Time:1 Hour 30 Minutes   Full Marks: 120

N.B.   i) Answer **ANY TWO** questions from each section in a separate script.
ii) Figures in the right margin indicate full marks.

Section A
(Answer **ANY TWO** questions from this section in Script A)

1. a) Define transducer. Briefly discuss the types of biosensors in terms of receptor-   (12)
analyte chemistry with their detection strategies.

b) Explain various bioreceptors used to make a sensor biologically active with   (13)
appropriate examples.

c) Write down the features of an ideal biosensor.   (05)

2. a) Write short notes on:- i) Potentiometric Biosensors, ii) Amperometric Biosensor   (12)
iii) Impedimetric Biosensor.

b) Why is calibration significant for biosensors? Demonstrate with necessary figures.   (08)

c) Briefly explain the hydrogen gas (H_2) sensing mechanism with a Schottky   diode-   (10)
based biosensor with its necessary architecture.

3. a) Briefly explain the sensing principle of resistors based on metal oxide   (15)
semiconductor for the detection of CO gas.

b) How does FET sense the presence of a biological target? Explain the process with a   (10)
basic FET structure.

c) How can biosensors be utilized in biodefense applications?   (05)

Section B
(Answer **ANY TWO** questions from this section in Script B)

4. a) Briefly explain the workflow chart of 2-D gel electrophoresis technique.   (10)

b) How many steps are involved in measuring gene expression in a biological sample   (12)
using DNA microarray? Explain them briefly.

c) Explain the surface chemistry of cDNA probes.   (08)

5. a) Describe the DNA microarray fabrication technique that uses the photolithography   (12)
process.

b) Can Functional protein microarray show the differential expression of protein? If it   (12)
could detect differential expression of protein, how would you explain it? If not,
which protein microarray do you think is appropriate for it?

c) Why is gold used as a surface material for Biochips design?   (06)

6. a) What are the main components of a Biochip? Explain them briefly.   (10)

b) Describe Ink-jet printing fabrication process for biochip design.   (15)

c) What are the direct detection microarrays' applications?   (05)

Khulna University of Engineering & Technology
B. Sc. Engineering 4ᵗʰ Year 1ˢᵗ Term Examination, 2020
Department of Biomedical Engineering

BME 4141
Brain and Neuroengineering

Time:1 Hour 30 Minutes   **Full Marks: 120**

N.B.   i) Answer **ANY TWO** questions from each section in **corresponding answer script**.
        ii) Figures in the right margin indicate full marks.

Section A
(Answer **ANY TWO** questions from this section in **Script A**)

1. a) What are the main areas associated with language? Explain them briefly with a neat   (10)
        sketch.

    b) What is an artificial retina? Discuss the working principle of an artificial retina.   (14)

    c) What are the negative effects of nerve regeneration?   (06)

2. a) Define Neuroprosthesis. How does neuroprosthesis work? Explain briefly with a   (12)
        proper diagram.

    b) What is FES? How does FES work?   (10)

    c) How does neuron encode information?   (08)

3. a) Discuss the interactions between EPSPs and JPSPs with necessary sketch.   (08)

    b) What is Parkinson's Diseases (PD)? How does PD affect the Brain?   (12)

    c) Discuss the working principle of Electronic Nose with a necessary diagram.   (10)

Section B
(Answer **ANY TWO** questions from this section in **Script B**)

4. a) What is EEG? Describe EEG patterns characteristics with suitable diagram.   (12)

    b) Draw the block diagram of BCJ system.   (07)

    c) Drive the ARMA model for feature extraction of EEG.   (11)

5. a) What is hemodynamic response (HDR)? What are the procedures of fMRI to   (14)
        measure of brain function?

    b) What is BOLD fMRI signal? Describe the BOLD response curve of fMRI device.   (16)

6. a) What is fNIR? What are the principles of fNIR?   (08)

    b) What is SQUID? Why do we need MEG helmet?   (10)

    c) Draw the construction of a MEG-Dewar. Mention each of it.   (12)

Time:1 Hour 30 Minutes   **Full Marks: 120**

N.B.   i) Answer **ANY TWO** questions from each section in a separate script.

    ii) Figures in the right margin indicate full marks.

Section A
(Answer ANY TWO questions from this section in Script A)

1.   a)   Distinguish between direct and indirect imaging system. Give examples to illustrate each   (10)
system.

   b)   Why is sensor used in image processing? What are the basic parts of a photo sensor?   (10)

   c)   Demonstrate the working principle of a radiographic film.   (10)

2.   a)   Illustrate aliased frequency with suitable example.   (10)

   b)   Demonstrate the method of image sensing with a single sensor and a sensor strip with   (10)
suitable application.

   c)   Explain how histogram stretch and histogram equalization improves the image quality.   (10)

3.   a)   Illustrate smoothing spatial filters and sharpening spatial filters. How can we implement   (15)
them on a digital image?

   b)   Show the steps of histogram equalization for the image of size 5×5 given in the table 2(a):   (15)

Table 2(a)

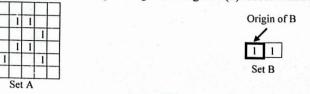| 3	1	0	5	0
6	2	5	7	6
7	5	3	6	5
3	7	4	6	4
5	7	6	4	7

Section B
(Answer ANY TWO questions from this section in Script B)

4.   a)   What is image segmentation? What are the main consideration points to segment a   (10)
biomedical image?

   b)   Briefly explain the role of illumination in biomedical image processing. Also give a solution   (10)
to reduce the effect of illumination.

   c)   Write down the algorithm to obtain basic global threshold automatically.   (10)

5.   a)   Why color image processing is necessary for biomedical image processing? Why R, G, B is   (14)
considered as primary color?

   b)   Explain the purpose of pseudo color imaging processing. Briefly explain gray level to color   (10)
transformation method with necessary diagram.

   c)   An RGB color image has the following color planes. Convert this from RGB to HSI.   (06)

$$R = \begin{bmatrix} 75 & 83 \\ 14 & 45 \end{bmatrix}, G = \begin{bmatrix} 105 & 185 \\ 112 & 180 \end{bmatrix}, B = \begin{bmatrix} 45 & 38 \\ 49 & 41 \end{bmatrix}$$

6.   a)   Perform dilation operation of set A by set B given in figure 6(b). Set B is structuring element.   (10)

Figure 6(b)

   b)   State and prove the duality between dilation and erosion.   (10)

   c)   How Hit or Miss transformation can be used to find the location of a small shape at large   (10)
image?

