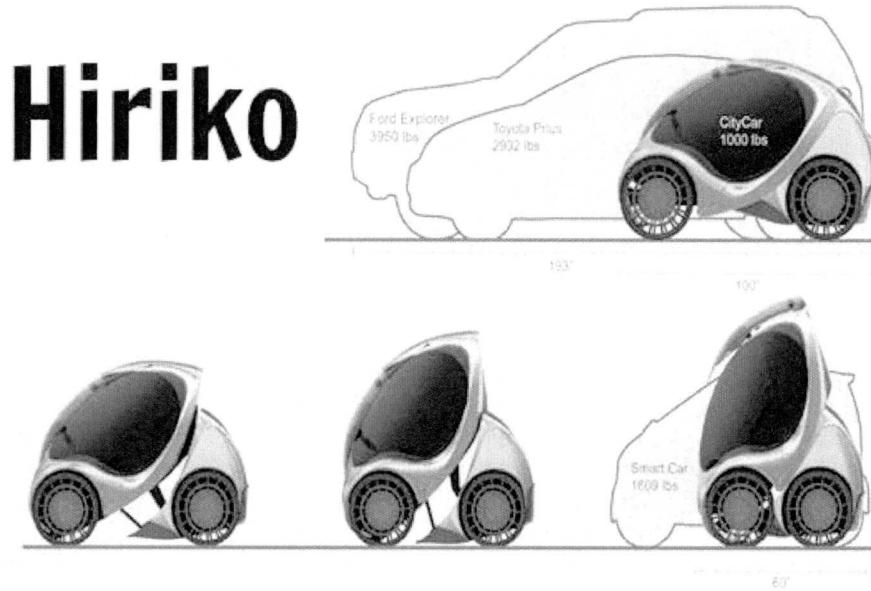


Figure 1: Diagram of Hiriko Folding car, from G. Munro [1]

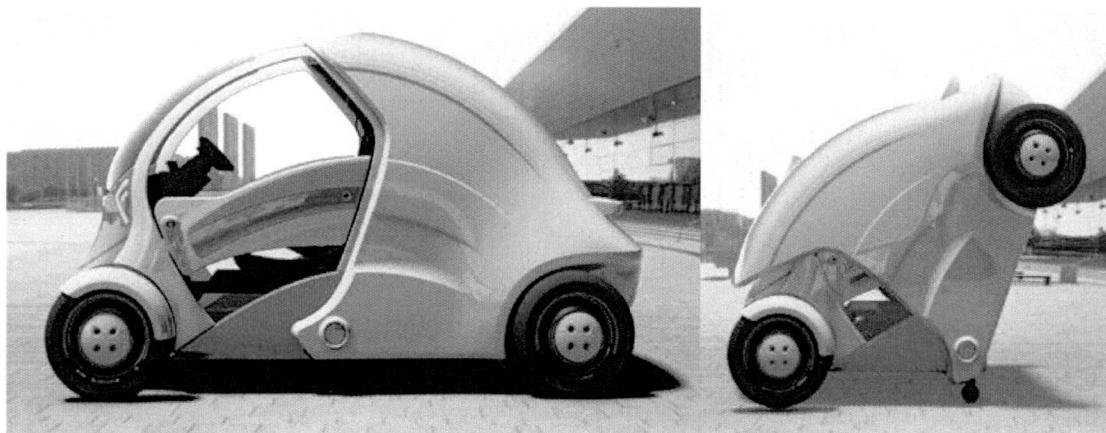


Figure 2: Armadillo-T driving and folded configurations. From K. Munro [2]

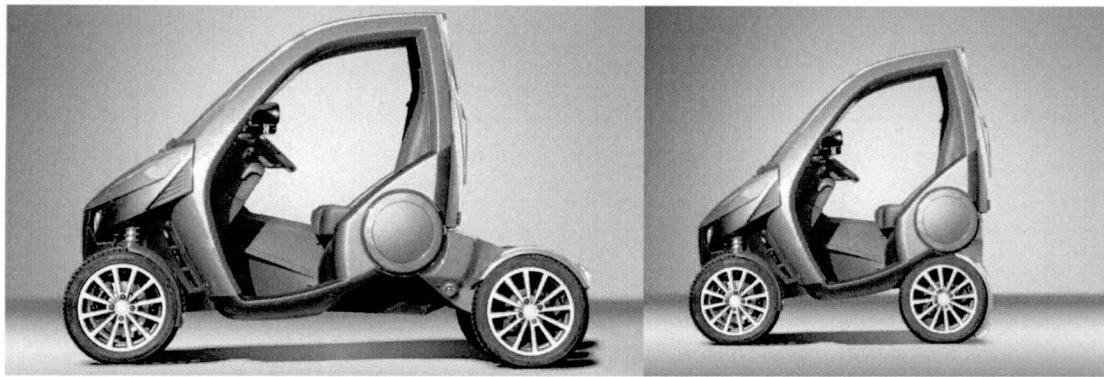


Figure 3: Casple-Podadera driving and folded configurations. From A. MacKenzie [3]

Measuring between 2.30 and 2.80 metres in use and between 1.65 and 1.90 metres when folded [1-3], these two person vehicles are the ultimate answer to the challenges of city driving and city parking! Up to three of these could fit in a conventional Toronto parking space (5.6\*2.6 metres) [4]. So, how it works is, the driver finds a parking spot about a third of the size of a normal spot, gets out of the car, folds it and parks it through a smart phone app.

