Khulna University of Engineering & Technology
B. Sc. Engineering 2nd Year 2nd Term Examination, 2016
Department of Biomedical Engineering

Hum 2215
Economics and Sociology

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) Define Economics. Explain the concept of Micro and Macro Economics.   (10)

    b) Use a production possibilities frontier (PPF) to illustrate society's tradeoff   (10)
        between a clean environment and high income. Explain.

    c) Show what happens to the frontier if engineers develop an automobile engine with   (15)
        almost no emissions?

2. a) Suppose, the cost of producing stereo systems has fallen over the last several   (15)
        decades. Now, use an equilibrium diagram to show the effect of falling production
        cost on the price and quantity of stereos sold.

    b) In your diagram show what happens to consumer surplus and producer surplus?   (10)

    c) Suppose, the supply of stereos is very elastic, who gets benefits most from falling   (10)
        of production cost; consumers or producers of stereos? Explain.

3. a) What do you mean by the word "Production" in Economics?   (05)

    b) What is meant by the word "Market". Briefly describe the types of markets.   (10)

    c) Draw and explain the cost curves for a typical firm. For a given price explain how   (20)
        the competitive firm choose the level of output that maximize profit.

4. a) If price rise, people's income from selling goods increases. The growth of real   (15)
        GDP ignores the gain, however. Why, then, do economist prefer real GDP as a
        measure of economic well-being?

    b) Define private savings, public savings, national savings, and investment. How are   (10)
        they related?

    c) Describe a change in the tax code that might increase private savings. If this policy   (10)
        were implemented, how would it affect the market for loanable funds?

Section B

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

5. a) What do you mean by 'Sociology'?   (10)

    b) Discuss the area and scope of sociology.   (10)

    c) Explain the importance of studying sociology in BME.   (15)

6. a) Give the definition and characteristics of culture.   (10)

    b) What are the relations between culture and civilization?   (10)

    c) Discuss about Bangladeshi culture.   (15)

7. a) What do you mean by crime?   (10)

    b) Discuss about the causes of Juvenile delinquency.   (10)

    c) Discuss the positive and negative impact of Urbanization on society.   (15)

8. a) What do you mean by 'family'?   (10)

    b) Discuss about the forms and functions of family.   (10)

    c) Define and explain the 'society' and 'community'   (15)

Khulna University of Engineering & Technology
B. Sc. Engineering 2nd Year 2nd Term Examination, 2016
Department of Biomedical Engineering
Math 2215
Linear Algebra, Complex Variable and Vector Analysis

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

N.B.   i) Answer **ANY THREE** questions from each section in separate scripts.
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Section A
(Answer **ANY THREE** questions from this section in Script A)

1. a) Define with example the following matrices: (12)
        (i) Lower triangular (ii) Elementary (iii) Skew symmetric

    b) Find the rank of the matrix   (10)
$$A = \begin{bmatrix} 1 & 2 & -2 & 3 & 1 \\ 1 & 3 & -2 & 3 & 0 \\ 2 & 4 & -3 & 6 & 4 \\ 1 & 1 & -1 & 4 & 6 \end{bmatrix}$$

    c) Using elementary row transformation, find the inverse of the matrix   (13)
$$\begin{bmatrix} 3 & -2 & -1 \\ -4 & 1 & -1 \\ 2 & 0 & 1 \end{bmatrix}$$

2. a) Find the eigenvalues and the eigen vector corresponding to the smallest eigen value for the   (15)
        given matrix
$$A = \begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$$

    b) Define trivial and non-trivial solutions using matrix   (14)
$$2x - 2y + 5z + 3w = 0$$
$$4x - y + z + w = 0$$
$$3x - 2y + 3z + 4w = 0$$
$$x - 3y + 7z + 6w = 0$$

    c) If $A = \begin{bmatrix} 1 & -1 \\ 2 & -1 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 1 \\ 4 & -1 \end{bmatrix}$, test whether A and B anti-commute.   (06)

3. a) Define a vector space with example. Find the basis and dimension of the vector space spanned   (16)
        by the following set of vectors:
$$X_1 = [1, 1, 1, 1]', X_2 = [3, 4, 5, 6]', X_3 = [1, 2, 3, 4]', \text{ and } X_4 = [1, 0, -1, -2]'.$$

    b) Show that every square matrix can be expressed as the sum of a symmetric matrix and a skew   (12)
        symmetric matrix.

    c) $Y = AX$ is a linear transformation and the matrix of transformation is given by   (07)
$$A = \begin{bmatrix} 1 & 0 & 3 \\ -2 & 3 & 4 \\ 5 & -2 & 1 \end{bmatrix}$$
        Find the image of $X = [-1, 2, 3]'$. Is the given transformation regular?

