

National Exams May 2014

**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 your understanding of the design process using items A – F below. The focus for this problem is on incorporating features in products that make them more sustainable. Sustainability of a product relates to its ability to be used without excessively taxing future generations. Note many of the design challenges relate to addressing sustainability include societal issues as well as technological issues.

- i. Hot Water Heater
- ii. Bicycle
- iii. Green bin for organic waste

\*Suggestion: This is meant to be an open-ended question where your ability to outline a defined design 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 above then outline how you would establish its current level of sustainability.
- B. Using the product selected in part A outline two design changes which you could implement to enhance its sustainability.
- C. Clearly outline how your design change impacts the long-term sustainability of the design.
- D. Using the design change from part B generate a set of realistic engineering specifications to implement your change.
- 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 that best enhances the sustainability of the selected product.

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

Question (2) (15 Marks)

Product design is often limited by materials and manufacturing processes.

A. Consider ONE (1) of the THREE (3) products listed below and outline the recent advancements in terms of technology, materials or manufacturing processes which make them commercially viable.

- i. Tablet computer
- ii. Hybrid electric vehicle
- iii. Segway

B. Given current trends speculate what changes might occur in the future for the product selected in Part A and discuss how it will impact future designs of the product.

C. Identify and describe TWO (2) major drivers for the changes that are taking place with the product you selected in Part A.

Question (3) (15 Marks)

Design teams are often times spread around the globe.

A. List and discuss three (3) challenges that these design teams face as they work on an integrated design team.

B. Outline how these challenges might impact the final design both positively and negatively.

C. Provide suggestions for enhancing positive aspects and overcoming challenges.

Question (4) (15 Marks)

A. Compare and contrast an engineer's design process to that of an artist's artistic process. For the Artist consider the thought process they would go through to come up with an idea for a painting or a sculpture.

B. Outline ways they can work together to enhance both of their objectives.

C. Outline where in the design process each group's skills are best applied.

Question (5) (15 Marks)

A. Identify and discuss three (3) technologies a designer can use to enhance the quality of their design.

B. Outline how these technologies can be interfaced to allow for a smooth transition from one technology to another.

Question (6) (15 Marks)

When designing a new product, designers can apply design techniques like Design for Manufacturing and Assembly, Design for the Environment and Universal Design.

- A. List TWO (2) different aspects of a products design which each addresses.
- B. Using examples provide an outline of how the proposed design techniques impacts the design process.
- C. Outline the short term and long term costs of applying these three techniques to a product design process.

Question (7) (15 Marks)

- A. Outline THREE (3) different materials that can be used to manufacture a coat hanger and the challenges associated with using each material.
- B. Outline how the choice of material impacts the design.
- C. Outline how the choice of material impacts the manufacturing process?
- D. Develop a framework for material selection and apply it to the coat hanger example.

