

CBCS SCHEME



17EE54

Fifth Semester B.E. Degree Examination, Aug./Sept.2020 Signals and Systems

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. Define signals and system. Explain classification of signals. (06 Marks)
- b. State whether the following signals given are periodic or not. If periodic find the fundamental period.
 - i) $x(t) = (\cos(2\pi t))^2$
 - ii) $x(n) = \cos\left(\frac{1}{5}\pi n\right) \sin\left(\frac{1}{3}\pi n\right)$. (06 Marks)
- c. Sketch and label for each of the following for the given signal $x(t)$ and $y(t)$ shown in Fig.Q1(c)(i), Fig.Q1(c)(ii).
 - i) $x(t) y(t-1)$
 - ii) $x(t-1) y(-t)$

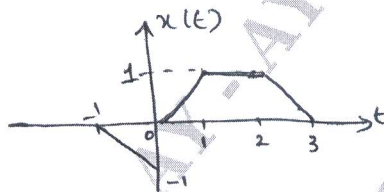


Fig.Q1(C)(i)

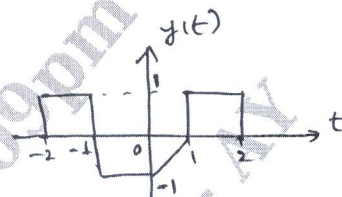


Fig.Q1(C)(ii)

(08 Marks)

OR

- 2 a. Find out the even and odd component of the following signal.
 - i) $x(t) = (1 + t^3) \cos^3(10t)$
 - ii) $x(t) = 1 + t + 3t^2 + 5t^3 + 9t^4$
 - iii) $x(t) = \cos(t) + \sin(t) + \sin(t) \cos(t)$. (06 Marks)
- b. For the trapezoidal pulse $x(t)$ shown Fig.Q2(b) find the total energy.

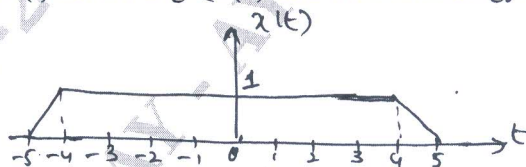


Fig.Q2(b)

(06 Marks)

- c. Determine whether the system $y(t) = x(t/2)$ is
 - i) Linear
 - ii) Time invariant
 - iii) Causal
 - iv) Stability. (08 Marks)

Module-2

- 3 a. Evaluate the discrete time convolution sum of signal $y(n) = \left(\frac{1}{2}\right)^n u(n-2) * u(n)$. (08 Marks)
- b. Consider a LTI system with unit impulse response $h(t) = e^{-t}$. If the input applied to this system is $x(t) = e^{-3t} \{u(t) - u(t-2)\}$ find the output $y(t)$ of the system. (08 Marks)
- c. Find the step response for the LTI system represented by the impulse response $h(n) = \left(\frac{1}{2}\right)^n u(n)$. (04 Marks)

OR

- 4 a. Find the forced response for the system described by

$$\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 6y(t) = 2x(t) + \frac{dx(t)}{dt} \text{ with input } x(t) = 2e^{-t}u(t). \quad (08 \text{ Marks})$$

- b. Sketch the direct form – I and direct form II implementations for the difference equation :
 $y(n) + \frac{1}{2}y(n-1) - y(n-3) = 3x(n-1) + 2x(n-2).$ (08 Marks)
- c. Determine a discrete – time LTI system characterized by impulse response $h(n) = \left(\frac{1}{2}\right)^n u(n)$ is
 i) stable ii) causal. (04 Marks)

Module-3

- 5 a. Find the Fourier transform of $x(t) = e^{-a|t|}$; $a > 0$. Draw its spectrum. (06 Marks)
- b. Find the inverse Fourier transform of $X(j\omega) = \frac{-j\omega}{(j\omega)^2 + 3j\omega + 2}$. (06 Marks)
- c. The impulse response of a continuous time LTI system is given by $h(t) = \frac{1}{RC}e^{-t/RC}u(t)$.
 Find the frequency response and plot the magnitude and phase response. (08 Marks)

OR

- 6 a. State and prove the following properties in continuous time Fourier transform :
 i) Linearity ii) Time shift iii) Convolution. (08 Marks)
- b. Find the frequency response and the impulse response of the system described by the differential equation :
 $\frac{d^2y(t)}{dt^2} + \frac{5dy(t)}{dt} + 6y(t) = \frac{-dx(t)}{dt}$. (08 Marks)
- c. Find the Fourier transform of unit step function. (04 Marks)

Module-4

- 7 a. State and prove : i) frequency shift ii) Parseval's theorem in discrete time domain. (10 Marks)
- b. Find the DTFT of the signal $x(n) = \alpha^n u(n)$; $|\alpha| < 1$. Draw the magnitude spectrum. (05 Marks)
- c. Find the inverse DTFT of the signal $X(e^{j\Omega}) = 1 + 2\cos\Omega + 3\cos 2\Omega$. (05 Marks)

OR

- 8 a. Obtain the frequency response and the impulse response of the system having the output
 $y(n) = \frac{1}{4}\left(\frac{1}{2}\right)^n u(n) + \left(\frac{1}{4}\right)^n u(n)$ for the input $x(n) = \left(\frac{1}{2}\right)^n u(n)$. (10 Marks)
- b. Find the difference equation description for the system having impulse response :
 $h(n) = \delta(n) + 2\left(\frac{1}{2}\right)^n u(n) + \left(-\frac{1}{2}\right)^n u(n)$. (05 Marks)
- c. Find the frequency and the impulse response of the system described by the difference equation : $y(n) + \frac{1}{2}y(n-1) = x(n) - 2x(n-1)$. (05 Marks)

Module-5

- 9 a. What is Z-transform? Mention properties of Region Of Convergence (ROC). (04 Marks)
 b. Find the Z-transform of the signal using appropriate properties.

i) $x(n) = 3 \cdot 2^n u(-n)$

ii) $x(n) = n \sin\left(\frac{\pi}{2}n\right) u(-n)$.

- c. Find the discrete-time sequence $x(n)$ which has Z-transform,

$$X(z) = \frac{-1 + 5z^{-1}}{\left(1 - \frac{3}{2}z^{-1} + \frac{1}{2}z^{-2}\right)} \text{ with ROC; } |z| > 1.$$

(08 Marks)

OR

- 10 a. A causal system has input $x(n] = \delta(n) + \frac{1}{4}\delta(n-1) - \frac{1}{8}\delta(n-2)$ and output

$y(n) = \delta(n) - \frac{3}{4}\delta(n-1)$. Find the impulse response of the system. (08 Marks)

- b. Solve the difference equation, $y(n] + 3y(n-1) = x(n]$ with $x(n] = u(n]$ and the initial condition $y(-1) = 1$. (08 Marks)

- c. Determine whether the system described is causal and stable $H(z) = \frac{2z+1}{z^2+z-\frac{5}{16}}$. (04 Marks)