4. a) Find all the values of $(-4 - 4i)^{\frac{1}{3}}$ and locate them graphically.   (12)

    b) If $f(z) = \bar{z}$, show that $f'(z)$ does not exist anywhere.   (11)

    c) If $u = e^x(x\cos y - y\sin y)$, find v such that $f(z) = u + iv$ is analytic.   (12)

5. a) Evaluate $\int_i^{2-i} (3xy + iy^2)dz$ along the straight line joining $z = i$ and $z = 2 - i$. (12)

   b) Evaluate $\oint_C \dfrac{dz}{z - z_o}$ where C is given by $|z| = a|z_o|,\ a\epsilon\mathbb{R}, z_o\epsilon\mathbb{C}.$ (10)

   c) Evaluate $\oint_C \dfrac{cos\pi z}{z^2 - 1}dz$ where C is the circle $(i)\ |z| = 0.5,$ $(ii)\ |z| = 2$ (13)

6. a) Evaluate $\nabla^2\left(\dfrac{1}{r}\right)$ (12)

   b) Define directional derivative. Find the directional derivative of $\varphi(x, y, z) = xy^2 + yz^3$ (12) at the point (2, -1, 1) in the direction of the normal to the surface $xlogz - y^2 + 4 = 0$ at (2, -1, 1).

   c) Define vector and scalar fields with examples. Find the work done in moving a particle in a (11) force field given by $\vec{F} = 3xy\hat{\imath} - 5z\hat{\jmath} + 10x\hat{k}$ along the curve $x = t^2 + 1,\ y = 2t^2,\ z = t^3;\ 1\le t \le 2.$

7. a) A vector field is defined by the vector point function (14)
$$\vec{V} = (x + 2y + 4z)\hat{\imath} + (2x - 3y - z)\hat{\jmath} + (4x - y + 2z)\hat{k}.$$
   (i) Is the vector field conservative? Why?
   (ii) Does it have any scalar potential? If so, find the scalar potential.

   b) State the Divergence theorem. Use it to evaluate (12)

   $\displaystyle\iint_S \vec{F}.\hat{n}ds$ over the entire surface of the region bounded by the cylinder

   $x^2 + z^2 = 9, x = 0, y = 0, z = 0,$ and $y = 8$ if $\vec{F} = 6z\hat{\imath} + (2x + y)\hat{\jmath} - x\hat{k}.$

   c) Find div $\vec{F}$, where $\vec{F} = \vec{\nabla}(x^3 + y^3 + z^3 - 3xyz).$ Hence comment about it if $x + y = -z.$ (09)

8. a) Express Stokes theorem in words. Use Stoke's theorem to evaluate (13)
$$\iint_S (\nabla \times \vec{B}).\hat{n}ds$$
   for $\vec{B} = (2x - y)\hat{\imath} - yz^2\hat{\jmath} - y^2z\hat{k}$ and S is the upper half surface of $x^2 + y^2 + z^2 = 1.$

   b) Using Green's theorem show that the area bounded by a simple closed curve C is given by (09)
$$\frac{1}{2}\oint_C (xdy - ydx)$$

   c) Evaluate $\displaystyle\iint_R (x^2 + y)dxdy$ where R is the region in the xy plane bounded by $x^2 + y^2 = 4.$ (13)

Khulna University of Engineering & Technology
B. Sc. Engineering 2nd Year 2nd Term Examination, 2016
Department of Biomedical Engineering

BME 2231
Biomedical Instrumentation

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 do you mean by Biomedical instrumentation? Briefly discuss about (17) Biomedical instrumentation system with necessary diagram.

   b) Briefly explain about the electrical model of heart. (08)

   c) Briefly discuss about the Driven-right-leg circuit. (10)

2. a) What are the requirements of a typical biopotential amplifier? (07)

   b) Why we need augmented leads in ECG? Draw the connection diagram of (07) electrodes for three augmented leads.

   c) What are the problems associated in ECG measurement? (07)

   d) What are the interference reduction techniques in ECG measurement? (07)

   e) Draw the circuit diagram of an ECG amplifier. (07)

3. a) What is sensor? What are the differences between a sensor and a transducer? (07)

   b) Write short notes on following transduction techniques: (10)

        (i)   Piezoelectric   (iv)   Optical
        (ii)   Piezoresistive   (v)   Electrochemical
        (iii) Thermoelectric

   c) Classify and briefly explain electrochemical sensor. (11)

   d) What is Fluorescence? Write down some biomedical applications of optical (07) sensors.

