Khulna University of Engineering & Technology
B. Sc. Engineering 3rd Year 1st Term Examination, 2018
Department of Biomedical Engineering

CSE 3115
Microprocessors and Microcontrollers

Time: 3 hours   **Full Marks: 210**

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

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

1. a) Give a detailed comparative discussion on organization among Intel Pentium *IV*, Intel (09)
dual core and Intel core *i3*.

    b) Explain execution unit of 8086 with proper diagram. (11)

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

    d) Explain the instruction below for packed BCD (05)

      ADD   AL, BL

      DAA

2. a) How does 16 bit data bus work with 20 bit address bus in 8086? Explain with proper (12)
block diagram and appropriate example.

    b) What instructions are used for clearing the bits and for setting the bits in 8086? Give (06)
example.

    c) What will be the output of the following instruction - explain (05)

      i)   MOV   BL, 80
             SHR   DL, 1,
            SHR   DL, 2

    d) Assume the following register status (12)
      DS = 2000 ,   SS = 3000 ,   BX = 012A , BP = 021B
      DI = 0010 , SI = 0020
      For each of the following memory location operand –
        i)   [SI+5]
        ii)   [BP] [SI] + 12h
        iii)   [BX] [DI]
        iv)   [BP-3]
      Compute its offset and absolute address.

3. a) Find the opcodes for the following instruction (12)
       (i)   MOV   DS : 2345 [BP] , DX
       (ii)   MOV   CL, [BX]
       (iii)   sub   BX , [DI]

    b) What is interrupt? Write down the steps of 8086 interrupt response. (12)

    c) What happens if two interrupts appear at the same time in 8259A? (05)

    d) How does 8255A work in I/O mode? (06)

4. a) How do you represent single precision? Explain with proper example. (06)
    b) How direct memory access works? (05)
    c) Define virtual memory. How does MMU manage virtual memory? (12)
    d) How does 80286 address upto 1GB of virtual memory by using segmentation? (12)

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

5 a) Explain the Von-Neuman architecture of microcontroller with appropriate figure. (07)

   b) Mention the difference between microprocessor and microcontroller with appropriate (08) block diagram.

   c) Briefly explain the architectural block diagram of 8051 microcontroller. (10)

   d) Classify microcontroller in terms of instruction set. (10)

6 a) Calculate the data storage of RAM and ROM in a 8051 microcontroller. (10)

   b) Which element of 8051 microcontroller use to indicate the arithmetic condition of (10) ACC? Explain it briefly.

   c) Define scratch pad RAM. In RAM memory space allocation in the 8051, which term (08) defines the collection of general purpose registers? Explain with appropriate figures.

   d) How program counter works in a 8051 microcontroller? Explain with an appropriate (07) microcontroller program and explanation.

7 a) Explain the stacks operation in 8051 microcontroller. How are stacks accessed in 8051- (10) Describe it from the following figure:

Register

| 27 | 54 | 2 | 99 | 71 | 4 | 29 | 47 |

   b) Write a short notes on the following terms in terms of AT mega 32. (09)

       i)   Pull-up register

       ii)   General purpose registers

       iii) USART, Boundary scan and watch dog time

   c) Briefly explain the cases occurred in AT mega 32 pin out and descriptions. (10)

   d) Define SREG. Mention each terms of SREG with appropriate figure. (06)

8 a) Briefly describe about EECR including the read/write procedure of EEPROM of (10) AT mega 32.

   b) Define system design. What are requirements for embedded system design? Briefly (10) explain.

   c) Develop a microcontroller based traffic light system for road intersection control. (15)

Khulna University of Engineering & Technology
B. Sc. Engineering 3rd Year 1st Term Examination, 2018
Department of Biomedical Engineering
BME 3141
X-ray and Ultrasound Imaging

Time: 3 hours **Full Marks: 210**

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

SECTION-A
(Answer **ANY THREE** questions from this section in Script A)

1. (a) What are the advantages and disadvantages of x-ray imaging? Compare the properties of (08)
x-ray with other waves or rays in electromagnetic spectrum.

 (b) Why the characteristics radiation is called so? Explain using suitable diagrams. (09)

 (c) Write down the significance of x-ray interactions. Explain the probability of x-ray (09)
interaction with bone and soft tissue for x-rays of different energies.

 (d) A voltage of 30 kV is applied in an x-ray tube with 10 mm separation between two (09)
electrodes. Calculate:
 (i) Strength of the field (E)
 (ii) Force on the electron (F)
 (iii) Acceleration of the electron (a)

2. (a) Briefly explain the line focus principle of x-ray tube. (05)

 (b) What is meant by direct detection and indirect detection in x-ray imaging? Briefly explain (10)
the indirect detection process of x-ray.

