Total No. of printed pages = 6

EE 131404

Roll No. of candidate

2019

B.Tech. 4th Semester End-Term Examination

SIGNALS AND SYSTEMS ANALYSIS

New Regulation (w.e.f. 2017-18)

Full Marks – 70   Time – Three hours

The figures in the margin indicate full marks
for the questions.

Answer Question No. 1 and any *four* from the rest.

1. Choose the correct option for each of the following
    questions : $(10 \times 1 = 10)$

    (i)   Z transform of $u(-n)$ is

          (a) $1/1 - z$

          (b) $1 - z$

          (c) $1/1 + z$

          (d) $1/1 - z^{-1}$

    (ii) ROC of $1/(1 - 3z^{-1})$ is

          (a) $|z| = 3$

          (b) $z |> 3$

          (c) $z |< 3$

          (d) $|z| >= 3$

[Turn over

(iii) Fourier transformation is a

  (a)   linear operation

  (b)   non-linear operation

  (c)   partially linear operation

  (d)   Partially non-linear operation

(iv) Time derivative of unit step function is

  (a)   a unit impulse

  (b)   another step function

  (c)   a unit ramp function

  (d)   a sine function

(v) $x(t+2)$ is the signal $x(t)$

  (a)   shifted to the right by two units of time

  (b)   shifted to the left by two units of time

  (c)   compressed by two units of time

  (d)   expanded by two units of time

(vi) Which of the following relations are true if x(n) is real?

  (a) $X(\omega) = X(-\omega)$

  (b) $X(\omega) = -X(-\omega)$

  (c) $X^*(\omega) = X(\omega)$

  (d) $X^*(\omega) = X(-\omega)$

(vii) Fourier series uses which domain representation of signals?

    (a)   Time domain representation

    (b)   Frequency domain representation

    (c)   Both combined

    (d)   Neither depends on the situation

(viii) Which type/s of discrete-time system do/does not exhibit the necessity of any feedback?

    (a)   Recursive Systems

    (b)   Non-recursive Systems

    (c)   Both (a) and (b)

    (d)   None of the above

(ix) Which condition determines the causality of the LTI system in terms of its impulse response?

    (a)   Only if the value of an impulse response is zero for all negative values of time

    (b)   Only if the value of an impulse response is unity for all negative values of time

    (c)   Only if the value of an impulse response is infinity for all negative values of time

    (d)   Only if the value of an impulse response is negative for all negative values of time

(x) What is the ROC of the system function $H(z)$ if the discrete time LTI system is BIBO stable?

    (a)   Entire z-plane, except at $z=0$

    (b)   Entire z-plane, except at $z = \infty$

    (c)   Contain unit circle

    (d)   None of the above

2. (a) Find which of the following signals periodic or not. If periodic, find the fundamental period (5)

(i) $x(n) = \cos(0.1\pi n)$

(ii) $x(t) = 2u(t) + 2\sin 2t$

(b) Compute the following : (5)

(i) $\int_{-100}^{100} t^4 \, \delta(t-2) \, dt$

(ii) $\sum_{n=-\infty}^{\infty} \left(\frac{1}{4}\right)^n \{u[n+1] - u[n-2]\}$.

(c) Define linear and non-linear system. Check whether the following system is linear or not $y(t) = x^2(t)$. (5)

3. (a) Define LTI system. Explain the following properties of discrete time LTI system. (5)

(i) Linearity

(ii) Invertibility

(iii) Causality.

(b) The impulse response of a LTI system is given by $h[n] = (0.8)^n u[n+2]$

Examine the causality and stability for the system. (5)

(c) The input and impulse response of a DT LTI system are $x[n]$ and $h[n]$ respectively. Show that the output of the system is (5)

$$y[n] = \sum_{k=-\infty}^{\infty} x[k] h[n-k]$$

EE 131404 4

4. (a) Let $x(t)$ be a periodic signal with fundamental period T and Fourier series co-efficient a_k. Determine the Fourier series co-efficient of the following using properties. (5)

$$y(t) = x(t - t_0) + x(t + t_0).$$

(b) A continuous time periodic signal is given by (5)

$$x(t) = 2 + \cos\left(\frac{2\pi}{3}t\right) + 4\sin\left(\frac{5\pi}{3}t\right).$$

Determine the fundamental frequency ω_0 and the Fourier series coefficients $\{a_k\}$ of the signal?

(c) State the following properties of DTFT (5)

(i) Time shifting

(ii) Linearity

(iii) Time reversal.

5. (a) Let $x(n)$ be a periodic sequence with period N and Fourier series co-efficient c_k. Derive the Fourier series co-efficient of the following sequence in terms of c_k. (5)

(i) $x(n - n_0)$

(ii) $x^*(-n)$

(b) State and explain sampling theorem as applied to digital signal processing. Also define Nyquist rate and Nyquist interval. (7)

(c) Explain the effect of aliasing (3)

6.   (a)   Define ROC (Region of Convergence). Mention five properties of ROC.   (5)

(b)   Find Z transform of the signal and its region of convergence   (5)

$$x[n] = -b^n u(-n-1)$$

(c)   Find inverse Z transform of the following using partial fraction method.   (5)

$$X(Z) = \frac{1}{1 - 1.5z^{-1} + 0.5z^{-2}} \quad ROC : |Z| > 1.$$

7.   (a)   Define FIR and IIR systems. Develop a scheme for realisation of an FIR system.   (8)

(b)   Write some advantages of block diagram realization.   (3)

(c)   Realize the following system function using direct form II structure.   (4)

$$H(Z) = \frac{1 + 0.5z^{-2} + 0.2z^{-3} + 0.4z^{-4}}{1 - 0.5z^{-2}}$$