CS/B.Tech BME(N)/SEM-3/BME-301/2012-13

2012

BIOPHYSICAL SIGNALS AND SYSTEMS

Time Allotted : 3 Hours   *Full Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words
as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives of the following :

$10 \times 1 = 10$

   i)   f (t) will be periodic signal of fundamental time period T if

      a)   f(t–T) = f(T)   b)   f(t + T) = f(t)

      c)   f(–t) = f(T)   d)   none of these.

   ii)   The capacitor has

      a)   no memory   b)   long time memory

      c)   flash memory   d)   none of these.

   iii)   A system will be linear if it obeys the principle of

      a)   filtering   b)   superposition

      c)   rectification   d)   none of these.

   iv)   In wavelet analysis, increased frequency leads to

      a)   Increasing window width

      b)   Increasing window height

      c)   Decreasing window width

      d)   Decreasing window height.

v) Noise in a semiconductor is due to
   a) diffusion of electrons and holes
   b) diffusion of holes and protons
   c) collision of electrons and holes
   d) collision of holes and protons.

vi) By using negative feedback in a system we can reduce
   a) Noise
   b) Distortion
   c) External sensitivity to system
   d) all of these.

vii) Sensitivity of a system having system Transfer function T & subsystem transfer function G is represented as
   a) S_T^G b) S_G^T
   c) $\left(S^T\right)^G$ d) $\left(S^G\right)^T$.

viii) Nominal characteristic resistance of the BPF R_k is
   a) $\sqrt{LC}$ b) $\dfrac{\sqrt{L}}{C}$
   c) $\dfrac{\sqrt{C}}{L}$ d) $L\sqrt{C}$.

ix) In cardiovascular system the electrical equivalent of pressure drop across a blood vessel is
   a) Charge   b) Voltage
   c) Current   d) Capacitance.

x) In the electrical model of Blood vessel the Capacitor incorperate to indicate its
   a) Resistivity   b) Elasticity
   c) Permeability   d) Conductivity.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. Define Energy signal and Power Signal.

3. How could you reduce the noise by using feedback system ?

$$2\frac{1}{2} + 2\frac{1}{2}$$

4. Check whether the following systems are linear or non-linear:

i) $\frac{d}{dt}[\,y\,(t\,)\,] + 2\,[\,y\,(t\,)] = x\,(t\,)$

ii) $Y(n\,) = n\,X(n\,)$
$$2\frac{1}{2} + 2\frac{1}{2}$$

5. Draw and discuss the equivalent model of nerve membrane.

6. What do you mean by noise ? Define different kind of noise with equation. $1 + 4$

GROUP – C

(Long Answer Type Questions)

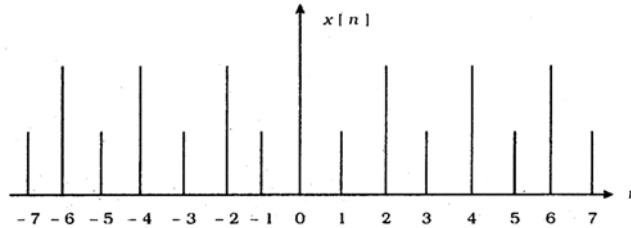Answer any *three* of the following. $3 \times 15 = 45$

7. a) Find the power and rms value of the signal $x\,(t\,) = A\cos(\omega_0 t + \varphi)$ $2 + 6 + 4 + 3$

b) A pair of sinusoidal signals with a common angular frequency is defined as

$X_1\,[n] = \sin(5\pi n)$

$X_2\,[n] = \sqrt{3}\cos(5\pi n)$

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 composite sinusoidal signal : $Y\,[n] = X_1\,[n] + X_2\,[n]$

c) A discrete time signal defined as $x\,[n] = C\,\alpha^n$, where C & α both are real.

Draw the curves when

i) $\alpha < -1$

ii) $-1 < \alpha > 0$

iii) $0 < \alpha > 1$

iv) $\alpha = 1$

v) $\alpha > 1.$ $(3 + 2) + 5 + 5$

8. a) Derive the synthesis and analysis equations of the Fourier transformation.

    b) A discrete time signal $x[n]$ is shown in the figure below :

Sketch and label each of the following carefully :

    i) $2x[n]$

    ii) $x[n/2]$

    iii) $x[3n]$

    iv) $\left(\dfrac{1}{2}\right) \times [3n-1]$

    v) $x[3n+1]$.

    c) Draw a model to show recording of nerve action potential. $4 + 7 + 4$

9. Write short notes on any *three* of the following : 3×5

    a) System Linearity

    b) Time Reversal and time shifting

    c) Even and Odd signals

    d) Sensitivity analysis by Feedback.

    e) Notch Filter and its importance for biomedical signal analysis.

10. a) What do you mean by Laplace Transform ?

    b) Find the Z-transform and the region of convergence (ROC) of the discrete time signal $x(n)$ given as

    $x(n)$ $= a^n$ for $n \geq 0$

    $= 0$ for $n < 0$

    c) Obtain the convolution of the two continuous time functions given below :

    $x(t) = e^{-t^2}$ and $h(t) = 3t^2$.