 (c) What is CT? Draw the block diagram of a typical CT system. (08)

 (d) What is the importance of Radon transform in CT? Compute the Radon transform for the (12)

 unit disk given by: $f(x,y) = \begin{cases} 1; x^2 + y^2 \le 1 \\ 0; otherwise \end{cases}$

3. (a) Explain the Fourier slice theorem for CT image formation. Also mention its limitations. (13)

 (b) Write down the benefits of using fan beam over parallel beam for CT formation. Also (12)
mention the modification in parallel beam based back projection algorithm if equiangular
fan beam is considered.

 (c) Briefly explain the different resolution measures in CT. (10)

4. (a) Briefly explain digital radiography system with necessary diagram. (12)

 (b) Write short notes on: (12)
 (i) Angiography
 (ii) Digital subtraction Angiography.

 (c) What are the risks and benefits of mammography? Briefly explain the design strategy of the (11)
x-ray tube in mammography.

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

5. (a) What is Ultrasound Imaging? Briefly explain ultrasound imaging setup. (13)

   (b) Write down the cardiological, inner medicine, and musculoskeletal applications of ultrasound imaging. (07)

   (c) Discuss about different types of array transducer. (09)

   (d) Calculate the remaining intensity of a 100 mW ultrasound pulse that losses 30 dB while travelling through tissue. (06)

6. (a) What is Doppler effect? Explain two practical examples of Doppler effect. (08)

   (b) Write short note on ultrasound elastography. (08)

   (c) What do you mean by scattering? What are the conditions for scattering sound wave from an object? (06)

   (d) What is pulsed ultrasound? Write down the relationship between imaging depth and pulse repetition period. (05)

   (e) What do you mean by acoustic impedance? At a "muscle-liver" interface, $Z_1 = 1.70 \times 10^{-4}$ kg/(m^{2}sec) and $Z_2 = 1.65 \times 10^{-4}$ kg/(m^{2}sec). Evaluate reflection coefficient and transmission coefficient. Comment on results. (08)

7. (a) Explain the construction of an ultrasound probe. (12)

   (b) Discuss on the relation among transducer frequency, diameter, and near field length. (07)

   (c) What do you mean by beam forming and focusing? Why are these operations performed in ultrasound imaging? (07)

   (d) Write short notes on: (09)
      (i) A-mode ultrasound imaging
      (ii) B-mode ultrasound imaging
      (iii) Duplex ultrasound imaging

8. (a) What is Doppler ultrasound? Briefly explain different types of Doppler ultrasound imaging. (13)

   (b) When aliasing occurs in pulsed wave (PW) Doppler ultrasound? How we can correct this? (06)

   (c) Discuss on ultrasound based tissue characterization process. (09)

   (d) Write down the steps for the speckle noise reduction in ultrasound images. (07)

Khulna University of Engineering & Technology
B. Sc. Engineering 3rd Year 1st Term Examination, 2018
Department of Biomedical Engineering
BME 3101
Cell Biology

Time: 3 hours   Full Marks: 210

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

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

1. a) What is cell? List the seven criteria of life. Write down the characteristics of Prokaryotic   (10)
        cell. What are the difference between animal cell and plant cell?

    b) Describe the fluid mosaic model of cell membrane.   (08)

    c) Draw and label the structure of mitochondria. Write down the difference between   (10)
        mitochondria and chloroplast.

    d) What are the types of membrane protein? Write down the functions of membrane protein.   (07)

2. a) What is microfilament or actin filament? Write down the function of Centrioles.   (10)

    b) Sketch and label the structure of chloroplast. What reaction occurs within the chloroplast   (08)
        during photosynthesis?

    c) Enumerate the types of membrane transport. Describe the process of diffusion with net   (07)
        sketch.

    d) Write short notes on :   (10)

            i)   Symport and Antiport

            ii)   Exocytosis and Endocytosis

3. a) Describe the various methods of cell to cell interaction.   (08)

    b) What are the types of receptors? Briefly discuss about the G-protein couple receptor.   (07)

    c) Describe the various types of solutions. What happens if you put a red blood cell in pure   (08)
        water?

    d) Illustrate the classification of cell junction with example. Briefly discuss the tight junction.   (12)

4. a) Write down the name of cell adhesion molecules. Discuss the mechanism of cell adhesion.   (08)

    b) What are the components of energy output? How energy conversion occurs? Describe   (10)
        cellular respiration.

