

National Exams December 2015

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 quality of the product. The focus for this question is on incorporating design features in products that improve the quality of the design. High quality is very subjective but is often based on an improvement in a critical area over another product.

- i. Car
- ii. Mobile Computer
- 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 better.
- B. Pick ONE (1) product from the list above and identify a typical customer, then outline how you would improve it in the THREE (3) ways listed and described in Part A for the typical customer you identified.
- 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)

Consider the impact that Additive Manufacturing, also known as 3D printing or rapid prototyping is having on innovation and new product development.

- A. Consider ONE (1) of the THREE (3) products listed below and outline how additive manufacturing can impact the functionality of that product.
 - i. Workpiece fixture for a machining operation
 - ii. Component mounting bracket
 - iii. Surgical implant used to repair a broken bone or missing tooth
- B. Discuss how additive manufacturing can be used to open up the design space for the product you selected in Part A.
- C. Identify and describe TWO (2) major impacts additive manufacturing can have on the final manufacturing process for the product you selected in Part A.

Question (3) (15 Marks)

- A. Outline the main objectives of Design for Manufacture and Assembly (DFMA).
- B. Provide THREE (3) examples of common design features consistent with DFMA objectives.
- 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 (4) (15 Marks)

- A. Discuss THREE (3) different ways to communicate important design information within a design team.
- B. Describe how the ways used might change when individual team members are located around the world, remote from one another?
- C. Outline and describe THREE (3) tools that are commonly used to enable the communication process?

Question (5) (15 Marks)

- A. Identify and describe FIVE (5) different options for securing intellectual property (IP) associated with a design.
- B. Pick an example of a recently launched product and outline the advantages and disadvantages of using each option listed in Part A. Be sure to outline which one you would ultimately have recommended.

Question (6) (15 Marks)

- A. Compare and contrast the thought process an industrial design engineer developing a new product would go through versus a manufacturing process engineer developing a new process versus an artist developing an art installation (public sculpture).
- B. Describe TWO (2) ways in which they would each describe critical information in their design.
- C. How would one assess success in each case?

Question (7) (15 Marks)

- A. Outline THREE (3) different materials that can be used to manufacture a table 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 table.

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