However, at Vision 20/20, we foresee a major drawback for these cars. They are so light (the Hiroki is a mere 452Kg [1] and the Armadillo-T is 3 Kg [2] lighter than that), they could easily be lifted and carried away by a small number of strong people with a minimal amount of equipment.

So, we believe that as these new foldable electric cars start to come on the market, there will be a need for a security device that prevents unauthorized removal of the vehicle while allowing law enforcement to tow when necessary. It would also be desirable for the security system to warn the car owner in the case of the car being moved. However, any such alarm system cannot create a disturbance if the car is parked in a residential neighbourhood at night. Finally, if an electrical source or a source of energy transformable to electrical power is available, it would be an added benefit if the security system could also charge the car's battery while the car is parked. In the case of this add-on, electromagnetic systems would be preferred.

- [1] G. Munro (2013 Jan 2) "New for 2013-The Hiroko-The Foldable Car!" [Online] *efergy* Available: [http://efergy.com/blog/new\\_for\\_2013-the\\_hiroko\\_the\\_foldable\\_car/#](http://efergy.com/blog/new_for_2013-the_hiroko_the_foldable_car/#)
- [2] K. Munro (2013 Aug 13) "Armadillo-T Foldable Electric Micro-car by KAIST" [Online] *de zeen magazine* Available: <http://www.dezeen.com/2013/08/23/armadillo-t-foldable-electric-micro-car-by-kaist/>
- [3] A. MacKenzie (2013 Feb 18) "The Casple-Podadera City Car Knows When to Fold 'Em" [Online] *Gizmag* Available: <http://www.gizmag.com/casple-podadera-folding-car/26268/>
- [4] City of Toronto (2014 Aug 19) *Chapter 200 Parking Space Regulations* [Online] Available: [http://www.toronto.ca/zoning/bylaw\\_amendments/ZBL\\_NewProvision\\_Chapter200.htm](http://www.toronto.ca/zoning/bylaw_amendments/ZBL_NewProvision_Chapter200.htm)

1. Circle T (TRUE) or F (False) for each statement below. If the answer is FALSE, then rewrite the entire statement to make the statement TRUE. There may be multiple ways to do this, just pick one. [1 Mark each; total 9 Marks]
  - a. [T or F]: The purpose of an engineering argument is to market.
  - b. [T or F]: The purpose of the Project Report (PR) is to define the solution.
  - c. [T or F]: The purpose of the Measures of Success is to persuade the client that your recommended design is the right design for them.
  - d. [T or F]: Idea selection defines the client's need by specifying the boundaries of the design problem.
  - e. [T or F]: The purpose of prototyping the design is to test the success of a design.
  - f. [T or F]: Design reports are written using a process called concision.
  - g. [T or F]: Considering the most-to-least way to prevent negative environmental impact, an engineering designer would: Reuse, Reduce, Recycle.
  - h. [T or F]: Every communication assignment should begin with research.
  - i. [T or F]: A constraint goal is the metric that the design tries to meet.

2. The design process is iterative in nature and a successful conceptual design will go through multiple processes, multiple times, before a final design is achieved. Draw an overview of the engineering design process that shows the iterative cycles that engineers go through during a typical engineering design. [10 Marks]

Take a holistic approach that clearly demonstrates your understanding of the overall engineering design process. Include as many stages as possible and avoid listing topics like FOC. **Take note:** Your answer must be drawn and labelled.

Questions 3 to 10 pertain to the Request for Proposal (RFP) – Security System for Foldable Electric Car

3. Identify the functionality of the problem using the three steps below (3.a to 3.c)
- a. Write a Gap for the problem. [3 Marks]

- b. Write a Functional Basis for the problem. It must be linked to your Gap. [3 Marks]

- c. Write one Primary Function and Two Secondary Functions for the problem. It must be linked to your Functional Basis in Question 3.b. [3 Marks]

4. Write a Problem Statement for the RFP. [10 Marks]

5. Perform a communication assessment. [5 Marks]

6. Write two Constraints complete with metric. (Limits not required) [4 Marks]

7. Write three Objectives complete with metric (goal is not needed). List them in order of importance and give evidence of this ranking. [6 Marks]

[Large empty rectangular box]

8. Identify three key Stakeholders upon whom the design will have significant impact and describe the impact. Avoid the client, user or design team. [3 Marks]

[Large empty rectangular box]

9. Identify three **specific** aspects of the Service Environment. [3 Mark]

[Large empty rectangular box]

10. Using two different idea generation methods, other than Brainstorming/Enumeration, generate and describe two **feasible** design alternatives. Identify which method was used for each design and why was it used. The more innovative and distinctly different the approach of the design alternatives, the more marks you will receive. [12 Marks]

11. Using the three Objectives you generated above and a Weighted Decision Matrix, recommend one of your alternative designs to the client. This recommendation must use the SEE structure for a credible argument as discussed in class. [12 Marks]

12. Identify the impact of your recommended design on one Stakeholder and on one Environmental Factor. Provide justification and an action plan to mitigate the impact. [6 Marks]

13. Using the three Objective you identified above, provide a detailed plan on how to evaluate the performance of your recommended design. Include measurements, tests and other engineering methods in this performance evaluation. [6 Marks]

14. If you were tasked with this RFP, you would need to do more research. With regard to Performance Measure, give three examples of research questions/areas you need to investigate and the type of source that would provide credible information. [3 Marks]