    c) Write down the function of extracellular matrix.   (07)

    d) Write short notes on :   (10)

            i)   Selectin

            ii)   Desmosome

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

5. a) What is nucleotide? Write down the difference between DNA and RNA. (10)

    b) What is chromosome? Explain the chromosomal abnormalities of chromosome in details. (10)

    c) What is enzyme inhibition? Explain the induced fit model of enzyme action. (10)

    d) Write short note on: miRNA and siRNA (05)

6. a) What is metastasis? Explain different routes of metastasis. (10)

    b) What is PCR? What are the main steps of PCR? Write down the importance of PCR. (10)

    c) Write down the medical application of recombinant DNA technology. (10)

    d) Write short note on Ligase enzyme. (05)

7. a) What is mRNA? Write down the structural characteristics of mRNA. (10)

    b) Draw and label the laptotene and diplotene stage of cell division. (10)

    c) Enumerate different types of stem cells. Write down the application of IPS. (10)

    d) Write short note on Proto-oncogene. (05)

8. a) Write down the role of IPS in medical research. (10)

    b) Define protein. Enumerate different structures of protein. (10)

    c) Write down the difference between cellular hypertrophy and hyperplasia (05)

    d) Write short notes on: (10)
       i) Translocation
       ii) Duplication

Khulna University of Engineering & Technology
B. Sc. Engineering 3rd Year 1st Term Examination, 2018
Department of Biomedical Engineering
BME 3111
Biomedical Signal Processing

Time: 3 hours   **Full Marks: 210**

N.B.i) Answer **ANY THREE** questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.
iii) Different window characteristic table will be supplied on request.

SECTION-A
(Answer **ANY THREE** questions from this section in Script A)

1. (a) What is a biomedical signal? Mention different types of biomedical signal with their nature   (15)
         and origin. Explain the steps of biomedical signal processing.

    (b) Briefly describe the real world application of Biomedical signal processing.   (08)

    (c) Write down the amplitude and frequency information of different types of biosignals.   (12)

2. (a) Derive the computational complexity of DFT and FFT. What are the practical applications   (15)
         of DFT?

    (b) Calculate the DFT of the sequence { 2, 3, 4.5, 5, 5, 4.5, 3, 2 } using Butterfly structure. If   (20)
         the data is sampled at 8 kHz, then plot the amplitude and phase spectra.

3. (a) Define z-transform and inverse z-transform. What is the difference between z-transform and   (08)
         Laplace transform?

    (b) Find the discrete-time sequence, x (n), with the following z-transform.   (15)

    $$x(z) = \frac{z^3}{(z-0.5)(z-1)^3}$$

    Assume c is a circle, $|z| = 1$.

    (c) Explain the following transfer function in terms of its poles and zeros and sketch the pole-   (12)
         zero diagram.

    $$H(z) = \frac{1 - z^{-1} - 2z^{-2}}{1 - 1.75z^{-1} + 1.25z^{-2} - 0.375z^{-3}}$$

4. (a) Define cross-correlation and auto-correlation. Write down their use in biomedical signal   (08)
         analysis.

    (b) Find the correlations between two signals $x_1(n) = \{1, 0, 0, 1\}$ and $x_2(n) = \{0.5, 1, 1, 0.5\}$ (15)
         using (i) conventional method, (ii) fast correlation method.

    (c) Determine the output of an electrical system of impulse response function   (12)
         {0, 0.899, 0.990, 0.991, 1} when the input {0, 2.5, 5.0, 0} (volts) is applied by applying
         convolution theorem.

5. (a) What is digital filter? Briefly describe different types of digital filters with their characteristic equations. (07)

   (b) Define phase delay and group delay. Describe the necessary conditions of a filter to have a linear phase response characteristics. (08)

   (c) Briefly describe the design steps of digital filters. (07)

   (d) Obtain the coefficients of an FIR lowpass filter to meet the specifications given bellow using the window method. (13)

Passband edge frequency	1.5 kHz
Transition width	0.5 kHz
Stopband attenuation	> 50 dB
Sampling frequency	8 kHz

6. (a) Write down the advantages and disadvantages of window method for the coefficient calculation of FIR filter. (07)

   (b) How to optimize the amplitude response of FIR filter in case of frequency sampling method. (06)

   (c) Compare the window, optimum and frequency sampling methods for FIR filter's coefficient calculation. (10)

   (d) Briefly describe the ways in which finite word length affects the performance of FIR filters and how to overcome them. (12)

7. (a) What are the methods normally use for the coefficient calculation of IIR filter? (06)

   (b) A band pass digital filter is required to meet the following specification: (16)

      (i) Complete signal rejection at dc and 250 Hz

      (ii) A narrow passband centered at 125 Hz

      (iii) A 3dB bandwidth of 10 Hz.

