City University of Hong Kong
BME 2105 Introduction to Biomedical Engineering
Homework Assignment I

Student No.: _____
Name: _____
Date of submission: _____

Please answer the following questions PRECISELY and CONCISELY:

1. Phospholipids can assemble into stable structures, such as bilayer membranes. Explain why these structures are stable, and what chemical features of phospholipids are important in this behavior.

2. What is hybridization of a nucleic acid? What chemical forces are responsible? Please describe one practical application of nucleic acid hybridization.

3. Please list at least 5 ways that nature use to regulate gene expression, and elaborate each process with one or two sentences.

4. Please list and explain two types of gene therapy technologies. What are your thoughts about current and future gene therapies?

5. In MRI imaging, two types of external magnetic fields are applied, B0 and B1. Please explain the specific utilities of these two fields, and also point what components of a MRI machine are used to generate the fields?

6. Both X-ray and Computerized Tomography use x-ray as the radiation source for examination. Please describe the instrumental difference between these two technologies.

7. Please give three examples of neural interfaces that is currently or potentially used for treating brain diseases. Also explain their similarities and differences.

8. In our lecture, we introduced nucleic acid sequencing for analyzing DNA or RNA. Another commonly used method to acquire the DNA/RNA sequence information is GENE chip. Please look into this method, and find out how a gene chip is produced, and also explain how it is different than sequencing, what is the Pros and Cons in comparison to sequencing.

9. Nano holes are used in the third generation of sequencing method developed by Pacific Biosciences. Given a cylindrical hole of 70 nm wide and 100 nm high, what is the volume of this hole? what is the concentration if it contains only one molecule of protein X?

10. In the COVID-19 pandemics that has been lasting for almost two years, PCR based method has been the major and gold standard method for detecting virus RNAs for diagnostic purpose. Please try to find out if there any alternative RNA detection technique that does not involve PCR? If so, what is the limitation of those methods in comparison to PCR based assays.

11. What is the mechanism for generating the imaging contrast in MRI and ultrasonic imaging?