Khulna University of Engineering & Technology
B. Sc. Engineering 3rd Year 1st Term Examination, 2020
Department of Biomedical Engineering

BME 3101
Cell Biology

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 **Script A**)

1. a) What is cell? Mention the difference between the Prokaryotic and Eukaryotic cell. (08)

b) Define neoplasm? Discuss about the molecular events of cancer development. (12)

c) Write short notes on: (i) Anaphase and Interphase (ii) Cloning. (10)

2. a) What is chromosome and chromatid? Briefly describe the classification of chromosome with proper diagram. (10)

b) Define nucleosides and Nucleotides. Mention the differences between the benign and malignant neoplasm. (10)

c) Define Proto-oncogene? Write down the function, mutation and cancer related to the following Proto-oncogene: (i) Myc (ii) RAS. (10)

3. a) What is a Gap Junction? Where it more abundant in human body? Sketch the Gap Junction model. (08)

b) What is cell signaling? How do cells communicate with each other? (10)

c) Discuss in brief about DNA transcription and translation. (12)

Section B

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

4. a) What is Immunology? Write down the classification of Immunity. (08)

b) What is vaccine? Suppose you take COVID vaccine in the last month what type immunity developed in your body? (07)

c) Write short notes on: (i) Classical pathway of complement activation (ii) Secondary Immune response (iii) Scanning Election Microscope (SEM). (15)

5. a) Define Immunoglobulin. What are the types of immunoglobulin? Describe the structure of a typical immunoglobulin with diagram. (10)

b) What is Auto-immunity? Classify the hypersensitivity with three example of each. (10)

c) What is antigen? Describe the main attributes that make a substance a good antigen. (10)

6. a) When a 10 years boy treated with bone marrow transplantation what types of reaction occurs in his body and why? (10)

b) Describe the different cell culture methods with example. (10)

c) What is flow cytometry? Explain the technique of flow cytometry. (10)

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BME 3141

X-ray and Ultrasound Imaging

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 **Script A**)

1. a) What is X-ray? Describe the construction and working principle of x-ray tube using necessary diagrams. (15)

b) Write down the significance of x-ray interactions in x-ray imaging. Draw the probability pattern of different x-ray interactions considering x-ray energies. (09)

c) In an X-ray set up the focal spot is 3mm, tube to patient distance is 150cm, and the detector is placed 75cm away from the patient. Calculate the penumbra width. (06)

2. a) Write down the technical features of 4th generation CT. What is the scan time for a 2G CT scanner having nine detectors spaced 0.5° apart. (09)

b) Describe the filtered back projection algorithm for CT image reconstruction. (15)

c) Define CT number. List different artifacts of CT. (06)

3. a) Briefly explain digital radiography system with necessary diagram. (15)

b) Define mammography. Write down the technical differences of mammography from conventional x-ray radiography. (08)

c) Why is the contrast necessary in angiography? Write down the procedural steps of Digital Subtraction Angiography (DSA). (07)

Section B

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

4. a) Explain B-mode ultrasound imaging with proper experimental set up. (14)

b) Write down the common applications of ultrasound imaging in medical diagnosis. (06)

c) Assume the simple case in Figure Q4(c), where the angle of insonation is 180° and that the velocity of sound in blood is 1.5×10^5 cm/sec. If the ratio of transmitted to received frequency is 0.9. (10)

i) Determine the speed of RBC.

ii) If the velocity of blood particles, transmitted frequency are reduced to half of their original values, and θ is reduced to 50°. How will be the Doppler frequency changed?