   Assuming a sampling frequency of 500 Hz, obtained the transfer function of the filter, by suitably placing z-plane poles and zeros and its difference equations.

   (c) How to choose between FIR and IIR filters for a specific purpose? (06)

   (d) What is meant by spectrum estimation? Briefly describe its application. (07)

8. (a) Briefly describe the pitfalls that should be avoided in performing nonparametric spectral analysis. (12)

   (b) Define data reduction algorithm. Mention different data reduction algorithm. (05)

   (c) Briefly describe AZTEC algorithm. Explain an AZTEC code of a data represented by (10)

   {18, 77, 4, 101, -5, -232, -4, 141, 21, 141}

   (d) Write short notes on: (08)
      (i) CORTES algorithm,
      (ii) Run length encoding.

Khulna University of Engineering & Technology
B. Sc. Engineering 3rd Year 1st Term Examination, 2018
Department of Biomedical Engineering
BME 3103
(Bioelectricity)

Time: 3 hours   **Full Marks: 210**

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

SECTION-A
(Answer **ANY THREE** questions from this section in Script A)

1. (a) What is the historical perspective of Bioelectricity? List the comparison of bioelectricity and man-made electrical system. (05)

    (b) What is meant by excitable cell? Describe the different types of neuron with example. (08)

    (c) What is meant by Neuroglia? Write down the different types of neuroglial cell with example. (10)

    (d) Define Resting membrane potential (RMP). Write down the RMP of various types of cell. Describe elaborately how the RMP is producing and maintaining in the cell? (12)

2. (a) What is semipermeable membrane? Give an example of natural semipermeable membrane. List the factor on which the rate of passage through the membrane depends on. (10)

    (b) What is Neuronal Action Potential? Write down the differences of skeletal muscle and cardiac muscle action potential. (10)

    (c) Define Ion channel. Draw and label the schematic Ion channel. What are the importanace of Ion channel? (10)

    (d) Write a short note on electrical synapse. (05)

3. (a) Write short notes on: (05)
        (i) Isoelectric point
        (ii) Donnan equilibrium.

    (b) Describe the Goldman-Hodgkin-Katz equation. (08)

    (c) What does the Nernst equation predict? Calculate the Nernst potential for Na$^+$, K$^+$, Cl$^-$ at room temperature from the following table. (12)

Ion	Concentration (mM)	
	Inside cell	Outside cell
Na$^+$	20	120
K$^+$	139	2.5
Cl$^-$	3.8	120

    (d) What is motor unit? How neuromuscular junction is formed? (10)

4. (a) Define electrode. Briefly describe different types of electrodes for bioelectric signal acquisition. (08)

    (b) What are the effects of external electric fields on biological tissue? (07)

    (c) What are iso-current and iso-potential lines? (05)

    (d) Discuss clinical application of bioimpedance. (15)

5. (a) Describe any two methods for bioimpedance measurement with their advantages and   (15)
         disadvantages.

    (b) What is sensitivity field in bioimpedance measurement? Describe its types mathematically.   (08)

    (c) Construct an electrical circuit model to describe electrical properties of biological tissue.   (12)

6. (a) Briefly discuss the subdivision of bioelectricity.   (08)

    (b) Define dielectrics, dielectric polarization and electric permittivity.   (05)

    (c) How many ways can you model volume conductor and volume source? Explain.   (12)

    (d) Discuss construction of an electrical equivalent circuit to represent surface electrode-skin   (10)
         interface.

7. (a) What is accommodation and anode-break excitation in neural signal propagation?   (08)

    (b) Briefly discuss patch clamp method with diagram.   (10)

    (c) Define lead field theorem. Deduce the following equation: (12)

$$V_{LE} = \frac{1}{\sigma} \int_{vol} \bar{J}_{LE}.\bar{J}^i dV \; ;$$

    Where the symbols carry their usual meaning.

    (d) Describe transfer impedance.   (05)

8. (a) How can you describe passive conduction neuron? Develop necessary equation.   (15)

    (b) What is Cole-Cole plot? What does this plot represent?   (05)

    (c) Define image surface in biopotential measurement. How can you measure biopotential of a   (08)
         point outside the biological body using electrode system?

    (d) Write a short note on Impedance Plethysmography.   (07)