Introduction to Biomedical Engineering: Spring 2021

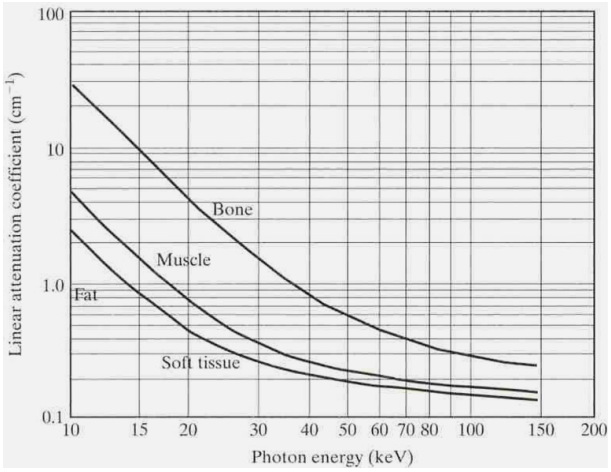
Homework 5

Due: **6/17 PM 1:10**

As usual, please submit your homework in .doc, .docx or .pdf file to me (*chuang@mail.ee.nsysu.edu.tw*). The file name should appear as "your student ID"-hw4. For example: B049011099-hw4.doc. NO late homework permitted.

1. According to the statistical report provided by Taiwan government, the top-1 leading cause of cancer death since 2004 was cancers of trachea, bronchus and lung. Among this category, lung cancer, formally termed lung carcinoma, raises increasing attention from the public in recent years due to its high mortality and high occurrence in non-smoking population. To improve the prognosis of lung cancer, early detection of tumor plays an important role because research studies found that the survival rate of early-stage lung cancer is substantially higher than that of late-stage. Unfortunately, most of the patients are not accurately diagnosed until late stage since early symptoms of lung cancer are easily ignored or mistaken with flu or allergy. What kind(s) of medical imaging modality is recommended for the examination of lung cancer? Please introduce the technique(s) and it would be great if more details on imaging setting can be provided.

2. This figure shows the X-ray linear attenuation coefficients (μ) for bone, muscle, and fat as a function of the incident X-ray photon energy.



   (a) It is known that the mean energy of an X-ray beam increases with its passage through tissue. In other words, when the X-ray penetrates the target tissue deeper, the average energy of it gets higher despite the X-ray intensity decreases in a mono-exponential decay. Explain why according to this plot.

   (b) The phenomenon described in (a) is termed "beam hardening", which could cause artifacts in CT radiography. Please explain the possible pattern of the artifact (how does it look like?) and its formation (how is it formed during reconstruction of CT?).