

## National Exams December 2017

### 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%. Marking Scheme is on page 4.
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 a typical design for manufacturability. The focus for this question is on incorporating design features that improve productivity and reduce cost.

- i. Hair dryer
- ii. Coffee maker
- iii. Computer desk

\*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 some key decisions made in your design process. I would recommend focusing your improvements at a high-level and discuss things like overall shape, size and functionality of main features of the full product, consider how the main components interact and how the redesign impacts major material, manufacturing, use and disposal issues which trigger lifecycle costs.

- A. List and describe TWO (2) very general ways one can assess manufacturability of a product. Pick one of the methods and outline how you would establish process feasibility and cost data.
- B. Pick ONE (1) product from the list above and then outline THREE (3) ways that you could use input from the method you described in A to improve its manufacturability.
- C. Outline and describe how your design change might impact the production floor in general.
- D. Discuss how you would convert design improvement ideas into realistic engineering specifications to implement your changes.
- E. Sometimes not all design specifications can be met. Outline and describe how you would go about establishing priorities for the design to meet manufacturing targets in terms of productivity and cost.

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

Question (2) (15 Marks)

- A. Provide a functional definition of Design as a verb and Design as a noun.
- B. Summarize some of the important steps in a typical design process.
- C. Comment on the importance of iteration in the design process.
- D. List the key requirements that define a final complete design.

Question (3) (15 Marks)

- A. Propose THREE (3) questions you would ask a manufacturing engineer when specifying a tolerance for a component.
- B. Describe the main concepts behind Design for Manufacturing and Assembly (DFMA) and outline how they can be used to improve a product.

Question (4) (15 Marks)

Consider the process one would go through to protect an idea:

- A. How would you work with others early in the design process before ideas are finalized?
- B. What are some of the challenges facing a new designer in terms of protecting their ideas?
- C. List FIVE (5) options that are available for protecting your idea.
- D. Provide ONE (1) example product where each is used for the FIVE (5) options listed in C.

Question (5) (15 Marks)

- A. Compare and contrast the thought process a designer developing a new product would go through versus a manufacturing process engineer developing a new process.
- B. Describe ways in which they would each represent critical data in the design and development process.
- C. How would each engineer assess success?

Question (6) (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 (7) (15 Marks)

- A. Select THREE (3) different materials that can be used for a bicycle crank arm and how each would impact the operation of a bicycle.
- B. List FIVE (5) design criteria for a bicycle crank arm.
- C. Develop a framework for material selection and apply it to select the best material to make the component.
- D. Show how your framework can be adjusted to target different markets (commuters, road racing and mountain biking).



## Marking Scheme

### Required Problem (40 marks)

1. (a) 8 marks
- (b) 8 marks
- (c) 8 marks
- (d) 8 marks
- (e) 8 marks

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

2. (a) 4 marks
- (b) 4 marks
- (c) 3 marks
- (d) 4 marks
3. (a) 8 marks
- (b) 7 marks
4. (a) 2 marks
- (b) 5 marks
- (c) 5 marks
- (d) 3 marks
5. (a) 6 marks
- (b) 5 marks
- (c) 4 marks
6. (a) 6 marks
- (b) 3 marks
- (c) 6 marks
7. (a) 3 marks
- (b) 3 marks
- (c) 3 marks
- (d) 6 marks