Khulna University of Engineering & Technology
B. Sc. Engineering 4th Year 1st Term Examination, 2020
Department of Biomedical Engineering
BME 4131
Bio-optics

Time:1 Hour 30 Minutes   Full Marks: 120

N.B.   i) Answer **ANY TWO** questions from each section in separate script.
        ii) Figures in the right margin indicate full marks.

Section A
(Answer **ANY TWO** questions from this section in **Answer Script A**)

1. a) What is polarization of light? Describe the interaction of light with biological samples   (08)
        with the viewpoint of electronic dipole moment.

    b) With the help of Jablonsky diagram, explain the possible fates of excitation and their   (12)
        applications.

    c) What is Spectroscopy? Write down the various Spectroscopic methods in Bio-optics.   (10)

2. a) What are the basis for electron absorption spectroscopy? Briefly explain the   (12)
        procedure for determining the concentration of an organic substance by absorption
        spectroscopy.

    b) Describe the process of Raman Spectroscopy for biological samples.   (08)

    c) What are the benefits offered by optical imaging? Differentiate between phase   (10)
        contrast and dark-field microscopy.

3. a) Classify optical methods of imaging. Describe the basic principle of   (14)
        Transillumination microscopic imaging method.

    b) What is the basic principle of OCT? Make a comparison between OCT and confocal   (10)
        microscopy.

    c) What is numerical aperture and resolution? Why is it important in microscopy?   (06)

Section B
(Answer **ANY TWO** questions from this section in **Answer Script B**)

4. a) Briefly explain various light induced processes in tissues.   (10)

    b) Explain the process of optical biopsy with its several advantages.   (09)

    c) List the various optical manifestation caused by the presence of an analyte in optical   (11)
        biosensor. Explain the principles that selectively recognize an analyte.

5. a) Describe the principles of optical biosensing. Draw the different configurations of   (12)
        optical fiber geometries used for sensing.

    b) Green light ($\lambda = 540$nm) is coupled into a glass fiber ($n = 1.50$) which is immersed   (07)
        in water ($n = 1.33$) at an angle of 70^0 from normal to the fiber-water interface. What
        is the penetration depth of the evanescent wave?

    c) What is flow cytometer? Explain the principle of hydrodynamic focusing to produce   (11)
        single cell flow in cytometer.

6. a) Describe the principle of operation of Photo Dynamic Therapy (PDT) in cancer   (14)
        treatment. What advantage does this have over conventional chemotherapy?

    b) Describe the principle of laser tweezer action.   (10)

    c) What is tissue Engineering? Shortly explain the principle of tissue restructuring.   (06)

Khulna University of Engineering & Technology
B. Sc. Engineering 4th Year 1st Term Examination, 2020
Department of Biomedical Engineering
BME 4151
Clinical Engineering and Hospital Management

Time:1 Hour 30 Minutes   Full Marks: 120

N.B. i) Answer **ANY TWO** questions from each section in **corresponding answer script.**
ii) Figures in the right margin indicate full marks.

Section A
(Answer **ANY TWO** questions from this section in **Answer Script A**)

1. a) How can you relate the followings: (12)
    i. Biomedical engineering with clinical practice
    ii. Biomedical engineering with medicine
    iii. Biomedical engineering with biological science.

    b) What are the duties of a clinical engineer?   (08)

    c) Illustrate the interaction of clinical engineer with other disciplines and personal.   (10)

2. a) Mention the responsibilities of CET and BMET? Illustrate the administrative model,   (15)
       functional model, and educational model of CE, CET, and BMET.

    b) What are the component of EMS system? Mention the roles and responsibilities of   (15)
       EMS professionals.

3. a) Mention different types of maintenance? Discuss the advantages and disadvantages   (15)
       of different type of maintenance? Explain maintenance cost curve.

    b) Discuss the physiological effects of electricity on human. Explain microshock and   (15)
       macroshock with examples and illustrations.

Section B
(Answer **ANY TWO** questions from this section in **Answer Script B**)

4. a) Write down the utility services related to a modern hospital. Describe the importance   (10)
       of HAVC System for patient care.

    b) Explain the design criteria of an inpatient service division.   (10)

    c) Define human resource management (HRM). What are the functions of HRM? What   (10)
       are the limitations of HRM in Bangladesh? How can it overcome?

5. a) What are the functions of a hospital? Enumerate different types of hospitals in details.   (10)

    b) What is function of ICU ventilator and high flow nasal cannulas for COVID patient?   (10)

    c) Explain a standard hospital organization structure.   (10)

6. a) Write down the methodologies to supply oxygen in a modern hospital. Mention the   (10)
       importance of Oxygen for COVID 19 patients.

    b) What is PACS? What are the typical components of PACS? Enumerate the potential   (10)
       benefits of PACS.

    c) What is central medical gas distribution system? What are the advantages of   (12)
       centralized medical gas delivery system? Mention different types of medical gases
       with their usage.