

National Exams May 2019

16-Mec-B5, Product Design and Development

THREE (3) hours duration

NOTES:

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.
2. This is an OPEN BOOK EXAM. One of two calculators is permitted - any Casio or Sharp approved model.
3. Question ONE (1) must be completed and is worth 40%, choose FOUR (4) out of the SIX (6) remaining questions each worth 15% for a total of 100%.
4. The first FIVE (5) questions as they appear in the answer book will be marked.
5. Most questions require an answer in essay format or the use of tables, figures and charts. Clarity and organization of the answer are important.

QUESTION 1 MUST BE COMPLETED.

Question (1) (40 Marks)

There is considerable concern that Canada is not keeping up with the productivity levels of other countries. Consider a simple definition of productivity:

$$\text{Productivity} = \frac{\text{Output (products produced)}}{\text{Input (resources used)}}$$

This problem explores how good product design can be used to improve productivity. In answering this question consider how a design effects utility or marketability of a product produced and for resources consider how a design impacts the materials, processes including automation and labour used.

Select ONE (1) of the following THREE (3) products and use it to demonstrate how you would improve the productivity expression.

- i. PC Case
- ii. Bicycle
- iii. Cell phone

*Suggestion: This is meant to be an open-ended question where your ability to outline and follow a defined design process to meet the objective is more important than the actual design improvement that you come up with so develop a design direction and consistently follow A. – E. showing your key decisions made through your design process. I would recommend focusing your improvements at a high-level and discuss the design in general terms.

- A. Pick a product from the list (i-iii) and outline FOUR (4) ideas of how you can improve productivity through design keeping in mind the simple definition.
- B. Select one of your ideas from part A and outline a detailed design for the product that captures this idea.
- C. Outline and describe how your design changes suggested in part B. will impact the productivity relationship provided.
- D. Discuss how you would convert your high-level design ideas outlined in part B. into realistic engineering specifications.
- E. In many cases not all design specifications can be met. Outline and describe how you would go about establishing priorities as part of the design process.

CHOOSE FOUR (4) OUT OF THE SIX (6) REMAINING QUESTIONS.

Question (2) (15 Marks)

- A. Discuss the advantages and disadvantages of taking a team approach to design.
- B. Describe the characteristics of a high performing design team.
- C. Outline THREE (3) challenges that can be faced if the whole team is not in one location.
- D. Provide ONE (1) solutions to each challenge outlined in C.

Question (3) (15 Marks)

- A. Describe the THREE (3) main stages in the life of a product that need to be considered when designing a product for its full life cycle.
- B. List and describe FIVE (5) factors that should be considered when calculating the life cycle costs associated with a new product.

Question (4) (15 Marks)

- A. Provide a working definition of a Canadian patent.
- B. What are the basic requirements for preparing a patent?
- C. If two people have the same idea who does the patent get awarded to in Canada?
- D. Under what conditions would you not be able to get a patent?
- E. If you cannot get a patent, outline another way you can try to protect your idea.

Question (5) (15 Marks)

- A. What are some of the first indications that a product design or development process is going badly?
- B. List FIVE (5) common underlying causes.
- C. Identify ONE (1) corrective action that can be taken to address each cause listed in part B.

Question (6) (15 Marks)

- A. Identify and describe FIVE (5) distinct phases in a product development process.
- B. Describe the decisions that need to be made after each phase and how iteration can be used to save money and develop a better design.
- C. Outline how concurrent engineering can impact product development costs and timelines.

Question (7) (15 Marks)

- A. Outline the conflicting requirements for Design for Manufacturing and Design for Assembly.
- B. Provide an example of an improvement that meets the objectives of Design for Manufacturing but not Design for Assembly.
- C. Provide an example of an improvement that meets the objectives of Design for Assembly but not Design for Manufacturing.
- D. Outline a process you would employ to resolve this conflict and make a sound decision.