

## National Exams December 2018

### 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. Approved Casio or Sharp calculator is permitted.
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)

Select ONE (1) of the following THREE (3) products and use it to demonstrate how you would improve the functional and non-functional aspects of a design.

- i. Office Chair
- ii. Kitchen Table
- iii. Bicycle

\*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. Provide a description of functional versus non-functional aspects of ONE (1) of the products (i, ii, iii) listed above and outline how you could quantify each of them.
- B. Using the same product chosen in A. outline THREE (3) design ideas that will improve the product from a functional and THREE (3) ways from a non-functional perspective for a new market segment.
- C. Outline and describe how your design changes suggested in part B. will impact the manufacturing process and cost of the product.
- 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 differences in goals an engineer has versus an artist has when designing a new product.
- B. Compare the design process they would each use to realize their goals.
- C. Comment on the differences in end customers each are working to satisfy.
- D. Describe the challenges associated with communicating the design details to the manufacturing team and end customers in each case.

Question (3) (15 Marks)

- A. List FIVE (5) common factors which limit a design in many applications.
- B. Provide suggestions on what an engineer can do to overcome the limitations listed in A.

Question (4) (15 Marks)

- A. List FIVE (5) options that are available for protecting your idea.
- B. Provide ONE (1) example where each is best used to provide an inventor with protection.
- C. What process would you use to discuss an invention with someone before it is fully protected.
- D. Provide TWO (2) options that are available to an inventor to commercialize their invention.

Question (5) (15 Marks)

- A. Compare the design process a designer developing a totally new product would go through versus a designer refining a product.
- B. Describe differences in how the design process might be guided.
- C. Describe differences in how the design process might be assessed.

Question (6) (15 Marks)

- A. List and describe FOUR (4) key pieces of information a designer needs to communicate to the manufacturing team to realize a product.
- B. Describe the challenges a design engineer would experience working with a manufacturing team that speaks a different language.
- C. Outline and describe THREE (3) tools that could be used to facilitate the communication process between the design and manufacturing team if they spoke different languages?

Question (7) (15 Marks)

- A. Outline the Design for Manufacturing and Assembly (DFMA) process and how it can be used to improve a product.
- B. Describe a typical change a product will experience when it goes through a DFMA process.
- C. How does the degree of automation used in production impact the DFMA process?