National Exams December 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. One of two calculators Casio or Sharp models.

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 cost effectiveness of the product. The focus for this question is on incorporating design features in products that improve the value to cost ratio.

i. Household safe
ii. Utility trailer
iii. Car roof rack for bicycles

*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 to showing some key considerations 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 of the full product, consider how the main components interact and how the product interacts with the end user as well as major material, manufacturing, use and disposal issues which trigger costs.

A. List and describe THREE (3) very general ways one can make a product more cost effective in general. In this case try to consider full life cycle costs in your analysis.

B. Pick ONE (1) product from the list above and then outline how you would improve it 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. Provide a functional definition of Design for Manufacture and Assembly (DFMA).
B. Provide an example of a common strategy consistent with DFMA objectives for improving manufacturing and assembly.
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. Design can be radical or incremental in nature. Provide TWO (2) examples of each using existing products and highlight the aspects which make them radical or incremental.
B. Comment on how consumer adoption differs for radical and incremental design changes.
C. What factors make a society more open to radical change?

Question (4) (15 Marks)

A. When are nondisclosure agreements (NDA) used and why?
B. Identify and describe FIVE (5) different options for securing intellectual property.

Question (5) (15 Marks)

There has been considerable discussion around the notion that Canada is lagging behind other regions in the world in terms of productivity.

A. Outline how design can be used to enhance productivity.
B. Describe the ways in which innovations in materials can improve productivity.
C. Describe the ways in which innovations in manufacturing processes can improve productivity.

Question (6) (15 Marks)

A. Outline the process you would go through to enhance the reliability or robustness of a product.
B. How would you validate this during the design process?
C. How would you measure and quantify success in the long run?

Question (7) (15 Marks)

A. Outline THREE (3) different materials that can be used to manufacture a kitchen 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 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) 8 marks
   (b) 4 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