

National Exams December 2013

**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 your understanding of the design process based on items A – F below. The focus for this problem is on incorporating features in products that make them more universal in nature and target the needs of people with disabilities.

- i. Bottle Opener – person with limited hand grip strength due to arthritis
- ii. Bicycle – limited use of legs and problems with balance
- iii. Artificial limb – below the knee amputation of both legs but otherwise fit

\*Suggestion: This is meant to be an open ended question where the process is more important than the actual design so develop a design direction and consistently follow it through to completion showing each step in the design process. I would recommend focusing your specifications of interest at a high level and discuss things like overall shape and size 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. Pick one product from the list then outline three (3) different ways of establishing design specifications for your product.
- B. Pick one of the methods you identified in part A and summarize the nature of the information that would be potentially collected for the product you choose.
- C. Using the general data summary from part B generate a set of realistic specifications for your product.
- D. Using simple sketches show THREE (3) different general design concepts which address the design requirements you outlined in B. Be sure to outline how you would convert the specifications into material requirements, overall geometry and specific features as well as general dimensions and show rough values on the sketches.
- E. Outline a methodology that could be applied to compare the design alternatives.
- F. Apply your methodology to rank your design ideas and select one design as the best one.

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

**Question (2) (15 Marks)**

- A. Outline the objectives of Design For Manufacture and Assembly (DFMA).
- B. Provide 3 examples of common design features consistent with DFMA objectives.
- C. Discuss the stage in the new product development process when DFMA principles should be applied.
- D. Discuss the considerations that should be taken into account when the product is to be manually assembled or using automated processes.

**Question (3) (15 Marks)**

- A. List and discuss three (3) different applications for computers which can be used to aid in the design process.
- B. Outline how these are changing as computer related technologies are developing.
- C. Discuss the role of the human designer as computer technologies develop.

**Question (4) (15 Marks)**

- A. Provide a definition of design.
- B. Identify three (3) ways in which an engineer's design process is similar to that of an artist's artistic process.
- C. Identify three (3) ways in which an engineer's design process is different than an artist's artistic process.

**Question (5) (15 Marks)**

- A. Identify and discuss three (3) challenges designers often experience which limit the design process.
- B. Discuss ways a designer can overcome each challenge listed in part B.
- C. How has technology helped to address these challenges over the years?

**Question (6) (15 Marks)**

When redesigning an existing product, designers can apply a number of design techniques like Design for Manufacturing, Design for the Environment, Universal Design.

- A. List two (2) different constraints for each of the three techniques outlined above.
- B. Using examples provide an outline of how the technique impacts the redesign process.
- C. Outline the impact that these different techniques have on society as well as short term and long term financial costs.

**Question (7) (15 Marks)**

- A. Outline three (3) different ways of manufacturing a bike pedal.
- B. What factors in design are important in choosing a final manufacturing process?
- C. Develop the framework of a selection method for choosing the best manufacturing technique for your target market based on your design.

## Marking Scheme

Required Problem (40 marks)

1. (a) 6 marks
- (b) 9 marks
- (c) 9 marks
- (d) 6 marks
- (e) 4 marks
- (f) 6 marks

Choice 4 of remaining 6 (60 marks):

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