4. a) What is optical transducer? Explain the working principles of SPR optical sensor. (10)

   b) Explain the functions of different parts of a CMOS sensor. (13)

   c) What are the properties of thermistor? Briefly explain the construction and (12) working principle of a resistance thermometer (RTD).

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

5. a) What is meant by blood pressure? Classify blood pressure. Explain noninvasive method of blood pressure measurement. (15)

   b) Define heart sound. Sketch two successive cycles of ECG signal with corresponding heart sounds. (08)

   c) What is cardiac output? What are the methods of measuring cardiac output? Explain Doppler ultrasound method of cardiac output measurement. (12)

6. a) What do you mean by electric shock? Explain different factors of electric shock. (13)

   b) What are the symptoms and applications of electric shock? Sketch a diagram showing physiological effects of electric shock with different current levels. (14)

   c) What is RMS voltage (at 60 Hz) required to deliver a current of 10 µA between two gelled surfaces each having a cross-sectional area of 1.5 cm^2? Assume that the skin impedance is 200 Ω. Given that for electrode gel on skin, the impedance per cm^2 is 10.8 kΩ. (08)

7. a) Define pacemaker. When it is used? Draw a block diagram of a cardiac pacemaker and explain each block in brief. (13)

   b) What is defibrillation? Explain the working principle of Lown waveform defibrillator with net sketch. (15)

   c) Sketch a complete diagram of Autoanalyzer system. (07)

8. a) Write short notes on: (12)

      (i). Spectrophotometer
      (ii) Autoanalyzer
      (iii) Heart-lung machine

   b) What is Biosensor? Write some applications of Biosensors? (10)

   c) What is ABG test? Why it is done? (06)

   d) Explain continuous blood glucose monitoring process. (07)

Khulna University of Engineering & Technology
B. Sc. Engineering 2nd Year 2nd Term Examination, 2016
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BME 2211
Signals and Systems

Time: 3 hours   Full Marks: 210

N.B.   i) Answer ANY THREE questions from each section in separate scripts.
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Section A
(Answer ANY THREE questions from this section in Script A)

1. a) Define 'signal' and 'system'. Classify signals with example. Develop the odd/even (12)
        decomposition of a general signal $x(t)$ by applying the definitions of odd/even signals.

    b) Briefly explain the basic operations performed on signal with necessary expressions. (13)

    c) A pair of sinusoidal signals with a common angular frequency is defined by (10)
$$x_1[n] = \sin[5\pi n] \quad \text{and} \quad x_2[n] = \sqrt{3}\cos[5\pi n]$$
        (i) Specify the condition which the period N of both $x_1[n]$ and $x_2[n]$ must satisfy for them to be
        periodic; (ii) Evaluate the amplitude and phase angle of the composite sinusoidal signal
$$y[n] = x_1[n] + x_2[n]$$

2. a) Write short notes on: (i) Step function (ii) Impulse function (iii) Ramp function (12)

    b) Show that the moving-average system described by the input-output relation (07)
$$y[n] = \frac{1}{3}(x[n] + x[n-1] + x[n-2]) \quad \text{is BIBO stable.}$$

    c) What is LTI system? Why it is needed? Determine the response of the LTI system if the (16)
        impulse response of the system and the input signal to the system are respectively
$$h[n] = \{1,\underline{2},1,-1\} \quad \text{and} \quad x[n] = \{\underline{1},2,3,1\}$$

3. a) Find the current through the RL circuit depicted in Fig. 3(a) for an applied voltage $x(t) = cos(t)$ (15)
        V, assuming normalized values $R = 1\Omega$ and $L = 1H$ and that the initial condition is $y(0) = 2A$.

    b) Determine the homogeneous solution of the system described by the first-order difference (10)
        equation
$$y[n] + a_1 y[n-1] = x[n]$$

    c) What do you mean by z-transform? Determine z-transform of the signal $x[n] = \left(\frac{1}{2}\right)^n u[n]$ (10)

