

## National Exams May 2016

### 07-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. No 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 functionality of the product. The focus for this question is on incorporating design features in products that improve the functioning of the device for a specific user group. Functionality is very subjective but is often based on an improvement in a critical aspect of its use.

- i. Can opener
- ii. Water bottle
- iii. Bicycle

\*Suggestion: This is meant to be an open-ended question where your ability to outline and follow a defined design process is more important than the actual design improvement that you come up with so develop a design direction and consistently follow it through to completion showing each step in the design process. I would recommend focusing your improvements at a high-level and discuss things like overall shape, size and functionality of main features and the full product, consider how the main components interact and how the product interacts with the end user as well as major material and manufacturing issues.

- A. List and describe THREE (3) very general ways one can make a product more functional for a specific user group like users with special needs.
- B. Pick ONE (1) product from the list above and then outline how you would improve it specifically for users with special needs in the THREE (3) ways listed and described in Part A.
- C. Outline and describe how your design change might impact society in general. List THREE (3) improvements that could be made to improve the impact on society.
- D. Using the THREE (3) design changes from Part B generate a set of realistic engineering specifications to implement your changes.
- E. Sometimes not all design specifications can be met. Outline and describe THREE (3) things you could do if all of the design specifications in Part D cannot be met.

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

Question (2) (15 Marks)

- A. Outline the main goal of Design for Manufacture and Assembly (DFMA).
- B. Provide an example of a common joining strategy consistent with DFMA objectives. Be sure to outline details on its features which specifically enhance its manufacturability and assemble ability.
- C. Discuss the stage in the new product development process when DFMA principles should best be applied. Clearly identify when it is too late.
- D. Discuss the different considerations that should be taken into account when the product is to be manually assembled or assembled using automated processes.

Question (3) (15 Marks)

- A. Discuss THREE (3) different ways to communicate important design information within a design team.
- B. Compare and contrast how the ways used might change when individual team members are located in the same room versus around the world, remote from one another?
- C. Outline and describe the challenges associated with passing information from the product design team to the manufacturing team.

Question (4) (15 Marks)

- A. Describe why a company may choose to have a visitor to their facility sign a nondisclosure agreement (NDA).
- B. Identify and describe FIVE (5) different options for securing intellectual property.

Question (5) (15 Marks)

Consider the impact that the internet of things, also called cyber physical systems (interconnected devices with integrated sensors) is having on innovation and new product development.

- A. Consider ONE (1) of the THREE (3) products listed below and outline how computer technology in specific, interconnect devices with integrated sensors can impact how a customer interacts with the product.
  - i. Household thermostat
  - ii. Refrigerator
  - iii. Cell phone
- B. Discuss how interconnected devices with integrated sensors can be used to open up the design space for the product you selected in Part A.
- C. Identify and describe TWO (2) major challenges associated with implementing interconnected devices with integrated sensors.

Question (6) (15 Marks)

- A. Outline the process you would go through to enhance the reliability or robustness of a product.
- B. How can this be validated?
- C. How would one assess success?

Question (7) (15 Marks)

- A. Outline THREE (3) different materials that can be used to manufacture a computer case and the challenges associated with using each material.
- B. Outline how the choice of material impacts its final use.
- C. Outline how the choice of material impacts the manufacturing process?
- D. Develop a framework for material selection and apply it to select the material to make the computer case.

## Marking Scheme

### Required Problem (40 marks)

1. (a) 9 marks
- (b) 9 marks
- (c) 4 marks
- (d) 9 marks
- (e) 9 marks

### Choice 4 of remaining 6 (60 marks):

2. (a) 3 marks
- (b) 6 marks
- (c) 2 marks
- (d) 4 marks
3. (a) 6 marks
- (b) 6 marks
- (c) 3 marks
4. (a) 5 marks
- (b) 10 marks
5. (a) 6 marks
- (b) 5 marks
- (c) 4 marks
6. (a) 9 marks
- (b) 3 marks
- (c) 3 marks
7. (a) 3 marks
- (b) 3 marks
- (c) 3 marks
- (d) 6 marks