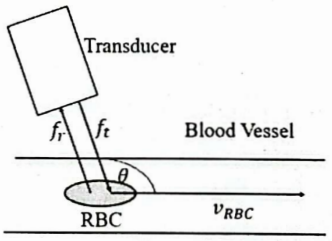

Figure Q4(c)

5. a) What is meant by scattering? Write down the conditions for scattering of sound waves from an object. (08)

b) What is phase aberration? Mention the steps for speckle noise reduction in ultrasound images. (08)

c) Show the relationship between acoustic impedance and reflection. At a "muscle-liver" interface, $Z_1 = 1.7 \times 10^{-4}$Kg/(m^{2}sec) and $Z_2 = 1.65 \times 10^{-4}$ Kg/(m^{2}sec). Evaluate the reflection coefficient and transmission coefficient. Comment on the obtained results. (14)

6. a) How the attenuation, depth of penetration, and resolution are affected by ultrasound frequency? Explain briefly. (10)

b) An ultrasound transducer with a 30cm diameter produces 11kHz frequency sound waves in the air medium. Find out the divergence of the ultrasound beam produced by the transducer. (08)

c) "The radius of ultrasound transducer has a great impact on the beam divergence, and focusing". Explain the quotation and verify your answer. (12)

Khulna University of Engineering & Technology
B. Sc. Engineering 3rd Year 1st Term Examination, 2020
Department of Biomedical Engineering
BME 3111
Biomedical Signal Processing

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 **Script A**)

1. a) A heart patient has a regular SA node pulse (firing) pattern and an irregular ectopic focus. Over a period of 10s, the SA node was observed to fire regularly at t = 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9s. The ectopic focus was observed to fire at t = 1.4, 2.7, 6.08 and 7.58s. Draw two impulse sequences corresponding to the firing patterns of the SA node and the ectopic focus. Draw a schematic waveform of the resulting ECG of the patient. (10)

b) Propose a time-domain technique to remove random noise given the possibility of acquiring multiple realizations of the signal or event of interest. (12)

c) Explain an EEG record. (08)

2. a) Explain the relationship of a QRS complex to the moving-window integrator output with schematic sketch. (10)

b) Which filter can be used to remove high frequency noise from carotid pulse signal? Describe in detail. (12)

c) Consider three motor units with action potentials (SMUAPs) that are of different biphasic and triphasic shapes. Consider the initial stages of contraction of the related muscle. Draw three plots of the net EMG of the three motor units for increasing levels of contraction with the spatial and temporal recruitment phenomena invoked individually and in combination. Assume low levels of contraction and that the SMUAPs do not overlap. (08)

3. a) How do MAV filters work? Explain it by drawing an 8-point MAV FIR filter whose total coefficient is 0.3. (10)

b) Explain the challenges of event detection in a biomedical signals. (10)

c) Propose an algorithm to detect the P wave in the ECG signal. (10)

Section B

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

4. a) Why spectrum estimation is essential in Biomedical signal processing? Briefly describe the pitfalls of nonparametric spectral analysis. (15)

b) Categorize the spectrum estimation techniques. Hence describe the autoregressive spectrum estimation technique. (15)

5. a) What is digital filter? Briefly describe the designing steps of a digital filter. (10)

b) An FIR bandpass filter is to be designed to meet the following frequency response specifications: (10)

Passband	0.18-0.33 (normalized)
Transition width	0.04 (normalized)
Stopband deviation	0.001
Passband deviation	0.05

(i) Sketch the tolerance scheme for the filter.

(ii) Express the filter band edge frequencies in the standard unit of kilohertz, assuming a sampling frequency of 10kHz and the stopband and passband deviations in decibels.

c) Define phase delay and group delay. Describe the necessary conditions of a filter to have linear phase response characteristics. (10)

6. a) Using the Pole-zero placement method, determine the transfer function, the difference equation as well as the coefficient of a notch filter that meets the following specifications: (15)

Notch frequency	50 Hz
3 dB width of notch	±5 Hz
Sampling frequency	500 Hz

b) Design a digital filter to approximate the following analogue transfer function using BZT method, obtain the transfer function, H(z), of the digital filter assuming a 3dB cutoff frequency of 150 Hz and a sampling frequency of 1.28 kHz (15)

$$H(s) = \frac{1}{s^2 + \sqrt{2}s + 1}$$

Khulna University of Engineering & Technology
B. Sc. Engineering 3rd Year 1st Term Examination, 2020
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BME 3103
Bioelectricity