4. a) Using power series expansion, determine the inverse z-transform of (10)
$$X(z) = \frac{2 + z^{-1}}{1 - \frac{1}{2}z^{-1}}, \quad ROC: |z| > \frac{1}{2}$$

    b) Determine the causal signal $x[n]$ having the z-transform $X(z) = \dfrac{1}{(1 + z^{-1})(1 - z^{-1})^2}$ (15)

    c) Determine the response of the system $y[n] = \dfrac{5}{6}y[n-1] - \dfrac{1}{6}y[n-2] + x[n]$ (10)

        to the input signal $x[n] = \delta[n] - \dfrac{1}{3}\delta[n-1]$

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

5. a) What is Fourier series? Determine the Fourier series coefficients (exponential representation) of (16)
        the signal $x(t)$ given in Fig. 5(a).

    b) Find the discrete-time Fourier series coefficients for (10)
$$x(n) = 1 + \sin\left(\frac{2\pi}{N}\right)n + \cos\left(\frac{2\pi}{N}\right)n + 2\cos\left(\frac{6\pi}{N}\right)n + 3\sin\left(\frac{8\pi}{N}n + \frac{\pi}{3}\right)$$

    c) What do you mean by frequency response function? What are the characteristics of frequency (09)
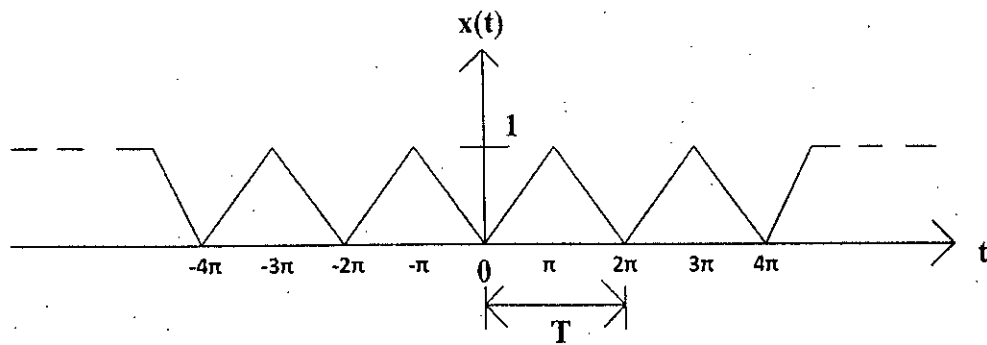   response function of LTI system?

Fig. 5(a)

6. a) What is Fourier transform? Determine the Fourier transform of the signal (12)

$$x(t) = e^{-at}\sin\omega_0 t\, u(t)$$

b) Determine $h_2(n)$ for the given system in Fig. 6(b). (12)

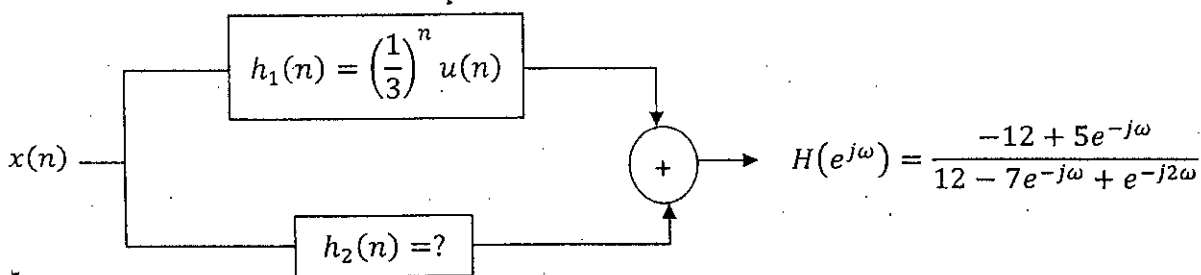$$H(e^{j\omega}) = \frac{-12 + 5e^{-j\omega}}{12 - 7e^{-j\omega} + e^{-j2\omega}}$$

Fig. 6(b)

c) What is sampling? State and describe Shannon's Sampling Theorem with necessary diagram. (11)

7. a) What is aliasing effect? How can we remove aliasing effect? (06)

b) Briefly explain a basic system for discrete-time processing of continuous-time signal with necessary diagram. (09)

c) Determine the Laplace transform of $x(t) = e^{at}u(t)$, and depict the ROC and the locations of poles and zeros in the s-plane. Assume that a is real. (10)

d) Find the Laplace transform of the output of the RC circuit depicted in Fig. 7(d) for the input $x(t) = te^{2t}u(t)$, where RC = 0.2s. (10)

