



UNIVERSITY OF GHANA
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SECOND SEMESTER EXAMINATIONS: 2012/ 2013

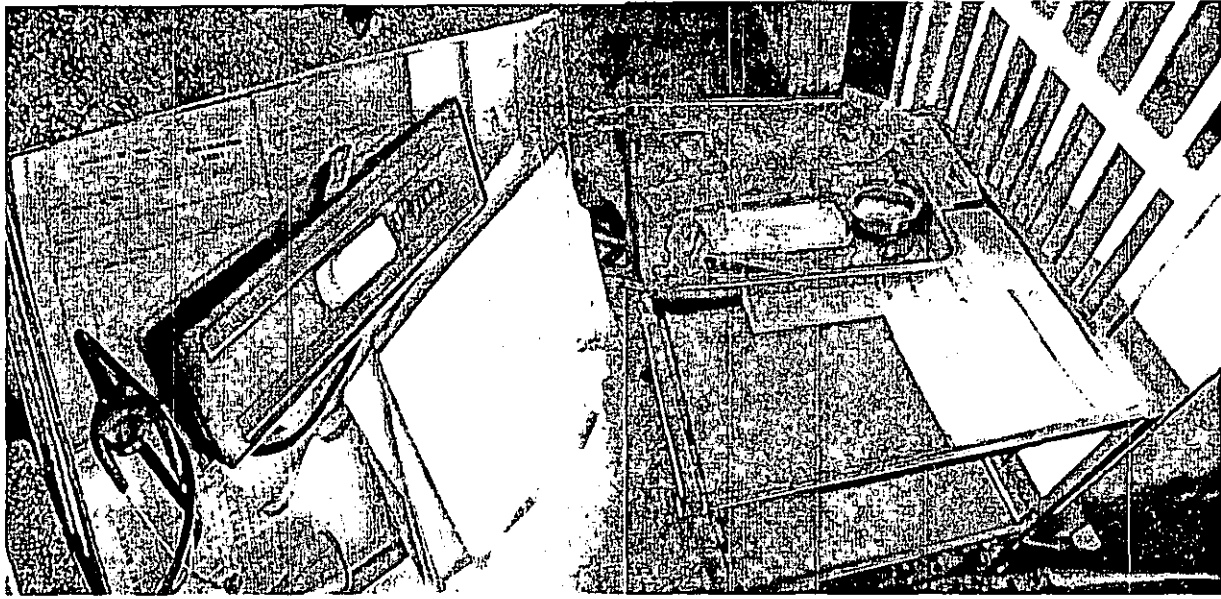
LEVEL 300 / 400: BACHELOR OF SCIENCE IN BIOMEDICAL ENGINEERING

BMEN 306 / BIEN 404: Design and Selection of Biomaterials (3 Credits)

Total Marks: **100.** Time allocation: 3 Hours

Attempt all questions.

1. During ward rounds, physicians move from patient to patient to check for the progress of their health conditions. To help ascertain this, they usually take along with them a number of items such as the sphygmomanometer, stethoscopes, test tubes, syringes, patient folders, prescription sheets among others. During a need assessment at the Korle-Bu Teaching Hospital, it was observed that most of these items were put on a mobile trolley. Unfortunately, when the wind blows, the light weight items fall off the trolley. The design of the trolley also makes it difficult for the doctors to write on it since not all beds have platforms that allow the doctors to comfortably take notes. The constant bending down to take notes is not the only discomfort but also results in waist pains due to the large number of patients they see each day. The surface design of the trolley also makes it difficult searching for a particular folder or document as the surface looks clumsy resulting from the number of materials placed on it (see Figs. 1a and b). The castors attached to the trolley also become locked due to rust (Korle-Bu is near the sea) resulting in immobility of the trolley after some time. You have been approached by a Physician to help come up with a design to address the problems above.



(a)

(b)

Fig. 1 (a) and (b): Trolleys used for ward rounds

Some of the user requirements from the client:

- i) The device should help them take notes comfortably at all times
 - ii) The device should be adjustable (it should be able to accommodate Physicians of all heights)
 - iii) It should allow to keep and easily access their documents at all times
- a) List **four** other product attributes that will be important in this project and explain why each of them is important. [16 marks]
 - b) i) Develop a table of specifications for the product starting from objective tree, functional analysis and specifications checklist.
 ii) Give **three** reasons why specification is important to the manufacturer [30 marks]
 - c) Develop at least **two** concepts for the product using your specifications. [10 marks]
 - d) Select one of the concepts for further development using decision matrix. [5 marks]

Note: Be sure to explain all scales used (arbitrary or otherwise). Also make a good attempt to have **quantitative target values**. You may use **qualitative** terms like "low", "high", etc where it is impossible to use quantitative values.

- a) What is extrusion? What are the advantages of extrusion over rolling and forging
- i) Explain why **high** elongation is important in manufacturing.
- ii) A piece of a material originally 305 mm long is pulled in tension with a stress of 276 MPa. If the deformation is entirely elastic, what will be the resultant elongation? Take Young's modulus of the material to be 110 GPa. [15 marks]
- b) Explain the difference between the **two** main types of plastics. Give **two** examples of each and **discuss** how these materials will be processed? [12 marks]
- c) i) Name **five** important mechanical tests which will give variable information about a material selected for medical device .
- ii) Explain with necessary formulations, the procedure to be adopted in any one in (i). [12 marks]