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) Define Bioelectricity. Briefly explain the excitability of nerve cells in response to various types of stimulus. (10)

b) How does the velocity of propagating nerve impulse depend on the unmyelinated and myelinated axon? Explain with appropriate mathematical expressions and graphical representations. (12)

c) Explain Na-K pump with its equivalent electrical circuitry. (08)

2. a) Write down the sequence of events occur at the synapse. (10)

b) Write short notes on: (i) Norepinephrine (ii) Serotonin. (10)

c) How does ion channel convert a mechanical force into an electrical signal in a nerve cell? (10)

3. a) Derive the cable model and explain its time dependent solutions. (15)

b) What are the limitations removed by the Hodgkin-Huxley model? Derive the Hodgkin-Huxley model. (15)

Section B

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

4. a) What is the feasibility of finding solutions to the inverse problem in bioelectric modelling? Briefly explain it with an example. (10)

b) The central region has more than twice sensitivity compared to neighboring regions. Prove it for impedance measurement with 8 electrode FIM. (10)

c) Explain the relationship between thorax impedance and simultaneous ECG and PCG. (10)

5. a) Which method is most suitable to illustrate the behavior of tissue impedance as a function of frequency? Explain the method briefly. (13)

b) How well does the constructed model represent its physiological counterpart? (10)

c) Sketch an equivalent circuit that represents the surface electrode-skin interface. (07)

6. a) Briefly describe 2-D 16 electrode EIT method for bioimpedance measurement with a neat sketch. Mention the advantages and disadvantages of EIT. (12)

b) Mention clinical application of bioimpedance. (10)

c) How many ways can you model volume conductors? (08)

Khulna University of Engineering & Technology
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CSE 3115
Microprocessor and Microcontrollers

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) Which feature does determine whether a microprocessor is considered as 8-bit, 16-bit or 32-bit device? (07)

b) If CS=23F2h and IP = 424Ah, find the: **i)** Logical address **ii)** Offset address **iii)** Physical address **iv)** Lower range of the segment **v)** Upper range segment. (13)

c) Draw Bus action in Memory read and write operations of 8086 with four state. (10)

2. a) What is Interrupt pointer table? If INT 12 is called then calculate the physical address of vector 12:CS and IP. (08)

b) How does MMU manage virtual memory? (10)

c) Write a program which reads the temperature of a cleaning bath solution and lights one of the three lamps according to the temperature read. If the temp $<30^{o}$ c, a yellow lamp will be turned on. If the temp $\geq 30^{o}$ c and $<40^{o}$, a green lamp will be turned on. Temperatures $\geq 40^{o}$ c will turn on a red lamp. (12)

3. a) Explain the following instructions with diagram: **(i)** MOV DX, [BX + DI] where memory address= 2010H, DS=100H, BX=100H and DI=10H **(ii)** MOV AL, [1234H] where DS = 1000H **(iii)** MOV BX, CX. (15)

b) How delay loop works? Explain with an example. 08

c) Define priority of 8086 interrupt. Write down the steps of 8086 interrupt response. (12)

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

4. a) Differentiate between microprocessor and microcontroller with appropriate block diagram. (10)

b) What are the criteria for choosing a microcontroller in an embedded system? Briefly explain Von Neumann and Harvard architecture with proper diagram. (15)

c) Where you should prefer RISC Machine over CISC machine? Explain. (05)

5. a) Calculate the data storage of RAM and ROM in an 8051 Microcontroller. (12)

b) How program counter works in an 8051 microcontroller? Explain with an appropriate example. (10)

c) Explain the stacks operation in an 8051 microcontroller with a suitable example. (08)

6. a) What do you mean by addressing mode? Describe Direct, Indirect, Displacement and Indexed addressing with suitable example and diagram. (16)

b) What do you mean by big-endian and little-endian? (04)

c) Describe the single cycle ALU operation in ATMEGA32. (10)