8. a) Find the inverse Laplace transform of (10)

$$X(s) = \frac{2s^3 - 9s^2 + 4s + 10}{s^2 - 3s - 4}$$

b) Use Laplace transforms circuit models to determine the voltage $y(t)$ in the circuit of Fig. 8(b), for an applied voltage $x(t) = 3e^{-10t}u(t)$ V. The voltage across the capacitor at time $t = 0^-$ is 5V. (13)

c) Find the transfer function of the systems described by the following differential equations: (06)

(i) $\frac{d^2}{dt^2}y(t) + 2\frac{d}{dt}y(t) + y(t) = \frac{d}{dt}x(t) - 2x(t)$

(ii) $\frac{d^3}{dt^3}y(t) - \frac{d^2}{dt^2}y(t) + 3y(t) = 4\frac{d}{dt}x(t)$

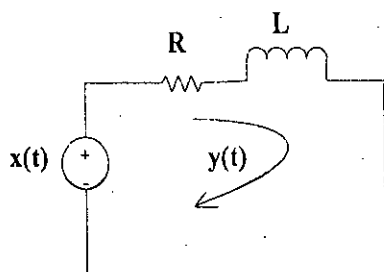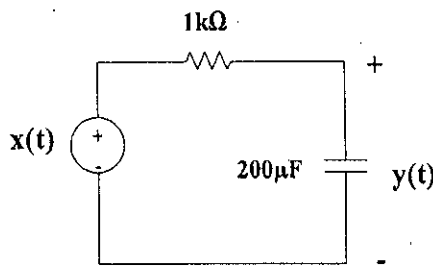d) Write short notes on: (i) Convolution integral (ii) Superposition integral (06)
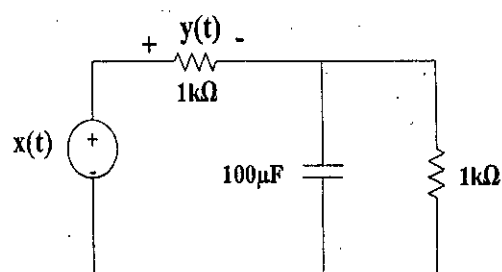

Fig. 3(a)   Fig. 7(d)   Fig. 8(b)

Khulna University of Engineering & Technology
B. Sc. Engineering 2nd Year 2nd Term Examination, 2016
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BME 2201
Human Physiology

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) Mention the functions of plasma membrane.   (10)

    b) Give a short note on endoplasmic reticulum.   (10)

    c) Discuss different stages of mitosis with diagram.   (15)

2. a) Name the blood cells with their normal values. State the functions of WBC.   (15)

    b) Name the major blood groups with their antigen and antibody in a tabulated form.   (10)

    c) Define blood coagulation. State the steps of blood coagulation. Name the diseases   (10)
        that transmitted by blood transfusion.

3. a) State the properties of cardiac muscle. State components of conductive system   (10)
        with their conduction velocity.

    b) What is ECG? Draw and label an ECG. How different waves are produced?   (15)

    c) What is blood pressure? Define different types of blood pressure with their normal   (10)
        range.

4. a) List the local hormone acting on gastrointestinal tract. State diagrammatically the   (15)
        components of GIT. State function of cholecystokinin.

    b) Describe the mechanism of HCl secretion in stomach.   (10)

    c) State the basis mechanism of formation of urine. What is GFR? State absorption of   (10)
        H$_2$O in different segment of renal tubule.

Section B

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

5. a) Enumerate main physiological characteristics of the action potential. (10)

   b) Mention different steps of synaptic transmission with diagram. (15)

   c) Give short note on neurotransmitters. (10)

6. a) What are the functions of vascular tunics of eye? (10)

   b) Name different visual abnormalities with diagram and how they are corrected. (15)

   c) Mention the functions of middle ear. (10)

7. a) Mention different types of body temperature. (08)

   b) Describe different methods of heat loss from the body. (15)

   c) Discuss about processes of heat production of the body. (12)

8. a) What is pulmonary ventilation? State different volume and capacities found in a spirogram. (15)

   b) How CO_2 is transported in blood? (10)

   c) What are major pulmonary function tests (Lung function test)? How respiration is regulated? (10)